TEACHING BEHAVIOUR'S MEDIATING ROLE IN TRANSFORMATIONAL LEADERSHIP AND SCIENCE INTEREST IN KLANG VALLEY PRIVATE SCHOOLS

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FACULTY OF EDUCATION
UNIVERSITY OF MALAYA
KUALA LUMPUR

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CONIE TOH

THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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Field of Study: Education and School Leadership (Teaching & Training)

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TEACHING BEHAVIOUR'S MEDIATING ROLE IN TRANSFORMATIONAL LEADERSHIP AND SCIENCE INTEREST IN KLANG VALLEY PRIVATE SCHOOLS

ABSTRACT

This research aims to enrich the existing body of knowledge on educational leadership, science education, and the intricate interactions between teachers and students within private school environments. The study's primary objective is to explore how teachers' transformational leadership practices influence students' interest in science in private schools in the Klang Valley. This influence is examined both directly and indirectly through the mediation of teachers' teaching behaviours. Employing a non-experimental quantitative approach, data were gathered via surveys distributed through Google Forms. The participants were students from selected private schools in Klang Valley, who received the surveys through email and WhatsApp application. A total of 250 completed Google Form questionnaires responses were collected and analysed. The results indicated that students perceived their teachers as exhibiting high levels of transformational leadership and effective teaching behaviours. Despite this, students rated their interest in science as moderate. Analysis using the Pearson product-moment correlation showed significant positive correlations between teachers' transformational leadership, students' interest in science, and teachers' teaching behaviours. Multiple regression analysis identified the intellectual stimulation dimension as the most significant predictor of students' interest in science. Additionally, the dimensions of clarity and rapport were found to be significant predictors of students' interest in science, with clarity having a moderate impact and rapport a larger effect. Further analysis revealed that the dimensions of individualized consideration, inspirational motivation, and intellectual stimulation significantly predicted teachers' teaching behaviours. Both inspirational motivation and

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intellectual stimulation had moderate effects, whereas individualized consideration had a more substantial impact on teachers' teaching behaviours. A mediation analysis using the PROCESS Macro for SPSS demonstrated that the relationship between teachers' transformational leadership practices and students' interest in science is partially mediated by teachers' teaching behaviours. This finding highlights the crucial role of effective teaching behaviours in enhancing students' interest in science. Structural equation modelling (SEM) using AMOS (Analysis of Moment Structures) was then applied to evaluate the model's fit with the collected data. The adjusted structural model aligned well with the data from private schools in Klang Valley, Malaysia. Overall, this study offers valuable insights into the impact of teachers' transformational leadership and teaching behaviours on fostering students' interest in science within private schools in Klang Valley, Malaysia. These findings have significant implications for educational policymakers, school administrators, and teachers, emphasizing the importance of integrating transformational leadership practices and effective teaching behaviours to enhance science education. By adopting these practices, educators can create a supportive learning environment that nurtures students' interest in science and subsequently promotes their academic achievement.

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PERANAN PERANTARA TINGKAH LAKU PENGAJARAN DALAM KEPIMPINAN TRANSFORMASI DAN MINAT SAINS DI SEKOLAH SWASTA LEMBAH KLANG

ABSTRAK

Kajian ini bertujuan untuk menyumbang kepada kajian sedia ada mengenai kepimpinan pendidikan, pendidikan Sains, dan interaksi yang kompleks antara guru dan pelajar dalam persekitaran sekolah swasta. Objektif utama kajian ini adalah untuk meneroka bagaimana amalan kepimpinan transformasi guru mempengaruhi minat pelajar dalam Sains di sekolah swasta di Lembah Klang. Pengaruh ini dikaji secara langsung dan tidak langsung melalui perantaraan tingkah laku pengajaran guru. Menggunakan pendekatan kuantitatif bukan eksperimental, data dikumpulkan melalui soal selidik yang diedarkan melalui Google Forms. Peserta kajian adalah pelajar dari sekolah-sekolah swasta terpilih di Lembah Klang, yang menerima soal selidik melalui emel dan aplikasi WhatsApp. Sejumlah 250 respon soal selidik Google Form yang lengkap telah dikumpulkan dan dianalisis. Hasil kajian menunjukkan bahawa pelajar menganggap guru mereka mengamalkan tahap kepimpinan transformasi dan tingkah laku pengajaran yang berkesan yang tinggi. Walau bagaimanapun, pelajar memberikan penilaian yang sederhana terhadap minat mereka terhadap matapelajaran Sains. Analisis menggunakan korelasi Pearson product-moment menunjukkan korelasi positif yang signifikan antara kepimpinan transformasi guru, minat pelajar dalam Sains, dan tingkah laku pengajaran guru. Analisis regresi berganda mengenal pasti dimensi rangsangan intelek sebagai peramal paling signifikan bagi minat pelajar dalam Sains. Selain itu, dimensi kejelasan dan dimensi hubungan didapati sebagai peramal signifikan bagi minat pelajar dalam Sains, dengan dimensi kejelasan mempunyai kesan sederhana dan dimensi hubungan mempunyai kesan yang lebih besar. Analisis lanjut menunjukkan bahawa dimensi

Universiti Malaya

pertimbangan berindividu, dimensi motivasi inspirasi, dan dimensi rangsangan intelek adalah peramal yang signifikan bagi tingkah laku pengajaran guru. Kedua-dua dimensi motivasi inspirasi dan dimensi rangsangan intelek mempunyai kesan sederhana, manakala dimensi pertimbangan berindividu mempunyai kesan yang lebih besar terhadap tingkah laku pengajaran guru. Analisis perantaraan menggunakan PROCESS Macro untuk SPSS menunjukkan bahawa hubungan antara amalan kepimpinan transformasi guru dan minat pelajar dalam Sains adalah dimediasi secara separa oleh tingkah laku pengajaran guru. Penemuan ini menekankan peranan penting tingkah laku pengajaran yang berkesan dalam meningkatkan minat pelajar dalam Sains. Model Persamaan Struktural (SEM) menggunakan AMOS (Analysis of Moment Structures) kemudian diterapkan untuk menilai kesesuaian model dengan data yang dikumpulkan. Model struktur yang telah disesuaikan didapati sepadan dengan data dari sekolah-sekolah swasta di Lembah Klang, Malaysia. Secara keseluruhan, kajian ini memberikan pandangan berharga tentang kesan kepimpinan transformasi guru dan tingkah laku pengajaran dalam memupuk minat pelajar dalam Sains di sekolah-sekolah swasta di Lembah Klang, Malaysia. Penemuan ini mempunyai implikasi yang signifikan untuk pembuat dasar pendidikan, pentadbir sekolah, dan guru, dengan menekankan kepentingan mengintegrasikan amalan kepimpinan transformasi dan tingkah laku pengajaran yang berkesan untuk peningkatan pendidikan Sains. Dengan mengamalkan amalan ini, pendidik dapat mewujudkan persekitaran pembelajaran yang positif yang memupuk minat pelajar dalam Sains dan seterusnya meningkatkan pencapaian akademik mereka.

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Universiti Malaya

TABLE OF CONTENTS

Universiti Malaya

Universiti Malaya

Universiti Malaya

Universiti Malaya

Universiti Malaya

LIST OF FIGURES

Universiti Malaya

LIST OF TABLES

Universiti Malaya

Universiti Malaya

Universiti Malaya

LIST OF SYMBOLS AND ABBREVIATIONS

ANOVA	:	Analysis of Variance
AR	:	Augmented Reality
DLP	:	Dual Language Programme
HODs	:	Heads of Departments
HOTS	:	Higher Order Thinking Skills
M	:	Mean
MLQ	:	Multifactor Leadership Questionnaire
MOE	:	Ministry of Education
PISA	:	Programme for International Student Assessment
PPSMI	:	Teaching and Learning of Science and Mathematics in English (*Pengajaran dan Pembelajaran Sains dan Matematik dalam Bahasa Inggeris*)
PT3	:	Form 3 Assessment (*Pentaksiran Tingkatan 3*)
SD	:	Standard Deviation
SIMSQ	:	Student Interests and Motivation in Science Questionnaire
SPM	:	Malaysian Certificate of Education (*Sijil Pelajaran Malaysia*)
SPSS	:	Statistical Package for the Social Sciences
STEM	:	Science, Technology, Engineering, and Mathematics
TBI	:	Teacher Behaviour Inventory
TIMSS	:	Trends in International Mathematics and Science Study
TSL	:	Transformational School Leadership
TTQ	:	Transformational Teaching Questionnaire
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
VAF	:	Variable Accounted For
VIF	:	Variance Inflation Factor

Universiti Malaya

LIST OF APPENDICES

Universiti Malaya

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Recently, the standard of teaching and learning of science subject has become a problem in hand (Sumintono, 2017; Yunus & Sukri, 2017; Mahmud et al., 2018; Wong et al., 2021). A number of researchers admitted that studying science at secondary school might not only be aimed at preparing students for education at tertiary level, but it's also necessary for life-long learning readiness and interpretation of the phenomenon around them (Kaptan & Timurlenk, 2012; Das & Singh, 2014).

The process of education is often described as a professional undertaking that necessitates effective decision-making skills on the part of teachers. When it comes to teaching science, teachers need to be resourceful, imaginative, and adept at making decisions. These decisions encompass various aspects such as selecting appropriate content to teach, determining suitable teaching methods, planning laboratory activities, and preparing for classroom management (Stephenson, 2017; Sulaiman et al., 2017). Teachers are not only responsible for conveying information and utilizing teaching aids, but also for generating student interest and curiosity in lesson plans (Stronge, 2018). This, in turn, enriches the learning process, as compared to students who solely rely on taking notes (Sulaiman et al., 2009; Major et al., 2015; Stronge, 2018). As outlined by Venville & Dawson (2004), Gupta et al. (2015), and Brookes (2019), science is not merely about acquiring knowledge; it also necessitates active participation from students in various activities, including comprehending information and actively searching for and gathering knowledge.

Universiti Malaya

The relationship between interest and learning has been a subject of research since the 19th century, with continued studies on various aspects of interest conducted by scholars such as Krapp, Hidi, Renninger, Guo, Triarisanti, and Purnawarman (2015, 2019). Towards the end of the 20th century, there was a shift in focus to examine how interest influences learning and development, as well as the origins and transformations of interests (Krapp, Hidi, Renninger, 2015, p. 4-5). This shift was driven by a growing body of evidence that indicates that increased interest in a subject can positively impact student achievement (Hulleman & Harackiewicz, 2009; Zhu et al., 2009; Wiradarma et al., 2021). It is widely recognized that interest in a particular subject is greatly influenced by the people we interact with and the associations we form with them (Rodd, Reiss, & Mujtaba, 2013). As such, teachers play a pivotal role in sparking and nurturing students' interest in a specific subject. They may employ selected teaching approaches that are more likely to capture students' attention, thereby offering a unique perspective in improving the educational system.

Encouraging teachers to actively assume leadership roles can serve as a vital component in driving reform efforts, as their unwavering focus remains on facilitating student learning (Sinha et al., 2017). Teacher leaders who prioritize student learning as their central focus can play a pivotal role in shaping reforms from within, generating far-reaching effects in the realm of education. Numerous scholarly investigations have consistently highlighted the significant impact of various teacher leadership styles on students' academic success (Beauchamp et al., 2014; Seritanondh, 2013), as well as on the overall efficiency of teachers and administrators (Xu & Patmor, 2012). As supported by the research of Ahmed and Qazi (2011), effective teacher leadership not only fosters students' motivation to learn, but also enhances the productivity and development of educational institutions. Furthermore, teacher leaders proactively support the teaching-

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learning process for both themselves and their colleagues, actively foster effective communication among peers, and eagerly embrace opportunities to cultivate progressive outcomes in educational settings (Kilinç, 2014). Tsai (2015) highlights that the greater the passion displayed by teacher leaders, the more effectively they can offer diverse learning opportunities, provide high-quality instruction, and subsequently achieve superior student outcomes.

Secondary education in the global context has become a focal point of attention for stakeholders at various levels. It is widely recognized not only for its role in connecting the gap between primary and tertiary education, but also for its significance in equipping students with the knowledge and skills necessary to thrive in the labour market (Katayama, Assad & Bell, 2011). The Director-General of UNESCO, Irina Bokova, has underlined the crucial importance of secondary education as a fundamental requirement for young individuals to acquire the essential competencies needed for a decent livelihood in today's highly competitive and globalized economy (as cited in Krishnapillai et al., 2016).

In Malaysia, the education landscape encompasses both national and private education systems. Private education, as delineated by the Ministry of Education, pertains to education that is offered by privately-owned educational institutions without any government assistance and is fully funded by the private sector. The establishment, management, and operation of private educational institutions are regulated by the Education Act 1996 (Act 550) and its accompanying regulations, as stipulated by the Ministry of Education (MOE, 2022a).

Universiti Malaya

In Malaysia, the concept of private education emerged in the 1950s as a viable option for students who faced challenges in pursuing their basic certificates through government schools. However, the role and function of the private education system underwent a significant transformation in the 1970s, with private education operators increasingly prioritizing pre-university courses, as indicated by the Ministry of Education (MOE, 2022a).

Private education is characterized by its autonomy in management and self-sustaining nature, encompassing both private and international sections that differ in their curriculum offerings. Private schools typically adopt local or self-developed syllabi, while international schools source their curriculum from countries such as the United States, Australia, Britain, Canada, and India, as indicated by the Ministry of Education (MOE, 2013). The private education sector encompasses various types of schools, including those following the National curriculum, Independent Chinese private schools, religious schools, special education schools, and correspondence schools. In the context of this research, the focus is exclusively on private schools within the Klang Valley that follow the national curriculum set by the Malaysian government. The Klang Valley was specifically selected for this study due to its notably high density of private schools, surpassing that of any other region in Malaysia, as noted by the MOE (2022b).

Approximately 11% of students have reportedly made the switch from the public to the private education system, as indicated by the Ministry of Education (MOE, 2013). This growth in private education can be traced back to 2012, when the government announced the removal of the 40% quota of Malaysian students in international schools, resulting in a significant surge in private education, as highlighted by Goh (2013). Statistical data reveals that private schools following the national curriculum have reported about 6%

Universiti Malaya

higher scores in the SPM exams compared to their counterparts in government schools, according to the MOE (2013). Undoubtedly, parents place a high priority on their children's academic achievements, and research studies have consistently shown that academic performance is one of the key criteria guiding parents in their selection of an ideal school for their children, as emphasized by Yaacob, Osman, and Bachok (2014). The increased enrolment of Malaysian students in private schools may also be attributed to the perception of higher household incomes and superior quality of education in private schools, as noted by the MOE (2013). This perception is supported by the rising number of Malaysian students attending private schools, which has increased from 175,713 in 2013 to 208,043 in 2017, marking an 18% increase in less than 5 years, as reported by the MOE (2019). This shift in parental preferences for school choices is driven by their genuine concern for the best interests of their children, as highlighted by Bosetti (2004). Furthermore, Krishnapillai et al. (2016) underscored that parents are more focused on the basic necessities of attending school, such as quality teaching and the well-being of their children, rather than additional features such as advanced facilities and a favourable environment. Hence, it is imperative for private school operators to understand and address the concerns of parents in their school selection process in order to attract more students. Prioritizing quality teaching and ensuring better learning outcomes for students should be the cornerstone of private schools' efforts to attract enrolment.

1.1.1 Private Schools and DLP Science Teaching in Malaysia

The Malaysian education system is divided into two main categories, namely public and private education. Public schools provide free education to all Malaysians and may offer instruction in multiple languages. In contrast, private schools in Malaysia are fee-based institutions that operate independently from the Ministry of Education, giving them greater autonomy in terms of management and governance. As a result, they are not

Universiti Malaya

constrained by many of the rules, regulations, and policies that public schools are obligated to adhere to. For example, private schools have the flexibility to utilize the national curriculum, but they also have the option to supplement it with additional subjects or even adopt an entirely different curriculum.

In Malaysia, there is a diverse range of private schools, including international schools, private schools following the national curriculum, expatriate schools, Chinese independent schools, and private religious schools. International schools typically offer curricula based on British, American, Australian, or International Baccalaureate standards. Expatriate schools cater to specific expatriate communities, such as French or Japanese schools, and adhere to the national curriculum of their respective countries. Chinese independent schools use Chinese as the medium of instruction. Private schools in Malaysia that follow the national curriculum are popular due to their offering of additional subjects, low teacher-to-student ratios, and relatively affordable tuition fees compared to other international schools. Lastly, private religious schools also adopt the national curriculum, but with a specific emphasis on religious studies.

Private schools typically set higher tuition fees in order to attract highly qualified teachers and provide enriched learning environments, which may include low student-to-teacher ratios, small class sizes, and well-equipped facilities such as libraries, science laboratories, and computers. Some private schools even offer boarding options, while there are privately owned or operated military academies as well. These schools rely on various sources of funding, such as tuition fees, fundraising, and contributions from alumni. In recent years, private sector education has gained significance as an investment opportunity for stakeholders, as highlighted by Yaacob et al. (2015). Additionally, there are various privately funded educational alternatives, such as independent schools.

Universiti Malaya

Private schools often have more flexibility compared to public schools in adhering to state regulations, although most still comply with regulations related to educational content. In the case of religious private schools, they may simply incorporate religious instruction into the curriculum of local public schools (Source: https://en.wikipedia.org/wiki/Private_school).

Recently, a growing trend among parents is to opt for private schooling for their children. This preference stems from the belief that private schools deliver a higher quality of education, foster a more conducive learning atmosphere, offer additional resources, and implement superior policies and practices. Evidence from PISA (OECD, 2012) supports this view, showing that private schools often enjoy greater autonomy, superior resources, and better performance on the PISA reading scale compared to their public counterparts in many countries. This autonomy spans four critical areas: curriculum development, instructional methods, staffing, and the management of finances and governance. Nina (2016) asserts that such autonomy enables private schools to effectively meet the demands of parents. Moreover, Najjar (2008) points out that private schools differ significantly from public schools in terms of external controls, internal authority structures, and interpersonal relationships. The increased decision-making freedom granted to principals and staff in private schools contributes to more efficient operations, heightened accountability to parents, a positive and disciplined learning environment, and enhanced job security for teachers, which fosters a stronger sense of belonging within the school community (Najjar, 2008). Consequently, Altaf (2016) suggests that private schools are well-positioned to deliver high-quality education.

Private schools derive their profits from student enrolment numbers. Successful private schools might expect profit margins ranging from 20 to 30 percent of their revenue, as

Universiti Malaya

noted by Nina (2016). To attract more students, private schools must carefully consider parental demands regarding curricula, teaching methodologies, facilities, and disciplinary measures, while also being responsive to student needs, as emphasized by the OECD (2012). The competition among schools becomes particularly intense at the upper secondary level of education, where educational programs are more diversified compared to lower levels of education. The competitive market environment in which both international and private schools operate necessitates balancing academic and commercial imperatives. Private schools must be customer-oriented, ensuring they meet parental expectations and the required educational standards, such as maintaining low student-to-teacher ratios, providing opportunities for teacher training and development, balancing academic and non-academic programmes to offer a holistic educational experience, and upholding high standards of infrastructure and facilities (Nina, 2016).

A significant innovation in the Malaysian education system is the Dual Language Programme (DLP), which allows certain subjects, including science, to be taught in English. The DLP aims to enhance students' English proficiency and improve their global competitiveness. Private schools, due to their autonomy, have effectively implemented the DLP by leveraging their resources and flexibility to achieve the programme's objectives (Suliman, Nor, & Yunus, 2020). The ability to attract highly qualified teachers, maintain low student-to-teacher ratios, and provide well-equipped learning environments has been crucial to the successful implementation of the DLP in private schools (Othman, Saat, Senom, & Adli, 2020). The high concentration of private schools in the Klang Valley provides fertile ground for studying the DLP's impact on science teaching. These schools have demonstrated significant success in implementing the DLP, evidenced by improved student proficiency in English and a deeper understanding of scientific concepts. The strategic allocation of resources, continuous professional development for

Universiti Malaya

teachers, and maintenance of high infrastructure standards have been pivotal in achieving these outcomes (Suliman, Nor, & Yunus, 2017).

1.1.2 Factors Influencing Science Interest

1.1.2.1 Teachers' Transformational Leadership Practices

Transformational leadership in teaching significantly influences students' interest in science. Effective leadership in an educational context involves adapting leadership styles to specific situations, thereby guiding and influencing individuals effectively. Tan, Tie, and Chua (2015) emphasize that leadership styles are diverse and context-dependent, varying based on situational factors, the leader's personality, or the task at hand. Effective leadership is crucial for the success of organizations, as it directs leaders on the appropriate actions, attributes, and skill combinations necessary for different situations (Bolden, 2004). Hersey, Blanchard, and Johnson (2001) highlight the importance of flexibility and adaptability in leadership styles to suit unique circumstances, while Pedersen (1980) and Watts (2009) assert that there is no universal leadership style suitable for all school settings.

Universiti Malaya

Teachers, as leaders, play a vital role in delivering high-quality education and leading by example in their professional endeavours. Teacher leadership, described as "job-embedded professional development," is essential for school advancement (Poekert, 2012). Research shows that teacher leadership positively affects various aspects, including teachers' feelings, professional growth (Avidov-Ungar & Reingold, 2018), leadership capacity (Chamberland, 2009), relationships with colleagues (Nicholson et al., 2017), school leaders (Margolis, 2012), and overall well-being (Cherkowski, 2018). In today's competitive world, with increasing standards and diverse educational options, teachers need a range of pedagogical and leadership skills to shape students to meet modern challenges (Zhang & Henderson, 2018; Wieczorek & Lear, 2018; Ahmed & Qazi, 2011).

Teachers as transformational leaders foster a relevant value system, adaptable to global challenges and opportunities, driving the wheel of education forward (Pushpanadham & Nambumadathil, 2020). The development of teacher leadership impacts individual educators and the teaching profession, strengthening its professional nature (Murphy, 2005). Effective teacher leaders take accountability for their actions and their impact on learners' growth (Pushpanadham & Nambumadathil, 2020). Teacher leadership is closely related to collaboration with students to provide the desired type of learning (Gunter, 2005). Transformational leadership is highly relevant to contemporary educational reforms, encompassing behaviours that inspire and empower others, transcend personal interests, and instil confidence to achieve higher performance levels. This leadership style is characterized by the ability to model exemplary behaviours, motivate followers to exceed their own expectations, and foster an environment of trust and collaboration. Scholars such as Avolio and Bass (1995), Dubrin (2004), Bass and Bass (2009), Yukl (2012), and Bass and Riggio (2006) have extensively discussed the principles and practices of transformational leadership, emphasizing its importance in driving positive change and achieving outstanding results in educational settings.

Research demonstrates significant positive correlations between instructors' transformational leadership behaviours and favourable student outcomes, such as heightened student effort, improved perceptions of leader effectiveness, and increased satisfaction with teaching (Pounder, 2008; Hoehl, 2008; Bolkan & Goodboy, 2009; Harrison, 2011). Transformative teacher leaders transcend self-interests for the greater

Universiti Malaya

good, fostering student awareness, self-fulfilment, and understanding of change, while building trust (Treslan, 2006; Pushpanadham & Nambumadathil, 2020).

1.1.2.2 Students' Interest in Science

Interest is a pivotal element in motivating learners and enriching the quality of their educational experiences. According to research, heightened interest can dramatically enhance academic performance by promoting both emotional and cognitive engagement with the subject matter (Schraw, Flowerday, & Lehman, 2001; Harackiewicz et al., 2014; Hulleman & Harackiewicz, 2009). Studies have demonstrated that fostering interest brings numerous benefits, including increased attention, integration of prior knowledge, and positive effects on various skills such as recognition, recall, persistence, effort, and academic motivation (Hidi & Renninger, 2006; Krapp & Prenzel, 2011; Mitchell, 1993; Wiseman & Hunt, 2013).

Science education holds particular significance in schools, as it is directly related to students' lives and aids in the development of critical thinking and problem-solving abilities (Arrieta et al., 2020). Engaging young students with captivating materials and experiences in science at an early age can spark motivation and curiosity, leading to a sustained interest in the sciences and the cultivation of valuable problem-solving skills throughout their academic journey (Helm & Katz, 2016).

Students who have a genuine interest in a subject are more inclined to attend classes regularly, participate actively, and achieve higher academic success (Hidi & Harackiewicz, 2000; Renninger & Hidi, 2015). Conversely, a lack of interest can adversely affect learning outcomes, underscoring the necessity to generate excitement for learning (KHairina & Syafrina, 2017; Riwahyudin, 2015). There is an urgent need for

Universiti Malaya

effective instructional behaviours and teaching materials that can stimulate students' interest in science (Toma & Greca, 2018). Teachers play a crucial role in enhancing student learning outcomes by nurturing and strengthening students' interest in their studies.

1.1.2.3 Teachers' Teaching Behaviour

Effective teaching involves supporting students with diverse interests and abilities through various instructional methods. Teachers aim to help students reach their academic potential, but they may face limitations due to inadequate familiarity or knowledge about specific approaches (Dawson, 2008). Teaching approaches such as inquiry, constructivism, and demonstrations each have strengths and limitations, with some educators arguing that inquiry may be the most effective for science learning (Jordan, 2005; Woolfolk, 2001; Marsh, 2004).

Thoroughly evaluating the appropriateness of various science teaching methodologies is essential for ensuring effective instructional delivery. Practices oriented towards external rewards and recognition can be particularly motivating for students with higher abilities, whereas methods that emphasize internal motivation and personal interest may prove more effective for students with lower abilities, as highlighted by Gunnes and Donze (2016). The choices teachers make regarding instructional practices and the design of the classroom environment play a significant role in shaping students' motivational patterns, which in turn affects their effort and academic achievement (Ames, 1992; Wigfield et al., 2009; Tokan & Imakulata, 2019).

Effective teaching also encompasses strong classroom management, fostering academic engagement, and tailoring instruction to suit the diverse strengths and needs of students

(Palumbo & Sanacore, 2007; Al Barwani et al., 2012). The quality of instructional teaching directly influences students' academic performance, impacting their motivation, cognitive processes, emotional well-being, and overall educational outcomes (Linnenbrink-Garcia, Patall, & Pekrun, 2016; Sánchez Rosas & Esquivel, 2016). Teaching behaviours are crucial predictors of the classroom learning environment, with specific elements such as classroom atmosphere, learning climate, and instructional support significantly contributing to positive student outcomes (Antoniou et al., 2011; Guldemond & Bosker, 2009; Konstantopoulos & Sun, 2014; Kyriakides & Creemers, 2009; Teodorovic, 2011).

Research on teaching effectiveness has identified that certain teacher behaviours—such as clarity in instruction, enthusiasm, interaction, disclosure, speech & pacing, organizational skills, and the ability to build rapport—have a positive impact on student outcomes (Hadie et al., 2019; Rodger, 2003; Rodger, Murray & Cummings, 2007; Kunter et al., 2008; Barnes & Lock, 2010; Long, Ibrahim & Kowang, 2013). These effective teaching behaviours capture students' attention and interest, which leads to enhanced engagement and improved learning outcomes. By incorporating these strategies, teachers can create a dynamic and supportive learning environment that fosters academic success and personal growth among students.

1.2 Rationale of the Study

The rationale behind this study is that to ensure students' interest in science in every private school, teachers must acquire a broad understanding of teaching approaches to choose optimal methods for any given situation. The relationship between learning and interest has been a topic of investigation since the 19th century (Krapp, Hidi & Renninger, 2015). Research consistently shows that increased interest in a subject can have a positive

Universiti Malaya

impact on student achievement (Hulleman & Harackiewicz, 2009). Moreover, studies in science education have established that heightened student interest leads to improved engagement and better learning outcomes (Darlington, 2017; Hidi & Renninger, 2006; National Foundation for Educational Research, 2011). Reiss (2018) found that when student interests, especially in biology education, are taken seriously, it can significantly enhance human development and promote student autonomy. This approach contributes to high-quality teaching and learning experiences. An increase in student interest has been shown to positively influence various aspects of learning, such as attention levels, information retention, persistence, and the effort invested in acquiring knowledge. These factors are essential for both individual and collective classroom practices (Hidi & Renninger, 2006; Krapp & Prenzel, 2011; Mitchell, 1993).

When students are uninterested or unwilling to learn, their learning outcomes are likely compromised. Therefore, it is imperative for educational researchers to explore how teachers' behaviours can be optimized to promote student engagement (Maulana et al., 2017; Cents-Boonstra et al., 2021). These investigations should encompass both the physical classroom environment and the less visible aspects, such as teaching activities and teacher-student relationships (Darlington, 2017). Teachers often play a critical role in igniting and nurturing students' interest in a subject. Factors impacting a student's engagement include social components, such as peer influence and parental attitudes, and personality traits like curiosity and risk-taking. A student's perception of activity relevance also shapes their response to the subject, leading to increased effort, improved knowledge acquisition, deeper understanding, and heightened interest (Darlington, 2017).

Surveys in England show a growing concern regarding student interest and career aspirations in science (Dewitt, Archer, & Osborne, 2014). Motivation and interest in

Universiti Malaya

STEM subjects are crucial for adolescents to pursue STEM careers (OECD, 2007). Therefore, schools and teachers must prioritize developing students' interest in science as a crucial educational objective. Understanding the factors influencing the emergence and sustainability of students' interest in secondary science lessons is paramount, as it may be their last formal opportunity to engage with science. Increased interest in science can lead to more students studying the subject and fostering positive attitudes towards it, impacting their educational and career trajectories.

The present research is grounded in the constructivist learning theory, which suggests that students actively construct their own understanding and knowledge based on their prior experiences and interactions with their environment. This learning theory emphasizes that learning is an active and personal process, varying for each student (Teaching & Education, 2020). Educators can apply constructivism principles to acknowledge each student's unique prior knowledge, helping students create their own understanding and learning. This approach encourages teachers to consider students' existing knowledge before starting a lesson, as seen in many classrooms (Teaching & Education, 2020). Constructivism is evident in early childhood education, where children engage in hands-on activities, promoting learning through doing rather than passive knowledge absorption (Jagodowski, 2020).

Effective teaching involves actively involving students in the planning process. Kohn (2014) argues that creating a classroom community that addresses students' unique needs and interests fosters a positive learning environment, promoting engagement and receptivity. Exploration as a means of learning is key, with students given the freedom to discover and explore ideas for true understanding. Kohn emphasizes the importance of

Universiti Malaya

teachers respecting students and creating a safe classroom environment that encourages learning and relationship building (Kohn, 2014).

Kohn's theory aligns with an assertive classroom management model, recognizing that effective management caters to the learning style of the group and lesson organization. Effective strategies identified by Hattie (2009) include the individual student, home environment, school setting, curricula, teacher, and teaching approaches, all influencing student achievement outcomes. "Visible teaching" is crucial, with teachers deliberately intervening to promote student development (CUREE, 2011). Effective teaching strategies create a visible, impactful learning environment fostering student growth and academic success.

Teaching behaviours that exhibit passion, rapport, clarity, and interaction have been demonstrated to positively influence student outcomes, fostering a more effective and engaging learning environment (Rodger, 2003; Kunter et al., 2008). These behaviours serve as a baseline for evaluating teaching quality and are related to transformational leadership competency. Specific classroom teaching behaviours are linked to components of transformational leadership competency, including idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. Teachers often prioritize individual students' cognitive abilities, tailoring the educational process to meet their needs and assessing progress (Nedzinskaitė & Barkauskaitė, 2017). Teaching quality is influenced by teachers' transformational leadership practices, contributing to students' interest in science.

Recent research emphasizes student-centred instructional practices, such as inquiry-based learning, project-based learning, and hands-on experiments, positively impacting students' interest and engagement (Rivet & Krajcik, 2008). Collaborative learning methods also enhance interest and motivation (Honkala et al., 2015). Teachers who use engaging instructional strategies, encourage active participation, and provide a supportive environment have a higher likelihood of fostering students' interest in science. Research conducted by Taş (2016) and Banks & Barlex (2020) underscores the beneficial impact of teaching behaviour on students' interest in STEM subjects.

This study focuses on private schools in the Klang Valley for several reasons. Private schools possess distinct characteristics and educational contexts that influence teaching behaviour, transformational leadership practices, and students' interest in science. For instance, smaller class sizes and more abundant resources in private schools enable the implementation of innovative teaching approaches and provide opportunities for individualized attention (Yaacob et al., 2015). Additionally, private schools serve a diverse student population from various backgrounds, which can shape their interest in science (Tytler & Osborne, 2012). The specialized curricula in private schools, which often include hands-on experiences and interdisciplinary connections, have been shown to positively impact students' interest in science (Banks & Barlex, 2020).

Despite these advantages, there remains a gap in the research regarding the relationship between teachers' transformational leadership, teaching behaviour, and students' interest in science. To address this gap, a quantitative study was undertaken. This study aims to explore the mediating role of teachers' teaching behaviour in the relationship between transformational leadership practices and students' interest in science, thereby contributing to a deeper understanding of these dynamics within the context of private education in the Klang Valley. Assumptions considered include normal distribution of data, equal variances, linear relationships, data independence, and no perfect multicollinearity among variables (Ledolter et al., 2020; Beyene, 2016; Lee, 2022; Daoud, 2017; Senaviratna & Cooray, 2019).

1.3 Statement of Problem

English is widely employed as the medium of instruction for teaching science and mathematics in various regions across the globe. Extensive research conducted in European countries (Kershaw, 2018; Mifsud & Farrugia, 2016) and African countries (Mthiyane, 2016; Mokiwa & Msila, 2013) has confirmed the prevalent use of English in these subjects. These studies often delve into topics such as student performance, teaching competence, and bilingual instructional techniques. Similar concerns have also been raised in countries such as the Philippines (Racca & Lasaten, 2016) and Hong Kong (Hu & Gao, 2018) in Asia, indicating a global trend towards the utilization of English as the medium of instruction for science and mathematics education. However, despite this trend, challenges persist in effectively integrating language (English) and content courses (Science and Mathematics).

Malaysia has taken a courageous step by implementing the use of English as the medium of instruction for teaching science and mathematics. This decision aims to tackle the declining English proficiency among Malaysians (Azman, 2016) and leverage the country's human potential to achieve the vision of becoming a developed nation, as outlined in Malaysia's Vision 2020 (Suliman, Nor & Yunus, 2017). The policy, known as 'English for the Teaching of Mathematics and Science' or PPSMI, was introduced to support this objective. After being well publicised for its execution and efficacy, the policy only lasted a decade and was fully abolished in 2014. According to Bullah and Yunus (2018), the policy was repealed because it failed to meet its primary goal of improving students' English skills. The policy not only failed to improve students' English skills, but it also resulted in increased failure, particularly in mathematics and science (Bullah & Yunus, 2018). The students' difficulty in understanding the language led to confusion during the teaching and learning process in the classroom, hindering effective communication and comprehension. The language of instruction, as well as the content of the textbook, were confusing to students (Nordin, 2006). Previously, Sumintono (2017) argued that the drop in the TIMSS (Trends in International Mathematics and Science Study) score was clear evidence of the PPSMI policy's impact.

In the interim, Habuan (2018) has highlighted that dissatisfaction among parents has remained persistently high in the aftermath of the post-PPSMI era, wherein English is no longer utilized as the primary medium of instruction for science and mathematics. The decision to abolish PPSMI has been met with doubt and opposition from certain groups, particularly parents in urban areas (Bullah & Yunus, 2018). Consequently, a new program has been introduced to address the shortcomings of PPSMI and accommodate the demands of various stakeholders who advocate for its continuation (Mohandhas, 2015; Yunus & Sukri, 2017). Since 2016, the Malaysian education system has implemented the Dual Language Programme (DLP) in both primary and secondary schools, as part of the government's policy of "Upholding the Malay Language and Strengthening the English Language." The DLP, as noted by Esquinca, Piedra, and Herrera-Rocha (2018), provides a conducive environment for students to expand their understanding of science, technology, engineering, and mathematics in two languages. Furthermore, the DLP has been associated with language competency development, increased student motivation, positive outcomes, academic achievements, and bilingualism, as supported by Hamman (2018), Lindholm-Leary (2016), Li et al. (2016), and Thomas & Collier (2012). Studying science and mathematics in English not only allows students to broaden their global knowledge, but also enhances their employment prospects (Suliman, Nor & Yunus,

Universiti Malaya

2017), while also fostering an appreciation for the English language and expanding linguistic horizons (Unting & Yamat, 2017). In conclusion, learning science and mathematics in English is in alignment with the goal of developing bilingual students in Malay and English as stated in the Malaysian Education Blueprint (2013-2025) by the Ministry of Education (2015).

There has been limited research conducted on the implementation of this program on a small scale, as noted by Yunus and Sukri (2017). They found that over 50% of pre-service teachers were opposed to teaching in English. However, students in the Dual Language Programme (DLP) expressed moderate confidence and willingness to study in English, as reported by Suliman, Nor, and Yunus (2017). Language proficiency was identified as a significant obstacle in the learning process, which aligns with the findings of Unting and Yamat (2017). In a study conducted by Suliman, Nor, and Yunus (2019) to assess the program's long-term sustainability from the students' perspective, including their readiness to learn in English, challenges faced, and suggestions for improvement, it was found that 88% of the students believed that the DLP should continue, but approximately 93% of them felt that the program needed improvement.

The struggles students face in balancing the content and language aspects of science and mathematics in the DLP have been reported by Din and Wing (2007) in a study of 100 Hong Kong schools. Similarly, Sulaiman and Konting (2014) found that urban students outperformed their rural counterparts in communication, classification, and observation in a study of first-year students' readiness to learn science in English in Malaysia. In another study by Suliman, Nor, and Yunus (2021) involving students from different localities and school types, respondents perceived that the DLP needed improvement for better implementation. Addressing potential language-related issues and ensuring quality instruction in schools that use English as the medium of instruction have been highlighted as important by Margic and Vodopija-Krstanović (2018).

Suggestions for improvement from DLP students, as reported by Suliman et al. (2019), included enhancing the quality of teachers, incorporating technology in the learning process, providing early exposure to English, adding another language in the teaching and learning process, and encouraging increased use of English during lessons. The suggestions emphasize the importance of effective teaching behaviours such as rapport, interaction, enthusiasm, clarity, disclosure, speech & pacing, and organization, all of which have been shown to positively influence student outcomes (Hadie et al., 2019). Consequently, having qualified and competent teachers is essential for providing students with opportunities to develop their interest in science subjects, which is crucial for the sustainability of the DLP (Suliman et al., 2019). The presence of qualified teachers and students with a high interest in science in the DLP may enhance the teaching and learning processes and result in better quality education, which is considered a vital element of sustainable development (Li, Yamaguchi & Takada, 2018). As emphasized by Ong (2009), teachers' teaching approaches play a significant role in improving students' learning outcomes and achievements in science and mathematics. Mustakim, Mustapha, and Lebar (2014) further underscored the importance of teachers in creating appropriate activities for students to foster a fun learning environment. It is believed that if teachers fail to support students in their learning, it may negatively impact their motivation and self-confidence. Therefore, the role of teachers is indispensable in ensuring the smooth operation of the teaching and learning process, as their contributions are pivotal to the overall educational experience.

Universiti Malaya

In order to successfully implement the Dual Language Programme (DLP) in schools, specific criteria must be fulfilled in accordance with the guidelines set by the Ministry of Education Malaysia in 2015. These criteria encompass various aspects such as the availability of adequate resources, the willingness of school principals and teachers to adopt the DLP, support and demand from parents, and achieving a certain level of proficiency in Bahasa Malaysia. It should be noted that participation in the DLP is purely voluntary, and schools have the autonomy to decline participation if they are not interested or willing to implement the program. The DLP is not mandatory for all schools and students, as it provides flexibility for schools, teachers, students, and parents to choose their preferred language of instruction, as elucidated by Suliman, Nor, and Yunus in their research findings in 2018. It is worth mentioning that private schools have already embraced the teaching of science and mathematics in English, in response to the increasing demands from parents who aspire for their children to learn these subjects in English, as observed by Suliman, Nor, and Yunus in their study in 2018. Additionally, research data collected by Bullah and Yunus in 2018 revealed that a substantial majority of parents, approximately 75%, preferred schools that implement the DLP, where mathematics and science are taught in English.

Private schools, managed by independent organizations and funded through tuition fees paid by students, typically charge higher fees to support superior facilities and cutting-edge technology. The administration of these schools regulates the fees and oversees the recruitment of teachers, with school administrators solely responsible for determining the qualifications required to become a teacher. Although private schools must adhere to the government-approved curriculum, the mode of delivery is decided by the school board, as noted by SchoolAdvisor.my in 2021. A critical need exists for qualified and proficient science teachers who can conduct lessons in English within private schools. Offering the

Universiti Malaya

DLP, especially in the urban Klang Valley area, presents a significant advantage for attracting parents who are keen to enrol their children in private schools. Parents continually seek the best possible education for their children, making the choice of a reputable school a top priority, as highlighted by Wespieser (2015), Priya (2018), and Skallerud (2011).

Schools face immense pressure to achieve excellence, as noted by Pang and Wang in 2016. This goal is no longer limited to just the school principal but extends to all individuals involved in the field of education. Teachers now have the power to enhance the academic performance of their schools by providing leadership in addition to the principal's efforts, as highlighted by Pang and Miao in 2017. According to several scholars, the ultimate aim of teacher leadership is to cultivate students' knowledge within the school environment, and thus, teachers' leadership styles should be integrated into everyday classroom activities in meaningful ways, as pointed out by Sinha et al. in 2017. Moreover, Suliman, Mohd Nor, and Md Yunus (2019), along with Mahmud et al. (2018), emphasized the importance of providing professional development opportunities for teachers to enhance their English proficiency and teaching skills in science and mathematics. These opportunities are essential for ensuring that teachers are well-equipped to deliver high-quality education in these subjects, thereby contributing to the overall effectiveness of the educational system. Additionally, students often develop a stronger bond with their teachers compared to their principals. Several studies have shown that the leadership of principals is the second most significant factor influencing students' learning outcomes, after the influence of teachers, as highlighted by Grissom, Kalogrides, and Loeb in 2015. Hence, qualified teachers who possess pedagogical and leadership capabilities play a crucial role in the success of schools. Overall, teaching is a complex profession that is influenced by multiple variables related to teachers and other factors

Universiti Malaya

affecting student achievement, as agreed upon by Stronge et al. in 2015. While there is no universally accepted list of effective teaching qualities, effective teachers are generally known to carefully plan lessons, use appropriate instructional materials, communicate learning goals to students, maintain an engaging pace, regularly assess student work, and employ a variety of teaching strategies. They effectively utilize classroom time and have coherent instructional strategies, holding high expectations for their students' learning and taking responsibility to support their students, as highlighted by Cohen et al. in 2003 and Stronge et al. in 2015. In the context of science education, the focus is on engaging students in inquiry-based investigations, encouraging interactions with teachers and peers, making connections between their prior knowledge and scientific concepts, applying science concepts to real-world questions, and actively participating in problem-solving, reasoning from evidence, and group discussions, as outlined by Contant et al. in 2018. Teachers play a critical role in making science interesting by being confident, credible, interested, and enthusiastic. Effective communication of scientific information by teachers, combined with students' interest and passion for the subject, is believed to contribute to improved academic achievement in secondary school science, as noted by Arrieta et al. in 2020. However, it is important to note that the effectiveness of specific teaching behaviours cannot be determined without considering whether students are genuinely interested in science as a result of these behaviours. Therefore, teachers face the challenge of not only identifying and mastering instructional strategies and behaviours known to be effective, but also effectively applying them to individual students and student groups in specific teaching situations to achieve desired learning outcomes, as highlighted by Hunt, Touzel, and Wiseman in 2009, and Mupa and Chinooneka in 2015. Transformational leadership, according to some educational experts, promotes to effective teaching, student educational achievement, and achieving targeted classroom objectives by focusing on students' needs, motivation, and behaviour (Bolkan &

Universiti Malaya

Goodboy, 2009; Stein, 2010). Furthermore, because the nature of these two notions, namely teacher’s transformational leadership and teaching behaviour, are inclusively concerned on students' interests and educational achievement, it appears that these two concerns interact closely theoretically. Numerous researchers have independently examined the effects of teachers' transformational leadership practices and teaching behaviours on various educational issues, such as students' commitment to their goals, motivation for achievement, and learning outcomes (Hoehl, 2008; Bolkan & Goodboy, 2009; Ahmed & Qazi, 2011; Harrison, 2011; Gunnes & Donze, 2016; Linnenbrink-Garcia, Patall, & Pekrun, 2016). These studies have also explored the impact on student achievement (Hattie, 2009; Seritanondh, 2013; Beauchamp et al., 2014). However, to the best of the researcher's knowledge, the potential relationship between teachers' transformational leadership practices and teaching behaviours has not yet been investigated comprehensively. Therefore, it is necessary for the researcher to approach this issue methodologically to fill the existing gap. Furthermore, teachers should focus on the impact of transformational leadership practices on their teaching behaviour and strive to enhance these practices to improve their teaching behaviour, which in turn can influence their students' interest in science. Transformational leadership practices are suggested to be a factor that can influence teachers' teaching behaviour, as it focuses on the leader/follower relationship and aims to improve followers, resulting in positive outcomes for students (Bolkan & Goodboy, 2009). The field of education is perpetually evolving, with an increasing focus on effective teaching practices and student engagement. In the realm of science education, it is particularly important to understand the factors that influence students' interest in the subject. Previous research has emphasized the significant role that teachers' leadership practices and teaching behaviours play in shaping students' interest in science. However, there remains a need to explore the

Universiti Malaya

relationships between these variables and to uncover the underlying mechanisms that mediate these relationships.

One of the most significant challenges in science education is the decline in student motivation and interest, particularly in the empowering sciences. This issue has been documented by several studies (Betsy et al., 2016; Kiemer et al., 2015; Potvin & Hasni, 2014). Extensive research conducted in countries such as the USA, Australia, and New Zealand has also revealed a marked decrease in student motivation during junior high and middle school years (Woods-McConney et al., 2013). Additionally, recent studies by Plenty and Heubeck (2013) and Vedder-Weiss & Fortus (2012) have highlighted a downward trend in youths' motivation towards learning mathematics and science over time. This trend presents a significant challenge for teachers in maintaining student interest and achievement in science. Kiemer et al. (2015) have reported a notable decline in students' interest in STEM (Science, Technology, Engineering, and Mathematics) subjects throughout secondary education, adding to the complexity of this issue.

Despite systematic efforts to promote student participation in science studies and foster positive attitudes toward science and technology, the percentage of students enrolling in science at the upper secondary level remains below the targeted 60:40 ratio of science to arts. This discrepancy is a matter of concern, as pointed out by Halim & Meerah (2016). The open education system, combined with misconceptions about learning science, has exacerbated the issue of low enrolment in science compared to the arts stream at the higher secondary level. Another contributing factor could be the low tolerance for failure among students. Studies have shown that Malaysian students do not necessarily dislike or fear science, but they often choose social sciences as they perceive them to be more manageable (KPM, 2013). Similar concerns have been raised by UK governments,

Universiti Malaya

universities, and businesses over the past decade regarding the inadequate number of students opting for science subjects at the 'A' level (post-16) and university level, as well as the limited number of individuals pursuing science or STEM-based careers. Numerous studies, including those by Archer et al. (2013) and Murphy & Whitelegg (2006), have investigated the underlying reasons for this trend. While various issues have been identified, such as perceptions of science/scientists and lack of awareness about STEM-based careers, a recurring theme is the declining interest of students in science as they progress through secondary school (Kiemer et al., 2015). Furthermore, studies by Jones, Howe, & Rua (2000) have also identified gender differences in interest in science.

Secondary education in Malaysia poses undeniable challenges in terms of academic performance. The performance of Malaysian students in science education, as evidenced by international studies such as TIMSS (Trends in International Mathematics and Science Study) and PISA (Programme for International Student Assessment), reflects the impact of the policy of teaching science and mathematics in English (PPSMI) implemented in 2000. Malaysia has been participating in TIMSS since 1999, and the results have shown a significant decline compared to other countries, particularly between 1999 (pre-PPSMI) and 2011 (post-PPSMI), as cited by Sumintono (2015). The decrease in science achievement among Malaysian students, in terms of both rank and score, has been attributed to various factors, including the language of instruction, as highlighted by Halim and Meerah (2016), suggesting that the introduction of PPSMI in 2003 may have contributed to this decline. Similarly, Malaysia's performance in PISA, where the country participated in 2009 and 2012, placed Malaysian students at rank 53 out of 74 countries, below the international average, as reported by Sumintono (2015). Further analysis from KPM (2013) indicates that Malaysian students have limited scientific knowledge that can only be applied to familiar situations, struggling to draw conclusions or make

Universiti Malaya

interpretations from simple investigations. This underscores the urgent need for the Malaysian government to take proactive measures to enhance the quality of science and mathematics teaching in the country, as the lack of science literacy among students could undermine their competency in the global arena, as pointed out by Jeff (2014).

Despite teachers being recognized as critical figures in improving teaching and learning conditions in schools, there is limited knowledge about the leadership strategies they should employ to improve outcomes, such as students' interest in the science subject. Harrison (2011) has suggested that transformational leadership behaviours exhibited by instructors have a more significant impact on student cognitive learning, affective learning, perceptions of teacher credibility, and communication satisfaction, compared to transactional behaviours. Previous studies by Pounder (2008), Hoehl (2008), Bolkan & Goodboy (2009), and Harrison (2011) have provided direct evidence of the relationship between instructor charisma, intellectual stimulation, and inspirational motivation with student cognitive learning, affective learning, student motivation, and student perceptions of instructor credibility. However, the previous study did not delve into the specific dimensions of transformational leadership or investigate the prospective mediating role of teaching behaviour.

To address this research gap, the current study aims to predict the dimensions within teachers' transformational leadership practices and teaching behaviours that influence students' interest in science, particularly after the implementation of DLP in private schools in the Klang Valley. By identifying and understanding the specific aspects of transformational leadership and teaching behaviours that contribute to students' interest, educators can implement targeted strategies to enhance science education experiences. This knowledge can inform professional development programs and policy initiatives

Universiti Malaya

focused on improving science teaching practices and promoting students' interest in the subject. Additionally, the investigation encompasses the mediating role of teachers' teaching behaviour in the relationship between teachers' transformational leadership practices and students' interest in science to fill the research gap.

The mediator in this study, teachers' teaching behaviour, plays a crucial role in bridging the gap between teachers' transformational leadership practices and students' interest in science. Teaching behaviour encompasses a broad spectrum of instructional practices, which include classroom management, pedagogical strategies, and interactions between students and teachers. Prior research has demonstrated that teachers' behaviour within the classroom has a significant impact on students' engagement and interest in learning (Brandišauskienė et al., 2021). Despite these findings, further investigation is necessary to understand how specific teaching behaviours mediate the relationship between transformational leadership and students' interest in science. Comprehending the mediating role of teaching behaviour is crucial for several reasons. Firstly, it reveals the underlying mechanisms by which teachers' leadership practices influence students' interest in science. Secondly, it allows educators to identify effective teaching behaviours that foster positive outcomes in science education. By pinpointing the specific behaviours that mediate this relationship, educators can design targeted interventions and professional development programmes aimed at enhancing teaching practices and increasing student engagement in science.

Universiti Malaya

1.4 Purpose of the Study

The purpose of this study is to investigate the relationship between teachers' transformational leadership practices and students' interest in science within private schools in the Klang Valley. This relationship will be analysed both directly and indirectly, considering the potential mediating role of teachers' teaching behaviour. By exploring these dynamics, the study seeks to provide valuable insights into how leadership and teaching practices can be optimized to foster greater student interest in science, thereby contributing to the overall improvement of science education in private schools.

1.5 Objectives of the Study

This study's objectives are as follows:

1. To examine the level of students' interest in science in Private Schools, Klang Valley, Malaysia.
2. The examine the level of teachers' transformational leadership practices in Private Schools, Klang Valley, Malaysia.
3. To examine the level of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia.
4. To analyse the relationship between teachers' transformational leadership practices, students' interest in science and teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia.
5. To explore the predicting dimensions of the teachers' transformational leadership practices on students' interest in science in Private Schools, Klang Valley, Malaysia.
6. To explore the predicting dimensions of the teachers' teaching behaviour on students' interest in science in Private Schools, Klang Valley, Malaysia.

Universiti Malaya

7. To explore the predicting dimensions of the teachers' transformational leadership practices on teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia.
8. To examine whether teachers' teaching behaviour mediate the relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia.
9. To evaluate the fit of the proposed model linking teachers' transformational leadership practices, students' interest in science, and teachers' teaching behaviour with the data collected from Private Schools, Klang Valley, Malaysia.

1.6 Research Questions

This study's research questions are as follows:

1. What is the level of students' interest in science as perceived by the students in Private Schools, Klang Valley, Malaysia?
2. What is the level of teachers' transformational leadership practices in Private Schools, Klang Valley, Malaysia?
3. What is the level of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?
4. Is there any significant relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia?
5. Is there any significant relationship between teachers' transformational leadership practices and teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?
6. Is there any significant relationship between teachers' teaching behaviour and students' interest in science in Private Schools, Klang Valley, Malaysia?

Universiti Malaya

7. Which dimensions of teachers’ transformational leadership practices are predictors of students’ interest in science in Private Schools, Klang Valley, Malaysia?
8. Which dimensions of teachers’ teaching behaviour are predictors of students’ interest in science in Private Schools, Klang Valley, Malaysia?
9. Which dimensions of teachers’ transformational leadership practices are predictors of teachers’ teaching behaviour in Private Schools, Klang Valley, Malaysia?
10. Does teachers’ teaching behaviour mediate the relationship between teachers’ transformational leadership practices and students’ interest in science in Private Schools, Klang Valley, Malaysia?
11. Do the data linking with teachers’ transformational leadership practices, students’ interest in science and teachers’ teaching behaviour collected from Private Schools, Klang Valley, Malaysia fit in the proposed model?

1.7 Significance of the Study

This research holds significance for the specific private school under study by helping stakeholders understand existing teacher leadership practices and identifying areas for improvement. The findings can serve as a valuable resource for other private schools in Malaysia, offering insights into leadership practices and allowing schools to assess their teachers' performance.

The anticipated outcomes are expected to provide valuable insights for school principals and science teachers, enabling them to develop effective teaching strategies and improve instructional design to enhance students' academic achievement. The broader societal impact may extend to the government, parents, students, and the community, as students

Universiti Malaya

with heightened interest in science can contribute to social and economic benefits through enhanced educational attainment.

Enhancing science literacy is a multifaceted endeavour encompassing personal choice, economic necessity, and societal engagement. By prioritizing science education and fostering improvement, students can be empowered to participate in science literacy, leading to a larger pool of science professionals serving as experts and advocates for public understanding of science. The contributions of competent and capable science professionals to the country are promising for the future. The findings may also have implications for revising examination regulations and integrating skill assessments, informing policy considerations in this area.

This study's significance also includes addressing the growing concern regarding student interest and career aspirations in science, particularly in STEM fields. Schools and teachers must prioritize developing students' interest in science to shape their willingness to pursue STEM careers. The study's insights can inform strategies to foster students' interest in science, promoting more engaging and successful science education practices.

Understanding the factors that influence the emergence and sustainability of students' interest in secondary science lessons is crucial, as it may be their last formal opportunity to engage with science. Increased interest in science can lead to more students studying the subject and fostering positive attitudes towards it, impacting their educational and career trajectories. Investigating these factors is critical for promoting students' interest in science and its long-term impact on their educational and career trajectories.

Universiti Malaya

1.8 Limitation of the Study

While conducting this study, several limitations should be acknowledged. Firstly, the research is limited to private schools within the Klang Valley, which may restrict the generalizability of the findings to other educational contexts. This study took place during the academic year 2021 – 2022. Furthermore, relying on self-report measures to assess teaching behaviour, transformational leadership, and students' interest in science may introduce response bias. To mitigate this limitation, participants will be assured of the confidentiality of their responses. As the researcher is a science teacher, self-reflection and reflexivity will be employed throughout the research process to acknowledge and mitigate potential biases. This involves actively recognizing personal beliefs and experiences that may influence data interpretation and analysis, seeking diverse perspectives, and engaging in peer debriefing and member checking to ensure a balanced and unbiased approach. Aside from that, prior to the main data collection, a pilot study will be conducted to refine the survey instruments and assess the clarity and comprehensibility of the questions. This pilot study will involve a sample of participants similar to the main study group, ensuring that the self-report measures effectively capture the intended constructs. While potential limitations exist, the researcher's unique position as a science teacher offers opportunities to mitigate biases and enhance the rigor of the study. By ensuring anonymity, practicing reflexivity, and piloting survey instruments, the study aims to minimize response bias and provide valuable insights into the mediating role of teaching behaviour between transformational leadership practices and students' interest in science in private schools within the Klang Valley.

1.9 Operational Definitions

In this empirical investigation, precise definitions have been formulated to ensure precise understanding and comprehension of the key terms and concepts employed in the study.

Universiti Malaya

The operational definitions presented below have been carefully crafted to align with the research scope, which centres on the exploration of the interrelationships among teachers' transformational leadership practices, students' interest in science, and teachers' teaching behaviour in private schools located in the Klang Valley, Malaysia.

1. Teachers' Transformational Leadership Practices

Transformational leadership refers to behaviours exhibited by teachers that empower and inspire others, go beyond self-interest, and instil confidence in others to achieve higher levels of functioning (Bass & Riggio, 2006). In this study, transformational leadership specifically pertains to the practices of teachers in private schools in the Klang Valley, Malaysia, who demonstrate idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration, with the aim of promoting positive teaching behaviour and increasing students' interest in science. The definition of transformational leadership by Beauchamp et al. (2010) was adopted for this study. Beauchamp's Transformational Teaching Questionnaire (TTQ) comprises four dimensions, each consisting of 16 questions rated on a 5-point numerical scale, with 1 indicating 'Not At All' and 5 indicating 'Frequently'.

a. Idealized influence takes place when leaders foster trust and respect among those that they lead, and model ethically desirable behaviours through the demonstration of personally held beliefs.
b. Inspirational motivation involves the communication of high expectations to followers, whereby leaders inspire and energize others to achieve their goals.
c. Intellectual stimulation involves encouraging people to see issues from multiple perspectives and question their own and others' commonly held assumptions.

Universiti Malaya

d. Individualized consideration takes place when leaders recognize and act on the personal and psychological needs of others, display a genuine sense of care and concern and celebrate the successes of others.

(Beauchamp et al., 2010)

2. Students' Interest in Science

This study specifically focuses on the self-reported interest, enjoyment, and motivation of students in science. Students' engagement with science, both currently and in the future, is influenced by their attitudes and perceptions of science as important, enjoyable, and useful (OECD, 2008). Hassan (2008) identified the most relevant factors affecting students' interest and motivation in science, which include: (a) motivation and enjoyment of science, and (b) students' choices. Motivation and enjoyment of science encompass various categories, such as students' motivation for science, enjoyment of science, absence of anxiety, perception of science as useful, and self-concept of ability in science. Students' choices include career interest and ability to make choices related to science. These factors can be assessed using an equal measure scale to gauge the level of science interest among students. In this study, the level of student interest in science is measured based on the seven dimensions identified by Hassan (2008), as briefly outlined here. The Student Interests and Motivation in Science Questionnaire (SIMSQ) is employed, consisting of 37 statements rated on a 5-point scale. Accurate measurement of student interest can inform targeted interventions to improve student interest outcomes.

a. Motivation for science refers to the extent to which students are motivated.
b. Enjoyment of science refers to the students' enjoyment of science learning experiences.
c. Lack of anxiety refers to the extent to which students feel less anxious.

Universiti Malaya

d. Usefulness of science refers to students' beliefs in the useful application of science for them and for society in general.
e. Self-concept of ability deals with students' perception of their achievement in science.
f. Career interest is a measure of the development of students' interest in pursuing a career in science.
g. Ability to make choices refers to students' empowerment to make decisions about their science learning.

(Hassan, 2008)

3. Teachers' Teaching Behaviour

For the purpose of this study, teaching behaviour of teachers refer to teacher's specific classroom behaviours which are based on students' observations on specific, concrete classroom teaching behaviours (including enthusiasm, clarity, rapport, and interaction) exhibited by teacher that have been proven to result in positive student outcomes (Hadie et al., 2019). The Teacher Behaviour Inventory (TBI) is developed by Hadie et al. (2019), which consists of seven dimensions as described below, which are operationalised by 32 statements on a 5-point numerical rating scale.

a. Clarity is defined as methods used to explain or clarify concepts and principles.
b. Enthusiasm is defined as use of nonverbal behaviour to solicit student attention and interest.
c. Interaction is defined as techniques used to foster students' participation in class.
d. Organization is defined as ways of organizing or structuring subject matter of the lesson.
e. Disclosure is defined as explicitness concerning subject requirements and grading criteria.

Universiti Malaya

f. Speech & Pacing is defined as characteristics of voice and rate of information presentation.
g. Rapport is defined as quality of interpersonal relations between teacher and students.

(Hadie et al., 2019)

4. Private Schools

In Malaysia, private schools are autonomous educational establishments that operate independently without being subject to the oversight of the Ministry of Education. As a result, they are not constrained by the same rules, regulations, and policies that govern public schools. For instance, private schools enjoy the flexibility to incorporate the national curriculum, while also having the freedom to supplement it with additional subjects or even adopt an entirely different curriculum altogether (MOE, 2013; SchoolAdvisor.my., 2021).

The profitability of private schools is determined by the number of students enrolled. Profit margins for effective private schools can range from 20 to 30 percent of revenue (Nina, 2016). To attract more students for enrolment, private schools must be responsive to parents' demands regarding curricula, teaching methods, facilities, and discipline, as well as students' needs (OECD, 2012).

1.10 Summary

This chapter serves as an introduction to the research study, presenting an overview of the background, rationale, problem statement, research purpose, objectives, research questions, significance of the study, limitations, and operational definitions. The primary focus of this research is to explore the relationship between teachers' transformational

Universiti Malaya

leadership practices, teachers' teaching behaviour, and students' interest in science, with the intention of understanding the role of teaching behaviour as a mediator.

The background section provides a foundation for the study, discussing the importance of teachers' transformational leadership practices and students' interest in science. It highlights the critical role teachers play in influencing students' interest and engagement in science subjects and recognizes the potential impact of transformational leadership practices on teaching effectiveness. Additionally, it emphasizes the significance of investigating the mediating role of teaching behaviour in this relationship.

Following the background, the rationale for conducting this research is presented. The rationale highlights the need to understand the mechanisms through which teachers' transformational leadership practices influence students' interest in science. By examining the role of teaching behaviour as a mediator, this research aims to provide insights into the underlying processes that contribute to students' enhanced interest and engagement in science.

The problem statement succinctly identifies the research gap and underscores the significance of bridging the knowledge deficit in the field. It emphasizes the need for empirical evidence to support the hypothesis that teaching behaviour acts as a mediating variable between teachers' transformational leadership practices and students' interest in science.

The research purpose of this study is to investigate and understand the relationship between teachers' transformational leadership practices, teachers' teaching behaviour, and students' interest in science. By exploring the potential mediating effect of teaching behaviour, this research aims to contribute to the existing literature on science education and educational leadership.

To achieve the research purpose, several objectives have been formulated. These objectives include: (1) examining the level of students’ interest in science; (2) examining the level of teachers’ transformational leadership practices; (3) examining the level of teachers’ teaching behaviour; (4) analysing the relationship between teachers’ transformational leadership practices, students’ interest in science and teachers’ teaching behaviour; (5) exploring the predicting dimensions of the teachers’ transformational leadership practices on students’ interest in science; (6) exploring the predicting dimensions of the teachers’ teaching behaviour on students’ interest in science; (7) exploring the predicting dimensions of the teachers’ transformational leadership practices on teachers’ teaching behaviour; (8) examining whether teachers’ teaching behaviour mediate the relationship between teachers’ transformational leadership practices and students’ interest in science; and (9) evaluating the fit of the proposed model linking teachers’ transformational leadership practices, students’ interest in science, and teachers’ teaching behaviour with the data collected from Private Schools, Klang Valley, Malaysia.

The research questions guide the study and provide a framework for data collection and analysis. These questions address the relationships between teachers' transformational leadership practices, teachers' teaching behaviour, and students' interest in science. They also inquire about the potential mediating effect of teaching behaviour in this relationship.

The significance of this study lies in its potential to inform educational practices and policies. Understanding how teachers' transformational leadership practices, teaching behaviour, and students' interest in science are interconnected can facilitate the

Universiti Malaya

development of effective interventions and strategies to enhance science education and increase students' interest in the subject. By exploring the mediating role of teaching behaviour, this research contributes to the existing body of knowledge in educational leadership and science education.

Despite its contributions, this study has some limitations that need to be acknowledged. These limitations include potential bias in self-report data, generalizability of findings to other educational contexts, and the inherent complexity of measuring and assessing teaching behaviour and students' interest in science. However, efforts will be made to mitigate these limitations and provide valid and reliable results.

Lastly, operational definitions of key terms and concepts used in this study are provided to establish clarity and consistency in understanding the variables under investigation.

Chapter 2 will present a comprehensive literature review, delving into previous studies and theories that support the research objectives and provide a theoretical framework for this study.

Universiti Malaya

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides an extensive review and analysis of existing definitions and previous studies related to teachers' transformational leadership practices, students' interest, and teachers' teaching behaviour. The literature review is organized in the following sequence: teachers' transformational leadership practices, students' interest, and teachers' teaching behaviour. Moreover, the interrelationships among these variables are discussed. The main objective of this study is to critically examine relevant theories and explore the relationships among variables, with the aim of developing guidelines that contribute to achieving the study's objectives.

2.2 Transformational Leadership

Transformational leadership in education has garnered significant attention as a means to enhance teacher effectiveness, student engagement, and overall school performance. This leadership style is characterized by the ability to inspire and motivate followers to exceed their own self-interests for the sake of the organization or community. According to Northouse (2016), transformational leadership comprises four critical components: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration.

- **Idealized Influence:** Teachers serve as role models, demonstrating ethical behaviour and high standards of conduct that students and colleagues aspire to emulate (Northouse, 2016).

Universiti Malaya

- **Inspirational Motivation:** Transformational teachers communicate a compelling vision of the future, encouraging students to engage deeply with the learning process and strive for excellence (Northouse, 2016).
- **Intellectual Stimulation:** These leaders promote creativity and critical thinking, encouraging students to explore new ideas and challenge existing assumptions (Northouse, 2016).
- **Individualized Consideration:** Transformational teachers recognize the unique needs of each student, providing tailored support and mentorship to foster individual growth (Northouse, 2016).

Research indicates that transformational leadership significantly influences teacher performance and student outcomes. For instance, a meta-analysis conducted by Wang et al. (2020) found that teachers who exhibit transformational leadership behaviours contribute to higher levels of student engagement and motivation, which in turn enhances academic performance. Ahmad and Rochimah (2021) highlight that transformational leadership directly impacts teaching effectiveness by promoting a supportive environment where teachers feel empowered to innovate and collaborate.

The relationship between transformational leadership and teacher motivation is another critical area of study. Research by Tsang et al. (2022) suggests that transformational leadership can reduce teacher burnout and increase job satisfaction by fostering a sense of belonging and purpose within the educational environment. This motivational aspect is essential, as motivated teachers are more likely to engage their students effectively and create a dynamic learning atmosphere. Additionally, transformational leadership plays a crucial role in fostering teacher professional development and improving teaching practices. It encourages continuous learning, promotes collaborative inquiry, and

Universiti Malaya

cultivates critical thinking among teachers (View et al., 2009). Research indicates that transformational leadership has a stronger effect on teacher self-efficacy compared to teachers' growth mindset, and significantly influences teachers' professional attitudes and adoption of desirable teaching strategies (Lin et al., 2022).

Despite the positive implications of transformational leadership, challenges remain. Implementing transformational practices requires a shift in mindset and culture within educational institutions. Resistance to change, lack of training, and insufficient support from administration can hinder the effectiveness of transformational leadership initiatives (Ahmad & Rochimah, 2021). Therefore, it is crucial for educational leaders to address these barriers through professional development and collaborative practices.

2.2.1 Teachers' Transformational Leadership

Similar to exemplary leaders, effective teacher leaders take ownership of their students' holistic development as they believe in their direct impact. Teacher leadership has been acknowledged as an integral aspect of teachers' professional responsibilities (Robertson & Strachan, 2001). Furthermore, teacher leadership is also significant when teachers collaborate with students to deliver the desired type of learning (Gunter, 2005).

Various measures of leadership styles, including transformational and transactional leadership (Avolio et al., 1999), spiritual leadership (Fry, 2003), the principal mindfulness scale (Hoy & Miskel, 2004), servant leadership (Laub, 1998), invitational leadership (Asbill & Gonzalez, 2000), distributed leadership (Hulpia et al., 2009), value-based leadership (Grag & Krishnan, 2003), and shared leadership (Wood, 2005), have been utilized in the existing literature on teacher leadership. Among these, the component pertaining to transformational leadership from the Multifactor Leadership Questionnaire

Universiti Malaya

(Avolio et al., 1999; Bass, 1985) has gained significant traction due to its well-established reliability and validity.

As proposed by Pounder (2006), teacher leaders are often perceived as highly skilled educators and are more likely to demonstrate attributes associated with transformational leadership. Based on an extensive review of existing literature and his own research, Pounder (2006) outlined four distinct waves of teacher leadership development. The first wave confined teacher leadership to formal roles within school hierarchies, while the second wave incorporated the instructional aspect of teaching. The third wave emphasized a process-oriented approach to understanding teacher leadership, rather than a positional one. Finally, Pounder introduced the fourth wave, which revolves around the concept of transformational classroom leadership.

Previous studies have categorized transformational leaders as individuals who exhibit high levels of engagement, passion, empowerment, vision, and creativity (Hackman & Johnson, 2004). Bass (1985) further refined Burn's concept by delineating four categories of transformational leadership behaviour: idealized influence, intellectual stimulation, individualized consideration, and inspirational motivation.

- **Idealized influence.** According to Bass (1999), idealized influence is the ability of a transformational leader to effectively communicate a compelling vision to their followers and persuade them to align with that vision (p. 19). This results in the development of a deep sense of trust in the leader among the followers (Bass, 1985). Yukl (2006) explains that idealized influence triggers strong emotional responses and fosters a sense of affiliation with the leader. Additionally, Banjeri and Krishnan (2000) note that charismatic leaders are often perceived by

Universiti Malaya

followers as being passionate about their responsibilities, commanding respect, and conveying a sense of purpose, which in turn influences the followers (p. 407).

- **Intellectual stimulation.** As stated by Avolio et al. (1999), intellectual stimulation involves inspiring followers to question established methods of problem-solving and encouraging them to improve upon existing approaches (p. 444). When followers are intellectually stimulated, they are more likely to challenge leader decisions and group processes, promoting creative thinking (Bass & Steidlmeier, 1999). Brown and Posner (2001) advocate for intellectual stimulation as a crucial component of organizational learning and transformation, as it appeals to followers' desires for achievement and growth in ways that resonate with them. According to Brown and Posner (2001), leaders who prioritize learning for both themselves and their followers recognize the valuable role of intellectual stimulation in promoting organizational learning.
- **Individualized consideration.** As per Avolio et al. (1999), transformational leadership involves the leader assuming the role of a mentor, providing followers with opportunities for growth and development through a self-actualization process. Corrigan and Garman (1999) highlight that individualized consideration, a component of transformational leadership, has a positive impact and aids in team-building activities. Yukl (2006) further explains that individualized consideration behaviours encompass providing support, encouragement, and coaching to followers. The mentoring and coaching relationship is geared towards addressing the individual developmental needs of followers, with the ultimate goal of transforming them into leaders (Bass & Steidlmeir, 1999). According to Barnett et al. (2001), individualized consideration is manifested when leaders establish interpersonal relationships with their followers, allowing for customized leadership and goal-setting for each follower (Barnett et al., 2001).

Universiti Malaya

- **Inspirational motivation.** As per Bass (1999), inspirational motivation in leadership entails providing followers with challenges and significance in order to foster shared goals. Bass and Steidlmeier (1999) further elaborate that inspirational motivation involves the leader's ability to effectively communicate their vision in a way that motivates followers to take action towards achieving the goal, even in the face of obstacles, while keeping the group's objective in focus (Kent et al., 2001). Yukl (2006) suggests that examples of actions that demonstrate inspirational motivation include effectively communicating an appealing vision, using symbols to align the efforts of subordinates, and modelling appropriate behaviours. Some scholars have also linked inspirational motivation to ethical considerations, positing that leaders who genuinely care about the organization's vision and employee motivation are more likely to make ethical decisions (Banjeri & Krishnan, 2000; Kent et al., 2001).

Universiti Malaya

The framework of the 4 Is—Idealized Influence, Inspirational Motivation, Intellectual Stimulation, and Individualized Consideration—was originally developed by Bernard Bass as an extension of James MacGregor Burns' foundational work on transformational leadership. In educational settings, the 4 Is maintain their core definitions and purposes, reflecting the same underlying principles as in the broader transformational leadership framework. While the 4 Is retain their foundational meanings, their application within educational contexts reveals some distinctions compared to their original conceptualization in business and organizational leadership.

- Contextual Emphasis: In educational settings, the focus of Idealized Influence often shifts from organizational goals to student development. Teachers are not only role models for academic success but also for social and emotional growth, which is less emphasized in traditional business contexts (Brady, 2022).

- Collaborative Environment: Inspirational Motivation in education often involves collaboration among teachers, students, and parents, creating a community-oriented approach to achieving educational goals. This contrasts with the more hierarchical structures often found in business settings, where leaders primarily motivate employees (Kaya & Koçyiğit, 2023).
- Innovation and Curriculum Development: Intellectual Stimulation in education emphasizes curriculum innovation and pedagogical strategies, encouraging teachers to experiment with new teaching methods. In contrast, in corporate settings, this component may focus more on process improvements and operational efficiencies (Steinmann et al., 2018).
- Holistic Support: Individualized Consideration in education extends beyond academic needs to encompass emotional and psychological support, recognizing the complex challenges students face. This holistic approach is less common in traditional organizational leadership, where the focus may be more on professional development and performance metrics (Ahmad & Rochimah, 2021).

The concept of transformational leadership in teacher educators can be elucidated as follows:
The teacher educator articulates a realistic vision of education in general and teacher education in particular, shares this vision with students, stimulates students intellectually, and motivates them to exert their best effort in professional preparation, taking into consideration individual differences (Pushpanadham & Nambumadathil, 2020).

Comparisons drawn from organizational literature between transformational and non-transformational leadership highlight the distinct outcomes associated with transformational leadership. Subordinates under the guidance of transformational leaders

Universiti Malaya

tend to experience reduced role conflict, exhibit higher levels of task performance, and report increased job satisfaction compared to those under non-transformational leaders (Howell & Frost, 1989). Furthermore, subordinates are more likely to exhibit helping behaviour and compliance with transformational leaders (Den Hartog et al., 2007). Additionally, transformational leaders are perceived as more effective, higher-performing, and held in higher esteem by their subordinates in terms of collective identity and task performance, as compared to non-transformational leaders (Conger et al., 2000; Hater & Bass, 1988).

Harvey et al. (2003) conducted a comprehensive study to investigate the effects of transformative leadership on university students. The researchers examined the influence of various independent variables, such as charisma, individualized consideration, and intellectual stimulation, on students' attitudes towards their courses. The findings revealed that charisma and intellectual stimulation were the most significant predictors of students' perceptions of their instructor's performance, including factors such as respect, satisfaction, and trust. Additionally, individualized consideration and intellectual stimulation emerged as key predictors of student involvement. These results led the researchers to conclude that transformational leadership had a significant impact on important outcomes in a university classroom setting. In a similar vein, Walumbwa et al. (2004) explored the full range leadership framework, encompassing both transformational and transactional leadership, in the context of a university. Their research revealed that higher ratings of the instructor's transformational leadership were positively associated with increased willingness of students to exert extra effort, higher perceptions of instructor effectiveness, and overall satisfaction with the instructor.

Universiti Malaya

According to Bolkan & Goodboy (2009), instructors who exhibit idealized influence, intellectual stimulation, individualized consideration, and inspirational motivation have the ability to positively impact student behaviours, perceptions, and learning outcomes. By providing support, encouragement, and building trust, these instructors can encourage students to exert extra effort, participate actively, and place trust in them. In other words, students who perceive their instructors as being supportive, appreciative, charismatic, and intellectually stimulating are more likely to engage in higher levels of effort, participation, and trust (Bolkan & Goodboy, 2009).

The educational system's effectiveness hinges on the presence of transformational leaders due to the need for large-scale changes and recommendations for teacher education redesign (Caldwell, 1994; Leithwood, 1994). Transformational leadership is seen as well-suited to address the challenges of modern educational reforms. Despite the complex and uncertain nature of these reforms, transformational leadership has the potential to foster growth in teachers' capacities to positively respond to the reform agenda (Jantzi & Leithwood, 1996). However, research on this type of leadership in educational settings is relatively limited, despite positive outcomes observed in non-educational contexts (Leithwood & Jantzi, 1997; Leithwood et al., 1996). Transformational leadership is viewed as crucial for generating a shared vision, distributing leadership, organizing the structure of the organization, and shaping school culture, all of which are essential for effective school restructuring (Leithwood et al., 1999). According to Pushpanadham & Nambumadathil (2020), teachers must also evolve into transformative leaders who possess specific competencies to oversee and implement continuous transformations in order to achieve better results.

According to Tsai's (2015) research, the existing body of literature on transformational school leadership consistently demonstrates a positive correlation with various educational outcomes, such as follower satisfaction, motivation, learning, and student performance. Tsai (2015) conducted a rigorous meta-analysis to synthesize empirical studies and discovered a significant effect size (.485) for the impact of teacher leadership on school outcomes, encompassing factors such as teachers' job satisfaction, organizational culture and climate, as well as student achievement and motivation. These findings suggest that high levels of teacher leadership can serve as a catalyst for enhancing teacher effectiveness and satisfaction, ultimately leading to improvements in student achievement. However, it should be noted that Tsai (2015) also acknowledged that the effect of teacher leadership on student achievement was relatively small when compared to other outcome variables. This indicates that while teacher leadership behaviours do play a role in explaining variations in student achievement, other factors such as learning strategies, content delivery methods, and contextual factors may exert more significant influence. Consequently, further investigation into the relationship between leadership, particularly transformational leadership, and other dependent variables from the perspective of students' perceptions would be valuable, as Tsai's (2015) findings were primarily based on instructors' opinions.

Different geographic or cultural regions may elicit varied responses from students towards transformational and transactional behaviours exhibited by teachers, as hypothesized by Goodboy and Bolkan (2009). Pounder (2008) has noted the lack of sufficient research on the replication of transformative leadership across cultures. While transformational characteristics in instructors may be valued in North American context, it may not hold true in other cultural settings. Hence, the purpose of this research is to explore students' perceptions of teachers' practices of transformational leadership in private schools located in the Klang Valley, with a focus on understanding how it is perceived by students from diverse cultural backgrounds.

2.3 Students' Interest in Science

The concept of interest is widely employed across diverse fields of research, including psychology, educational psychology, sociology, and science and technology education, as emphasized by Krapp and Prenzel (2011). The motivation of students to actively participate in the learning process is a critical aspect of their educational journey, as highlighted by Darlington (2017). Interest plays a significant role in shaping an individual's emotional and cognitive engagement with learning, as supported by Bandura (1997), Hidi (1990), Kim (2005a), and Lamb et al. (2011). In fact, interest is often regarded as a key source of intrinsic motivation, as noted by Hidi (2006), Hidi & Renninger (2006), and Silvia (2006). Recent evidence indicates that enhancing students' interest in the subject matter can have a positive impact on their affective and cognitive engagement, resulting in improved academic achievement and intrinsic motivation, as demonstrated by Schraw, Flowerday, and Lehman (2001), Harackiewicz et al. (2014), and Hulleman and Harackiewicz (2009). Furthermore, studies by Hidi and Renninger (2006), Krapp and Prenzel (2011), Mitchell (1993), and Wiseman and Hunt (2013) suggest that increasing interest can also lead to favourable effects on various abilities such as recognition, recall, persistence, effort, and academic motivation.

Scholars such as Travers and Harring (1978), Gottfredson (1981), Todt, and Schreiber (1998) have put forth comprehensive models outlining the typical stages of interest development from childhood to late adolescence. According to these theories, during the preschool and primary school years, children go through an extended developmental phase where they exhibit curiosity towards a wide range of natural phenomena. Even

Universiti Malaya

young adolescents display a systematic inclination towards observing their surroundings, actively seeking out new experiences and learning about the natural world they are exposed to. As children progress from primary to secondary school, their interests are shaped by their experiences, and they start developing preferences for specific areas, such as animate nature or technology, based on their encounters in science classes. The adolescent period is especially critical for the development of science curiosity, as it is during this time that students begin to define their personal goals and aspirations, thus shaping their sense of identity.

The distinction between situational and individual interest, as highlighted in the work of Krapp and Prenzel (2011), provides the groundwork for an alternative perspective on describing the development of interest. Interests change and evolve throughout an individual's lifetime, and externally induced interests, especially in subjects like chemistry and physics that are typically introduced in school, may diminish quickly. However, in certain cases, a situational interest may transform into a more lasting one due to the unique composition of a particular teaching setting (Krapp & Prenzel, 2011). Krapp (2002) proposed a model that delineates three prototypical stages of interest development: (1) an emerging situational interest that is sparked or triggered for the first time by external stimuli; (2) a stabilized situational interest that persists during a specific and limited learning phase; and (3) an individual interest that reflects a relatively enduring predisposition to engage in a specific area of interest. The initial stage of situational interest is largely influenced by the distinct motivational quality of the learning situation or task, often referred to as "interestingness". The subsequent two stages of interest development are crucial in terms of educational objectives, encompassing the progression from a transient state of initial attraction or curiosity to a more stable motivational state

Universiti Malaya

that is conducive to effective learning, and the shift from a relatively stable situational interest to a more enduring individual interest (as cited in Krapp & Prenzel, 2011).

Hidi and Renninger (2006) put forth a comprehensive four-phase model of interest development that builds upon existing research, with the aim of (a) providing a descriptive framework for understanding the process of interest development, (b) highlighting the importance of specifying the type of interest being studied in research, and (c) offering practical recommendations for educators and parents on how to facilitate children's interest development. The four phases, arranged in a sequential order, include triggered situational interest, maintained situational interest, emerging (or less-developed) individual interest, and well-developed individual interest. According to Hidi and Renninger (2006), each phase of interest development is characterized by varying levels of affect, knowledge, and value. Individual experiences, temperament, and genetic predisposition are likely to influence the duration and nature of each phase. These four phases are considered consecutive and distinct, representing a cumulative and progressive development in situations where an individual's interest is sparked and sustained by external factors, such as efforts of others or perceived obstacles or opportunities in a task. It should be noted that any phase of interest development can become dormant, regress to a previous phase, or fade away altogether without external support (Renninger, 2000; Renninger & Hidi, 2002; Renninger, Sansone, & Smith, 2004).

Hidi (2006) argued that when individuals are fully engaged in an activity or topic, their brains generate internal sentiments that are generally positive, leading to enhanced motivation, learning, and performance. These neuroscientific findings are supported by educational research, which indicates that performance based on interests leads to optimal motivation in students across different ages and abilities. Therefore, one of the crucial

Universiti Malaya

objectives of education should be to foster the development of academically relevant interests. Recent research has further supported this notion, suggesting that interests can trigger spontaneous and automatic attention, resulting in more efficient and expedited information processing (Hidi, 1995, 2001; McDaniel, Waddill, Finstead, & Bourg, 2000).

Researchers (Ainley, Hidi & Berndorff, 1999; Hidi, 2001; Johnson, Alexander, Spencer, Leibham & Neitzel, 2004) have identified three distinct categories of interest - individual, situational, and topical - that are relevant to student learning. Interest is a multifaceted phenomenon characterized by concentrated attention, flow, improved cognitive performance, and heightened affective functioning, and has been widely studied (Annetta et al., 2009; Ainley, Hidi & Berndorff, 2002; Krapp, Hidi & Renninger, 1992). These different forms of interest are believed to interact with each other to facilitate learning (Rheinberg & Vollmeyer, 1998; Schiefele, 1998). Individual interest is a stable and enduring personal inclination towards specific actions, objects, events, or ideas, which is shaped by life events, intrinsic tendencies, or orientations that develop over time (Hidi, 2006; Silvia, 2006; Krapp, 2007). For example, one student may exhibit a profound passion for learning about natural phenomena, while another may be captivated by music (Derek, 2018). Situational interest, on the other hand, is triggered by the environment, such as the structure of a task, its presentation, or the theme, capturing an individual's attention in a specific context (Edgar & Fox, 2006) (Hidi, 2006; Silvia, 2006). It is a transient psychological state characterized by high attention and positive mood, which may or may not persist over time. For instance, a surprising science laboratory experiment may immediately ignite a student's interest, even if they are generally not interested in science lessons. Individual and situational interest converge in the third category of interest, known as topical interest, which refers to the arousal reaction to specific topics presented to an individual (Schiefele, 1998). It encompasses the interplay between an

Universiti Malaya

individual's enduring interests and the situational context, as the topics presented can trigger interest reactions in individuals.

Motivation, as expounded by Hassan (2008), is a multifaceted concept with diverse implications for learning and educational development. The term "motivation" has its roots in the Latin word "movere," which denotes being impelled to take action (Pintrich, 2003). A motivated individual is someone who is invigorated and enthused towards achieving a goal. Intrinsic motivation, one of the numerous types of motivation, holds special significance in education as it fosters high-quality learning and nurtures creativity. It involves engaging in a task because it is inherently interesting and intrinsically rewarding (Hassan, 2008). The ideas of individual and situational interests appear to be encapsulated within the construct of intrinsic motivation, and these terms are often used interchangeably in various scholarly investigations (Hidi and Harackiewicz, 2000). However, individual interest, as elucidated by Schiefele (1999), precedes cognitive processes that influence an individual's level of motivation to engage in specific situations. Thus, individual interest is considered a fundamental prerequisite for the development of intrinsic motivation. Intrinsic motivation denotes a state or process of motivation that arises from an individual's genuine interest, and the experience of discovering one's own interest is often equated with intrinsic motivation in the extant literature (Sansone and Harackiewicz, 2000; Deci and Ryan, 2002; Hassan, 2008).

Based on an extensive literature review conducted by Hassan (2008), the factors that have been identified as most relevant to students' interest and motivation in science are: (a) students' interest and enjoyment of science; and (b) students' choices. Under the category of students' interest and enjoyment of science, several sub-categories were identified, including students' motivation for science, enjoyment of science, lack of anxiety,

Universiti Malaya

perception of the usefulness of science, and self-concept of ability. Additionally, students' choices were found to be significant, including career interest and students' ability to make choices. Hassan (2008) provides a concise summary of the literature organized by seven different scales.

- **Motivation for science.** Motivation is characterized by an individual's drive to achieve difficult tasks, attain high standards, and excel, which is positively correlated with desired goals (Hidi and Harackiewicz, 2000). Recent research has shown that students exhibit the most favorable achievement patterns when they focus on mastery goals. In this context, researchers have explored how students utilize learning strategies that promote conceptual understanding and information recall to achieve their goals (Ames and Archer, 1988; Cain and Dweck, 1995; Elliot and McGregor, 2001; Grant and Dweck, 2003; Greene and Miller, 1996; Meece and Miller, 2001; Nolen, 1988; Nolen and Haladyna, 1990; Wolters, 2004).
- **Enjoyment of science.** This concept pertains to the level of pleasure experienced during science learning. Students' engagement in laboratory instruction and fieldwork has been found to positively impact their enjoyment of science (Freedman, 1997). In fact, Freedman (1997) reported that students who participated in laboratory activities exhibited higher levels of enjoyment in their science classes compared to those who did not. Similarly, visiting a science museum has been shown to potentially enhance students' enjoyment of their science classes.
- **Lack of anxiety.** Managing anxiety at a young age is a critical element in achieving academic success for many students. As previously mentioned, research has shown that students who experience less stress and anxiety towards studying science tend to be high achievers and hold positive attitudes towards the subject (Atwater, Gardner, and Wiggins, 1995). Therefore, students who exhibit lower

Universiti Malaya

levels of stress and anxiety towards science are more likely to be motivated in their studies and pursue a career in the field. "Lack of anxiety" refers to students' absence of concern and, consequently, a positive outlook when engaging in scientific pursuits.

- **Usefulness of science.** This concept pertains to students' perception of the practical applications of science in their own lives and in society as a whole. Students who highly value the relevance of science are more likely to continue their studies in this field. Conversely, a negative perception of science can increase scepticism towards the subject and contribute to a decline in students' interest in it. Previous studies have shown that students who perceive science as being useful are more likely to enrol in science-related subjects (Haselhuhn and Andre, 1997; Khoury and Voss, 1985). Students who associate science with the betterment of humanity and society are more inclined to pursue further studies in this field.
- **Self-concept of ability.** This concept relates to how students perceive their own achievements in science. Academic self-concept in science is a specific aspect of a student's overall self-concept (Woolfolk, 1998). Self-concept refers to an individual's perception of themselves, along with an evaluative judgment of their self-worth (Pajares and Schunk, 2001). Similar to the lack of anxiety, self-concept of ability serves as an intrinsic motivator. Pascarella and Terenzini (1991) indicate that students' self-confidence may temporarily decrease during the transition from school to university, influenced by extrinsic motivational factors. Students' willingness to engage in science may be influenced by their self-concept in relation to their abilities in science. Research has shown that as students become less confident in their ability to perform in science, their attitude and perception of the subject may be negatively impacted (Piburn and Baker, 1993). Students'

Universiti Malaya

confidence and ability to achieve play a significant role in their interest and motivation in science. Students who avoid science courses have been found to exhibit lower levels of self-confidence in learning science (Khoury and Voss, 1985).

- **Career interest.** This concept pertains to assessing students' interest in pursuing a future career in science. Without a clear goal, students may lack motivation. Personal values and aspirations serve as important motivators, and career aspirations can strongly influence students' choices of science subjects (Fraser, 1981). Therefore, a student who harbours a strong desire to become a scientist is likely to be motivated to pursue a career in science.
- **Ability to make choices.** There is a prevalent belief that providing students with choices in their learning can boost their enjoyment in the classroom. This concept pertains to empowering students to make decisions about their own science education. Allowing students to have choices is a significant factor in learning. As a result, feeling empowered may serve as a motivation for students to pursue their science-related goals. This form of encouragement to involve students in the decision-making process can enhance their interests and potentially increase enrolment in science subjects (Cavallo and Laubach, 2001).

"Individual interest in science education within a school setting" refers to a persistent and enduring personal sentiment that encompasses emotional and behavioural responses towards activities in regular science classes. When students express a strong interest in science as a school subject, they tend to develop a deep passion for it, become absorbed in the learning experiences offered in science classes, and show keen attention to tasks assigned by their science teachers. The investigation of individual interest in school science lessons is of utmost importance, as research has consistently shown that it has a

Universiti Malaya

positive impact on academic performance (Chang & Cheng, 2008; Hidi, 1990; Schiefele, Krapp, & Winteler, 1992), as well as future interest in science-related programs and careers (Hulleman & Harackiewicz, 2009; Taskinen, Schütte, & Prenzel, 2013). Furthermore, studies have indicated that students' interest in science may decline during the transition from primary to secondary school (Krapp, Hidi, & Renninger, 1992; Osborne, Simon, & Collins, 2003; Van Griethuijsen et al., 2015).

Teaching and learning in schools in certain developing countries face numerous challenges, including a lack of emphasis on the development of higher-order cognitive skills, which is evident in poor performance on international assessments like the TIMSS and the PISA (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2015). A study conducted on scientific learning performance revealed that students in these countries display minimal interest in science and struggle with low proficiency in studying the subject (Othman et al., 2009). Furthermore, in Malaysia, the enrolment rate in the science stream at the senior middle school level falls short of the expected 60:40 percent ratio (Economic Planning Unit [EPU], 2005).

Previous empirical studies have predominantly concentrated on situational interest among students (Dohn, 2013; Lin, Hong, & Chen, 2013; Palmer, 2004, 2009) or individual interest in specific science topics (Alexander, Johnson, & Kelley, 2012; Dawson, 2000; Trumper, 2006) across various science disciplines (Baram-Tsabari & Yarden, 2009; Häussler & Hoffmann, 2000; Osborne & Collins, 2001), as well as diverse teaching methods and learning activities (Dawson, 2000). Hidi and Renninger's four-phase model of interest development (2006) holds implications for instructional approaches for teachers (Harackiewicz et al., 2016). According to the model, interest grows over time and can be nurtured through external support, such as engaging lectures or field

Universiti Malaya

excursions. Without external support, interest may diminish or be abandoned. The model also suggests that students at different stages of interest development may benefit from different types of external guidance. For example, teachers can create situations that engage students who are unfamiliar with a topic, and they can also intervene to enhance understanding and reinforce perceived value for students with pre-existing interest. Thus, in the first two phases (triggered and maintained situational interest), teachers can cultivate new interests, and in the latter two phases, teachers can sustain or strengthen existing interests (emerging and well-developed individual interest), which can have a positive impact on students' motivation and academic achievement (Harackiewicz et al., 2016).

A strong interest is crucial for academic success. Interventions to enhance student interest are particularly important in educational settings where many students lack initial interest or where interest tends to decline over time (Harackiewicz et al., 2016). For example, during the transition from middle to high school, students' academic interests in STEM topics often experience a decline (Brophy, 2008). The role of teaching in students' learning is crucial, encompassing various factors such as teachers' pedagogical approach, classroom environment, and accommodating attitude towards students (Carroll et al., 2009). An ideal classroom setting should create opportunities for students to observe effective teaching practices while also allowing teachers to observe genuine learning (Hattie, 2012). Teachers' accommodating behaviours, such as displaying an open-door policy, responding to students' questions, showing empathy, being actively engaged, and acknowledging students' efforts, can have a positive impact on students' motivation and overall performance (Rashid & Zaman, 2018). When it comes to academic achievement, Fredricks, Blumenfeld, and Paris (2004) identified study habits and attitudes towards studying as two significant drivers. According to Rashid and Zaman (2018), teachers'

Universiti Malaya

attitudes can significantly influence students' learning abilities and performance. Teachers have multiple roles beyond just teaching, including being subject experts, promoting interest in the subject, and serving as role models for students (Bogler, Caspi, & Roccas, 2013). Student motivation can be nurtured through intellectual stimulation and individualized consideration, which are key aspects of transformational leadership (Pounder, 2003). Students have highlighted the importance of intellectual stimulation in transformational leadership, noting that the lack of such stimulation significantly reduces their interest in the subject, while also stating that when teachers pay individual attention to them, they increase their efforts (Morton et al., 2010). Despite the value of past research, there has been minimal comparison of multiple aspects, particularly teachers' transformational leadership practices and teaching behaviour that affect students' individual interest in classroom science classes.

2.4 Teachers' Teaching Behaviour

One of the pivotal factors that profoundly affects student achievement is the quality of instructional teaching (Hattie, 2009). Recognizing the utmost significance of instructional teaching in the advancement of students' learning processes is a fundamental objective for improving teacher education and enhancing student learning outcomes (Praetorius, Lenske, & Helmke, 2012). The behaviour exhibited by effective teachers, encompassing their actions that shape students' learning and outcomes (Creemers, 1994; Sammons, Hillman, & Mortimore, 1995), has been established as a critical determinant of students' academic performance. The actions and behaviours demonstrated by a highly skilled teacher during the teaching-learning process exert a substantial impact on motivating students to learn effectively (Markley, 2004). According to Rockoff (2004), teachers play a pivotal role in students' academic progress, and the quality of their teaching can significantly influence students' outcomes.

To this day, extensive research has identified numerous domains of effective teaching behaviour that have a substantial impact on students' academic outcomes. However, previous studies have often focused on isolated domains of behaviour, rather than holistically examining them together. These domains encompass various aspects, such as pedagogical knowledge, teacher-student relationships, instructional methods, clarity of instruction, support for deep learning, classroom management, teaching methods, enthusiasm for teaching, professional characteristics, teaching skills, and classroom climate, as documented in multiple research studies (Beishuizen et al., 2001; Maulana et al., 2013; Kottler et al., 2005; Witcher et al., 2001; McBer, 2000). Nevertheless, there is a scarcity of research that integrates a more comprehensive and evidence-based set of domains of effective teaching behaviour. Incorporating a broader range of teaching behaviour domains and evaluating their impact on students' outcomes would undoubtedly enrich the existing knowledge in this area. Furthermore, previous research has also highlighted the influence of personal factors, such as gender, and contextual factors, such as teaching subject, on effective teacher behaviour (Maulana et al., 2012, 2013; Opdenakker et al., 2012). Previous studies have shown that effective teaching behaviour significantly impacts students' academic engagement (Davidson et al., 2010; Goodenow, 1993; Maulana et al., 2012; Opdenakker et al., 2012). Academic engagement in academic work is characterized by behavioural indicators, such as effort exertion, persistence, mental effort signs, attention, and focus, as well as emotional indicators, such as enjoyment and excitement (Skinner et al., 2009). However, there is limited understanding of the relationship between effective teaching behaviour and students' engagement in the specific context of science teachers' instructional practices.

Universiti Malaya

Malaysia recognizes the paramount importance of teachers in facilitating student progress and places great emphasis on improving teacher quality. However, despite extensive studies, there has been limited success in pinpointing the specific aspects of a teacher's personality that strongly predict student achievement (Idris, 2012). Nevertheless, research suggests that effective teachers exhibit exemplary classroom management and teaching practices, including effective communication, critical thinking, and systematic preparation (MOE, 2013; Idris, 2012; Halim et al., 2014; Stigmar, 2010). Moreover, effective teachers possess in-depth knowledge of students' preconceptions and misconceptions in science education, and this knowledge, along with other forms of expertise, should be highly regarded and adapted to suit the unique circumstances of teachers (Darling Hammond et al., 2005; Shulman, 1987; Kreber, 2002). According to Klutse (2021), effective science teachers foster a collaborative learning environment where they and their students work together as active learners, aligning with the vision of science education outlined in the syllabus. To effectively deliver science education in line with the syllabus, teachers need to possess both theoretical and practical knowledge and skills in scientific learning and teaching. The Integrated science approach incorporates the four dimensions of learning behaviours (knowledge acquisition, comprehension, application, and experimental skills) into objective setting, lesson delivery, and assessment. However, the results suggest that there are operational challenges in fully implementing all these learning behaviours in science teaching, making it difficult to achieve an ideal teaching approach.

In today's modern educational landscape, there is a growing recognition of the need to prioritize student-centred and independent learning, project-based and collaborative learning, and authentic assessment, as underscored by Sener et al. (2015). In the realm of science education, it is paramount for teachers to craft learning activities that foster

Universiti Malaya

critical thinking skills in students. Higher Order Thinking Skills (HOTS) encompass the ability to effectively employ knowledge, skills, and values in reasoning, reflection, problem-solving, decision-making, innovation, and creativity, as defined by the Ministry of Education (MOE, 2013). Teachers are encouraged to infuse HOTS elements into 21st-century education to foster deep thinking among students, aligning with the goals outlined in the Malaysian Education Blueprint 2013-2025. Nevertheless, as highlighted by Sulaiman et al. (2017), teachers face challenges in incorporating HOTS into their instruction, such as varying levels of students' ability to grasp concepts, time constraints in larger class sizes, the need for appropriate methods or approaches in larger classes, and teachers' understanding of HOTS and their application skills.

The characteristics of effective teaching in higher education can be examined from two perspectives: high-inference behaviours and low-inference behaviours, as elucidated by Feldman (1976), Marsh (1984), and Rosenshine & Furst (1971). High-inference behaviours, which encompass subjective criteria such as clear explanations and positive relationships with students, are one aspect to consider. On the other hand, low-inference behaviours, which involve concrete and explicit teaching practices such as providing multiple examples and addressing students by their first names, as delineated by Murray (1999), are another crucial aspect. While both types of behaviours are noteworthy, assessing low-inference behaviours presents certain advantages. Firstly, low-inference behaviours are relatively straightforward to measure and document in research, as they are grounded in specific and tangible behaviours. Secondly, low-inference behaviours are effective in providing teachers with actionable feedback on their performance. For instance, if a teacher receives a negative evaluation based solely on overall impressions rather than specific behaviours, it may be challenging for them to pinpoint areas for improvement in their classroom performance (Murray, 1983).

Universiti Malaya

In the academic setting, the quality of instructional teaching can have a significant impact on various student variables, including emotions, task value, self-efficacy, and attention, as evidenced by studies conducted by Goetz et al. (2013) and Lohrmann (2008). Instructional behaviours have been identified as predictors of boredom, as they can contribute to the monotony of instruction, as noted in studies by Daschmann, Goetz, & Stupnisky (2011, 2014), Bartsch & Cobern (2003), Hill & Perkins (1985), and Robinson (1975). Conversely, certain aspects of instructional teaching quality have been shown to alleviate classroom boredom, as highlighted in research by Daschmann et al. (2011), Goetz (2004), and Goetz et al. (2013). Students' emotions, such as enjoyment, have been found to be related to teacher enthusiasm and perceived teacher behaviour, as demonstrated in studies by Frenzel et al. (2009), Hatfield, Cacioppo, & Rapson (1994), and Mottet & Beebe (2002), as well as Sánchez Rosas, Takaya, & Molinari (2016). Teacher enthusiasm for a subject has been shown to enhance students' perceived value of the task, as it is seen as relevant to their academic learning or daily life, as indicated in studies by Hulleman et al. (2010), Hulleman & Harackiewicz (2009), and Johnson & Sinatra (2013). Furthermore, how a teacher presents a task, such as through challenging exercises or negative comments, can impact students' self-efficacy, or their confidence in their ability to complete the task, as noted in research by Bandura (1997). Several studies have found associations between instructional teaching quality, task value, and self-efficacy, as conducted by Ahmed et al. (2010), Assor, Kaplan, & Roth (2002), Federici & Skaalvik (2014), Grolnick, Ryan, & Deci (1991), Smart (2014), and Velez & Cano (2012). Expressive behaviour, monotony, tempo, and other teaching behaviours have also been shown to influence student attention in the classroom, as demonstrated by studies conducted by Murray (1991), Murray & Lawrence (1980), Brigham, Scruggs & Mastropieri (1992), Goetz et al. (2013), and Sánchez Rosas, Takaya, & Molinari (2016).

Universiti Malaya

Thus, teachers who utilize expressive speech, move around during instruction, use humour or jokes, maintain eye contact with students, and pace their instruction appropriately are more likely to effectively capture and maintain student attention.

Teacher's behaviour, according to Hadie et al. (2019), comprises of seven distinct components of behaviour:

- **Clarity** refers to the utilization of methods to elucidate and simplify concepts and principles. As stated by Powell, R.G., & Powell, D.L. (2015), teacher clarity is a communication strategy that exists within an instructional context, and it enhances the accuracy of instructional messages.
- **Enthusiasm** is characterized by the use of nonverbal behaviours to engage student attention and generate interest. Often referred to as "enthusiasm," expressiveness is believed to be transmitted to students in the form of increased motivation and greater engagement in studying outside of instructional time, as noted by Murray (1991, 1997).
- **Interaction** is characterized as the utilization of techniques to encourage active participation of students in the classroom. Research conducted by Liu et al. (2021) on the relationship between university teacher leadership, teacher-student interaction, and student learning satisfaction revealed that positive teacher-student interaction significantly impacts student learning satisfaction.
- **Organization** is defined as the strategies employed to structure and arrange the subject matter of a lesson. Effective organization and planning of course content are crucial to student learning, as highlighted by Kallison (1986). Organization can also serve as cues that direct students' attention to specific material, such as through well-structured presentations, lecture outlines, headings, subheadings, topic

transitions, syllabi, and seriation of relevant points, as mentioned by Feldman (1989) and Murray (1991).

- **Disclosure** is defined as explicitness concerning subject requirements and grading criteria.
- **Speech & Pacing** is defined as characteristics of voice and rate of information presentation.
- **Rapport** is defined as quality of interpersonal relations between teacher and students.

Despite the crucial role of effective teaching behaviour in influencing pupil outcomes, there is still a lack of clarity on the extent to which science teachers exhibit effective behaviour in the classroom, as well as how their behaviour may impact pupil engagement and interest.

2.4.1 Constructivism Learning Theory

Constructivism is a prominent learning theory that posits learners actively construct their knowledge through experiences and interactions with their environment. Constructivism emphasizes that knowledge is not passively received but actively constructed by learners. Key principles include:

- **Active Learning:** Learners engage with material, building upon prior knowledge to create new understandings (Brooks & Brooks, 1993).
- **Social Interaction:** Learning is inherently social, with collaboration among peers enhancing understanding (Vygotsky & Cole, 1978).
- **Contextual Learning:** Knowledge is situated in real-world contexts, making learning relevant and meaningful (Brown, Collins, & Duguid, 1989).

Universiti Malaya

- **Reflection:** Learners reflect on their experiences to assess their understanding and identify areas for improvement (Schön, 2017).
- **Embracing Mistakes:** Constructivism views mistakes as opportunities for learning, encouraging experimentation and exploration (Brusilovsky & Millán, 2007).

Teachers play a crucial role in facilitating a constructivist learning environment. Instead of being the primary source of knowledge, they act as guides, fostering an atmosphere where students can explore and construct their understanding. Effective constructivist teaching behaviours include:

- **Eliciting Prior Knowledge:** Teachers assess students' existing knowledge to tailor instruction (Baviskar 1, Hartle, & Whitney, 2009).
- **Creating Cognitive Dissonance:** By presenting challenging problems, teachers encourage students to reconcile inconsistencies in their understanding (Oliver, 2000).
- **Facilitating Collaboration:** Teachers promote group work and discussions, allowing students to learn from one another (Johnson & Johnson, 1987).
- **Providing Feedback:** Constructivist teachers offer constructive feedback that helps students refine their understanding and skills (Hattie & Timperley, 2011).

Research indicates that constructivist teaching practices significantly enhance student outcomes. For instance, Kim (2005b) found that students taught using constructivist methods demonstrated higher academic achievement and improved self-concept compared to those in traditional settings. Furthermore, a meta-analysis by Semerci and Batdi (2015) confirmed that constructivist approaches positively influence academic performance, retention, and attitudes towards learning.

Universiti Malaya

Constructivism has particular relevance in science education, where fostering interest and engagement is vital. Studies show that constructivist teaching strategies can enhance students' interest in science subjects. For example, Saunders (1992) emphasized that constructivist methods, such as inquiry-based learning, promote deeper engagement with scientific concepts, leading to increased motivation and interest in science among students.

Additionally, Cetin-Dindar (2016) reported that students in constructivist learning environments exhibited higher motivation levels, particularly in science, as they engaged in hands-on experiments and collaborative projects. This active participation not only solidifies their understanding of scientific principles but also cultivates a lasting interest in the subject.

Constructivism provides a robust framework for understanding how students learn and the critical role teachers play in facilitating this process. By adopting constructivist teaching behaviours, educators can significantly enhance student outcomes and foster a deeper interest in science.

2.5 Relationship Between Teachers' Transformational Leadership, Teachers' Teaching Behaviour and Students' Interest

There is extensive evidence indicating that leadership styles, particularly those aligned with transformational leadership, can have a significant impact on student interest and are closely related to teaching behaviour. Effective educational leadership involves creating a supportive organizational environment that promotes student learning and supports teachers' instructional practices within the organization. The following section will

Universiti Malaya

review relevant literature and experimental studies that explore the relationship between these variables.

2.5.1 Relationship Between Teachers' Transformational Leadership and Students' Interest

The main objectives of teacher leadership encompass enhancing students' academic achievements while creating a conducive environment for their holistic development. The leadership approaches employed by educators can impact both the academic and personal growth of students. The attitudes and strategies of educational leaders have the potential to positively influence students' cognition, aptitude, integrity, consistency, and proficiency, as well as their intellectual, social, emotional, and physical maturation (Rashid et al., 2020).

Scholars have developed various leadership models with the aim of identifying effective leadership practices that can improve student learning outcomes. This research gained momentum during the late 1990s in response to school restructuring and improvement movements. Through this research, specific processes, such as the impact of emotions on learning and student achievements, as well as the characteristics of engagement, have been analysed. For example, Ainley, Hidi, et al. (2002) and Ainley, Hillman, et al. (2002) conducted studies to examine the correlation between different types of student interests, emotional reactions, persistence, and learning outcomes. Results have shown that individual interest and intrinsic motivation often lead to similar outcomes, including the drive for mastery, enjoyment of sustained and focused participation in a task for the sake of the task itself, and the pursuit of challenging opportunities (Renninger, 2000).

Universiti Malaya

Effective leadership holds a critical position in the realm of education, exerting a significant influence on student outcomes and academic achievements. Transformational leadership, a well-researched leadership model in both educational and non-educational contexts (Sun et al., 2017), has been found to play a key role in enhancing student engagement and learning. Drawing from research on transformational leadership in corporate settings, where leaders empower and motivate their followers (Bolkan & Goodboy, 2010; Pillai & Williams, 2004; Pounder, 2003), studies have shown that teachers can also create a similar impact by implementing transformational leadership in their classrooms and fostering a conducive learning environment (Bolkan, Goodboy, & Griffin, 2011). Research conducted by Leithwood and Sun (2012) has consistently demonstrated favourable benefits of Transformational School Leadership (TSL) on various aspects of education, including teachers' commitment, satisfaction, perceived leader effectiveness, classroom practices, and instructional quality. TSL has also been found to be strongly associated with school culture, planning, change strategies, and organizational learning. Empirical studies conducted in different countries worldwide, such as Australia (e.g., Greaves et al., 2014), Cyprus (e.g., Menon, 2014), Iran (e.g., Zeinabadi, 2013), Israel (e.g., Eyal and Roth, 2011), Jordan (e.g., Abu-Tineh et al., 2008), Kenya (e.g., Chemobo et al., 2014), Taiwan (e.g., Huang and Hsieh, 2010), Turkey (Leithwood & Steinbach, 1993), and the UK (Sammons et al., 2014), have reported emerging research on TSL in educational settings. Furthermore, TSL has been found to have a significant positive impact on student learning outcomes (Leithwood & Sun, 2012; Sun & Leithwood, 2015; Leithwood & Jantzi, 2005).

Transformational leadership practises have a favourable impact on the school atmosphere and organisation, resulting in positive interactions between teachers and students who use highly successful teaching practises (Boberg & Bourgeois, 2016). Successful leadership

Universiti Malaya

strategies, particularly in poor schools, have a major impact on enhancing student learning (Dutta & Sahney, 2016). Transformational educational leaders lead by reforming the teaching and learning environment in schools to focus the academic environment (Ninković & Knežević-Florić, 2018). These leadership powerful practice people to join in change by instilling a sense of collective effectiveness that boosts personal self-esteem and gives significance to their lives (Burns, 2003). This empowerment contributes to a positive school climate and organisation, which aids in student academic progress (Dutta & Sahney, 2016; Wang et al., 2016).

Harvey et al. (2003) observed a correlation between the transformational leadership exhibited by teachers and various positive student outcomes, including increased student engagement, improved perception of instructor performance, and enhanced student respect for the instructor. These findings were further supported by Jingkun et al. (2021), who found that teachers' transformative leadership had a positive influence on students' motivation to study. Noland & Richards (2014) conducted a comprehensive survey involving 273 college students and found a significant association between teacher transformational leadership and multiple student outcomes, such as increased student motivation, emotional learning, and markers of learning. Similarly, Rashid et al. (2020) conducted a study with 29 Heads of Departments (HODs) and 206 students from five public sector universities and identified a significant relationship between teachers' transformational leadership style and students' academic achievement. The data was collected through a reliable Likert scale questionnaire with high reliability coefficients of 0.82 and 0.86 for HODs and students, respectively. However, Rashid et al. (2020) also argued that teachers in the selected universities did not solely rely on a single leadership style, but rather employed a combination of democratic, transformational, transactional,

Universiti Malaya

and autocratic leadership styles depending on the specific requirements and situational context of their teaching.

Kim et al. (2021) conducted a comprehensive study involving 295 middle school students from three private middle schools in the southwestern region of the USA. The study revealed that transformational leadership played a significant role in enhancing students' expectancy-value in physical education (PE), underscoring the positive impact of transformational leadership on teaching and students' learning. Furthermore, Al Saidi & Ali (2021) reported a robust and positive relationship between teachers' leadership skills and students' academic optimism in basic and post-basic education schools, further underscoring the critical role of teacher leadership as a determinant of student learning success.

Transformational leadership in education has been associated with increased student interest in science. Teachers' transformational leadership that promotes students' interest in science include:

- **Idealized Influence:** Teachers who act as role models and demonstrate high ethical standards can inspire students to take an interest in science (Northouse, 2016).
- **Inspirational Motivation:** Transformational leaders who communicate high expectations and provide meaning to students' work can increase their interest in science (Northouse, 2016).
- **Intellectual Stimulation:** Teachers who challenge students to think critically and creatively about scientific problems can foster their interest in the subject (Northouse, 2016).

Universiti Malaya

- **Individualized Consideration:** Transformational leaders who provide personalized attention and support to students can help them develop their interests in science (Northouse, 2016).

As a result, the present study aims to investigate perceptions of teacher leadership practices and their impact on student engagement and interest, with the ultimate goal of enhancing student learning. Despite existing research indicating the influence of transformational leadership on student interest, there is a dearth of studies specifically focused on private schools and student interest in science subjects, necessitating further investigation in this area.

2.5.2 Relationship Between Teachers' Transformational Leadership and Teachers' Teaching Behaviour

Teacher leaders possess a range of qualities and skills, including confidence, knowledge, adaptability, reflection, collaboration, risk-taking, decision-making, innovation, lifelong learning, problem-solving, and relationship building, as described by Mackiewicz-Wolfe (2013). According to Bush (2015), teacher leadership combines leadership with specific teaching qualities and behaviours. Teacher leaders, who are experienced professionals, demonstrate leadership in various areas, aiming to improve student achievement and school success by focusing on instructional competence in the classroom (Bush, 2015). Key abilities of effective teacher leaders include pedagogical confidence, interpersonal skills, active engagement in the leadership process, and expertise in teaching and learning contexts, among others (Crowther, 2009).

Teachers adopt features of Bass's transformational leadership theory in order to nurture transformational traits in their teaching, according to Eichelberger (2017), because

Universiti Malaya

teachers emphasise the development and use of successful teaching practises. Teachers at an all-girls school in California used 18 key transformational teaching practises that aligned with the dimensions of Bass's theory of transformational leadership: idealised influence, inspirational motivation, intellectual stimulation, and individualised consideration, according to the findings. Teacher leadership and teaching behaviour are commonly linked, according to Bianchi (2017), with Creaby (2013) stating that teachers with aspirations for leadership often focus on improving classroom practise and curriculum improvements.

Based on theoretical and empirical research, it has been concluded that specific classroom teaching behaviours, such as clarity, enthusiasm, interaction, organization, disclosure, speech & pacing, and rapport, have been proven to have a positive impact on student outcomes. These behaviours are directly related to components of transformational leadership competency, including idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. Teachers often prioritize abilities that involve understanding the cognitive needs of individual learners, which is reflected in tailoring the educational process and diagnosing progress (Nedzinskaitė & Barkauskaitė, 2017), through transformational leadership practices that shape teachers' teaching quality. Moreover, as both transformational leadership and teaching behaviour are focused on students' interests and educational achievement, it appears that these two concepts are closely intertwined theoretically. While previous research has separately examined the impact of teachers' transformational leadership practices and teaching behaviour on various educational issues, such as student goal commitment, achievement motivation, and learning, as well as student achievement, the potential relationship between teachers' transformational leadership practices and teaching behaviour has not been thoroughly investigated. Therefore, it is necessary for researchers to methodically

Universiti Malaya

approach this issue and fill the existing gap in the literature. Furthermore, teachers should pay more attention to the influence of transformational leadership practices on their teaching behaviour and strive to enhance these practices to improve their teaching behaviour, which in turn can positively impact their students' interest in learning. Transformational leadership practices, which focus on the leader/follower relationship and effective teaching behaviour for the betterment of followers, i.e., students' positive outcomes, have been suggested to influence teachers' teaching behaviour (Bolkan & Goodboy, 2009).

2.5.3 Relationship Between Teachers' Teaching Behaviour and Students' Interest

Teachers consistently strive to tailor their instructional approach to accommodate the unique interests, knowledge, and skills of their students, while building upon their questions and ideas. A thorough understanding of students' cognitive potential, developmental stage, physical attributes, affective development, motivation, and learning style is essential for informed decision-making regarding instructional strategies (Klutse, 2021). Effective teacher behaviour, which encompasses the actions of teachers that influence student learning and outcomes (Creemers, 1994; Sammons, Hillman, & Mortimore, 1995), has been consistently identified as a crucial factor in determining students' academic performance. Extensive research has shown that positive teaching behaviour significantly impacts students' academic engagement, including their effort exertion, persistence, attention, focus, enjoyment, and excitement in learning (Davidson, Gest, & Welsh, 2010; Maulana et al., 2012; Opdenakker et al., 2012; Skinner, Kinderman, & Furrer, 2009; Jingkun et al., 2021). Moreover, teachers' behaviours have been found to wield a substantial influence on students' motivation to learn and the overall effectiveness of the learning process (Jingkun et al., 2021). According to research findings, teaching expertise extends beyond subject matter knowledge and necessitates a comprehensive understanding of pedagogy and learning theories for effective instructional delivery (Ismail et al., 2018). Teachers must continually strive to improve their instructional practices by learning from their peers, sharing experiences, and considering various approaches and techniques that can be implemented in the classroom. Student motivation, as defined by Gunnes & Donze (2016), is the internal drive that propels students to engage in learning tasks and is influenced by factors such as the extrinsic value of the task, intrinsic interest, self-concept of ability, and perception of control over the task. Different students may exhibit varying levels of motivation, and intrinsic motivation has been linked to better failure tolerance and increased effort after experiencing failure (Anderman and Wolters, 2006). Teachers can influence students' motivational patterns and enhance student effort and achievement through the utilization of diverse teaching methods and classroom environment design (Ames, 1992; Wolters, 2004).

Past research has identified numerous domains of effective teaching behaviour that have an impact on students' academic outcomes. However, many of these studies have focused on specific domains in isolation, rather than taking into account the entire spectrum of domains. These domains encompass various aspects such as pedagogical knowledge, teacher-student relationships, instructional methods, clarity of instruction, classroom management, enthusiasm for teaching, professional characteristics, teaching skills, and classroom climate. In a recent study conducted by Maulana et al. (2017), it was found that effective teaching behaviour was positively correlated with students' academic engagement across all six domains. Notably, classroom management and clarity of instruction were found to exhibit the strongest links to academic engagement in comparison to other domains, a finding corroborated by another study of experienced teachers conducted by Maulana et al. (2012). Despite the acknowledged significance of effective teaching behaviour in fostering student interest and outcomes, there has been

Universiti Malaya

limited attention devoted to exploring how teachers can cultivate intrinsic motivation in students, which in turn can enhance effort and reduce dropouts (Akerlof & Kranton, 2002). Additionally, the extent to which teachers' effective behaviour in the classroom relates to students' interest or engagement remains an unanswered question.

Effective teaching behaviours are crucial for fostering students' interest in science. Research has identified several key aspects of teaching behaviours that contribute to increased students' interest in science:

- **Clarity:** Teachers who present information clearly and logically help students better understand scientific concepts, which can spark their interest (Seidel & Shavelson, 2007).
- **Enthusiasm:** Enthusiastic teachers who demonstrate passion for their subject matter can inspire students to engage more deeply with science (Patrick et al., 2000).
- **Interaction:** Interactive teaching styles that encourage student participation, such as hands-on activities and discussions, have been linked to higher levels of students' interest in science (Telli et al., 2008).
- **Organization:** Well-organized lessons that flow logically and provide clear learning objectives help students stay focused and interested (Schroeder et al., 2007).
- **Disclosure:** Teachers who share their own experiences and perspectives in science can make the subject more relatable and interesting for students (Hativa, 2001).
- **Speech and Pacing:** Appropriate speech clarity, volume, and pacing help maintain students' attention and interest in science lessons (Schroeder et al., 2007).

Universiti Malaya

- **Rapport:** Positive teacher-student relationships characterized by mutual respect and understanding contribute to students' interest in science (Roorda et al., 2011).

2.5.4 Relationship Between Teachers' Transformational Leadership, Teachers' Teaching Behaviour and Students' Interest

Despite the abundant existing literature on transformational leadership, interest, and teaching behaviour, these variables are frequently investigated in isolation, with limited attention given to exploring the potential mediating role of teaching behaviour, particularly teacher-student interaction, in relation to student learning satisfaction (Liu et al., 2021). The findings from Liu et al.'s (2021) study reveal that leadership exhibited by university teachers has a significant positive impact on both teacher-student interaction and student learning satisfaction. Additionally, the results suggest that teacher-student interaction acts as a mediator between university teacher leadership and student learning satisfaction, underscoring the crucial role of this interaction in enhancing students' satisfaction with their overall learning experience.

Undoubtedly, teachers often play a crucial role as mediators in the classroom, facilitating improved learning outcomes through interaction with their students. They can foster interactions among students by creating interactive tasks and activities, and promoting group and pair work. Additionally, teachers can support learning by providing constructive and motivating feedback, while also identifying and addressing major errors in oral or written tasks and activities. Such approaches can help maintain students' interest and enhance their learning experience (Hamamorad, 2016).

Moreover, various factors, including student characteristics and the learning environment, can impact learning outcomes (Junianto, 2015). Among these, motivation and learning styles are crucial determinants of student learning results. The school's academic environment, the leadership exhibited by teachers during the learning process, and the intensity of pedagogy are all environmental factors that play a role. As noted by Bush (2011), teachers should enhance their teaching strategies by considering the classroom situation and conditions, and adopting an adaptive approach to determine the most effective teaching methods based on students' learning processes and styles. Teachers' active involvement can aid in identifying suitable instructional approaches that align with students' learning styles, which in turn can enhance students' knowledge acquisition and enjoyment of the learning process.

In addition, Marks & Louis (1997) conducted a study to investigate the correlation between empowerment and student performance in 24 schools at the elementary, middle, and high school levels, all of which were undergoing restructuring. This study found that although empowerment was identified as a significant factor, it may not be adequate on its own to bring about substantial changes in teachers' instructional practices. The influence of empowerment on classroom practices was observed to vary depending on the specific area of teacher influence. However, the study revealed that teacher empowerment had an indirect impact on pedagogical quality and student academic performance through its effects on the overall organization of instruction within the school.

In a distinct investigation, Sulistiyarini & Sukardi (2016) discovered that motivation, learning styles, teacher leadership, and teaching intensity had significant impacts on the learning outcomes of X grade students in Mathematics at Vocational High Schools. Correlation analysis revealed that motivation, learning styles, teacher leadership, teaching intensity, and learning outcomes exhibited correlations ranging from 0.532 to 0.627.

Universiti Malaya

However, there is a research gap when it comes to the science subject, as no studies have been conducted yet in this area. As also emphasized by Sulistiyarini & Sukardi (2016), it is crucial to adapt teacher leadership in the learning environment to the specific characteristics of the teaching subject, as each subject may have unique requirements that need to be addressed.

Science education plays a vital role in shaping students' interest and engagement in scientific subjects, laying the foundation for future scientific discoveries and advancements. Teachers, as key influencers in the classroom, have a significant impact on students' interest in science through their leadership practices and teaching behaviour.

Teachers' transformational leadership practices have been widely recognized as an important predictor of student learning (Bolkan & Goodboy, 2009; Bolkan et al., 2011), and has a positive influence on student engagement (Ko et al., 2022). Intellectually stimulating behaviours can influence students' intrinsic motivation. Students are more likely to adopt a deep and strategic approach to their studies when their intrinsic motivation is increased (Bolkan et al., 2011). Transformational leaders inspire and motivate their followers, encouraging them to reach their full potential. In the educational context, transformational teachers create a positive classroom climate by creating dynamic relationships between teachers, students, and a shared body of knowledge to promote student learning and personal growth (Slavich & Zimbardo, 2012). Transformational teaching involves providing modelling and mastery experiences, challenging and encouraging students, personalizing attention and feedback, creating experiential lessons that transcend the boundaries of the classroom, and promoting ample opportunities for perfection and reflection (Slavich & Zimbardo, 2012), thereby influencing students' attitudes and interest in science. Research has shown that transformational leadership can lead to improved student outcomes in science education (Elliott & Asghar, 2014). These practices involve focuses on the needs of others, rather than the needs of the leader, and uses modern leadership techniques like empowerment and inspiration (Bostock, 2018), thus offering opportunities for meaningful scientific exploration. When teachers exhibit transformational leadership qualities, students perceive them as role models, leading to increased interest and engagement in science.

While the significance of transformational leadership practices is well-established, the specific mechanisms through which these practices impact students' interest in science remain less explored. Recent studies have fruitfully distinguished the aspects of teacher leadership practice from characteristics that reflect the actual practice of teaching in the classroom, which is teaching behaviour (Lai & Cheung, 2015; Ovando, 2020). Teaching behaviour refers to the actions, strategies, and instructional approaches employed by teachers in the classroom (Hadie et al., 2019). It encompasses elements such as enthusiasm, clarity, organization, rapport, interaction, disclosure, speech & pacing exhibited by teacher that have been proven to result in positive student outcomes (Rashid & Zaman, 2018). Different teacher leadership practices have differential impacts on teaching and learning practices and the effectiveness of school improvement efforts (Lai & Cheung, 2015). Teacher leadership might adversely affect some teaching practices, such as planning and preparation for instruction (Ovando, 2020). Thus, while teacher leadership practice should be related to teaching behaviour, the two are not interchangeable.

Teaching behaviour serves as a mediator in the research framework proposed in this study. As transformational teachers exhibit inspiring leadership practices, their teaching behaviour aligns with these practices, thereby positively influencing students' interest in science. By employing innovative instructional strategies, fostering active student engagement, and creating a supportive learning environment, teachers can stimulate students' curiosity, enhance their motivation, and ultimately increase their interest in active participation and involvement in the class (Kamran et al., 2022). Research has shown that teachers who adopt student-centred instructional practices, encourage critical thinking and problem-solving, and provide opportunities for hands-on experiments and discussion-based instruction tend to foster greater science learning outcomes among their students (Granger et al., 2012). Additionally, teachers' classroom management abilities have an impact on teacher-student interactions and the amount of academic learning time. Research indicates that effective teaching requires the use of classroom management skills. Well-organized classrooms are more conducive to learning and have fewer disruptions, hence can significantly impact students' interest and outcomes (Fricke et al., 2012). In another study, teacher interpersonal behaviours were found to be positively correlated with students' efficacy for learning science, value for learning science, and mastery orientation (Smart, 2014).

Several recent studies have explored similar relationships between transformational leadership practices, teaching behaviour, and students' interest in science. For instance, a study by Kalakesh & El Zein (2021) have shown that teachers' transformational leadership practices are positively associated with students' cognitive and affective learning. Additionally, students' interest in science has been found to be positively related to their academic achievement, motivation, and self-efficacy (Taskinen et al., 2013). Moreover, teachers' teaching behaviour has been found to have a significant impact on promoting students' learning and inclination to learn (Loes et al., 2012).

Universiti Malaya

The present study is similar to a study conducted by Sutjonong et al. (2022) that investigated the relationship between teachers' self-efficacy, perception, and behaviour regarding creative teaching for elementary school students (Sutjonong et al., 2022). The study found that teachers' self-efficacy mediated the relationship between teachers' perception and behaviour regarding creative teaching and students' academic achievement. The present study is also similar to previous research that has investigated the mediating role of teacher self-efficacy in the relationship between transformational leadership and teacher agency (Polatcan et al., 2021). According to another study conducted by Fauth et al. (2019), it was found that the correlation between teacher competence and student outcomes was influenced by three aspects of teaching quality: cognitive activation, supportive climate, and classroom management.

Studies have found varying levels of teachers' transformational leadership, with some reporting moderate levels and others finding higher levels (Leithwood & Jantzi, 2006). Research has also shown that effective teachers' teaching behaviour, such as clarity, enthusiasm, and interaction, is associated with higher levels of student achievement and interest (Seidel & Shavelson, 2007; Patrick et al., 2000; Telli et al., 2008). Studies have reported a range of students' interest in science levels, with some finding higher levels of interest (Cetin-Dindar, 2016) and others reporting lower levels (Schroeder et al., 2007). Factors such as grade level, gender, and socioeconomic status may influence students' interest in science levels (Telli et al., 2008).

In this study, teachers' teaching behaviour will be examined as a mediator between teachers' transformational leadership practices and students' interest in science. Teachers' teaching behaviour is expected to mediate the relationship between teachers' transformational leadership practices and students' interest in science because it is the

Universiti Malaya

teacher's behaviour that directly affects students' learning outcomes (Rashid & Zaman, 2018). When teachers exhibit transformational leadership qualities, they are more likely to employ effective teaching behaviours that enhance students' interest in science. For example, transformational leaders who provide intellectual stimulation may encourage students to engage in hands-on science activities, which can increase their interest in the subject (Cetin-Dindar, 2016). By investigating the relationships between these variables, this research contributes to a deeper understanding of the mechanisms through which teachers can effectively enhance students' interest in science, leading to more engaging and effective science education practices. The findings of this study can inform teacher professional development programmes and educational policies aimed at promoting interest and engagement in science among students.

Additionally, considering the strong connection between teachers' practices of transformational leadership and their teaching behaviour, it would be intriguing to examine how these constructs contribute to students' interest in science, not only in terms of the quality of science education but also in addressing broader economic concerns. However, there is a scarcity of similar studies in this specific context, particularly in the private school setting in Malaysia. Therefore, the purpose of this study is to investigate the potential mediating role of teachers' teaching behaviour in the relationship between teachers' practices of transformational leadership and students' interest in science in Private Schools located in the Klang Valley region of Malaysia. The findings of this study could serve as a foundation for future research in Malaysia, shedding light on the relationship between these variables in a unique educational setting.

Universiti Malaya

2.6 Theoretical Framework of the Study

Interest development theory, as proposed by Hidi and Renninger (2006), suggests that interest is a dynamic and multifaceted psychological construct that develops over time through the interplay of personal and environmental factors. According to interest development theory, students' interest in science is influenced by their initial individual interest, which can be nurtured and developed through teachers' instructional practices, such as their teaching behaviour. The emotional aspect of learning in individuals is significantly influenced by the concept of interest, as demonstrated in research conducted by Bandura (1997), Hidi (1990), and Kim (2005a). Interest in the context of student learning can be classified into three types: individual, situational, and topical, as discussed by Ainley, Hidi, and Berndorff (1999), Hidi (2001), and Johnson, Alexander, Spencer, Leibham, and Neitzel (2004). In this study, teaching behaviour is hypothesized to mediate the relationship between teachers' transformational leadership practices and students' interest in science, based on the assumptions of interest development theory and constructivist learning theory. The measurement of interest is of great importance to educators, as it has a significant impact on student learning outcomes and future career choices, as emphasized by Nieswandt (2006) and Boyd, Grossman, Lankford, Loeb, and Michelli (2006).

Drawing from an extensive review of the literature, Hassan (2008) identified key factors that play a significant role in students' interest and motivation in science. These factors include students' interest and enjoyment of science, as well as their choices related to science. Under the category of students' interest and enjoyment of science, the constructs include motivation for science, enjoyment of science, lack of anxiety, perceived usefulness of science, and self-concept of ability. Students' choices include career interest and ability to make choices (Hassan, 2008). To measure these constructs, the study

Universiti Malaya

utilized scales in the questionnaire, as they are believed to be influential in students' motivation towards science. Therefore, the objective of this study is to assess students' level of interest in science and explore the relationship between teacher transformational leadership practices, students' interest in science, and teacher's teaching behaviour.

Without a doubt, educators hold a crucial position in fostering academic excellence and promoting school effectiveness, especially in the implementation of an efficient educational system that aims to cultivate an informed and educated society. As emphasized by Rahman et al. (2020), the presence of competent teachers is paramount to the success of any educational system. Among the pivotal factors in elevating the effectiveness of teaching and learning in schools is the presence of innovative, skilled, motivated, and highly-educated teachers. Additionally, Maughan et al. (2012) emphasized the pivotal role of leadership in driving, implementing, and reinforcing positive changes within the classroom setting.

The theory of transformational leadership, initially proposed by Bass and Riggio (2006), revolves around exhibiting behaviours that empower and inspire others, transcending self-interests, and instilling confidence in others to achieve higher levels of performance. This theory encompasses four key dimensions: idealized influence, inspiring motivation, intellectual stimulation, and individualized consideration (Bass & Riggio, 2006). While the concept of transformational leadership has been widely studied in educational settings, most of the research has focused on the effects of school principals' behaviours on teachers, rather than exploring the impact of teachers' transformational behaviours on students' cognition, emotions, and actions (Beauchamp et al., 2010). However, the potential of the transformational leadership theory in guiding how teachers' actions

Universiti Malaya

influence students' engagement in school-based learning is substantial. In other words, effective teaching can be likened to exemplary leadership, and vice versa.

The Multifactor Leadership Questionnaire (MLQ), which was developed by Bass and Avolio (1995), is a commonly used tool for measuring transformational leadership. However, the language and items in MLQ are primarily tailored for organizational contexts rather than classrooms, and may not be suitable for use with teenagers, as pointed out by Beauchamp et al. (2010). Consequently, Beauchamp et al. (2010) have developed a reliable and valid measure of transformative teaching practices that is specifically designed for classroom settings. In this study, the level of transformational leadership practices among science teachers will be assessed using this classroom-focused measure.

Teachers' transformational leadership practices influence teaching behaviour, but teachers' teaching behaviour also influences students' learning/outcome/interest. The main elements of teaching behaviour, including passion, clarity, rapport, and interaction, have been shown to lead to favourable student results (Rodger 2003; Rodger, Murray, and Cummings 2007; Kunter et al. 2008; Barnes and Lock 2010; Long, Ibrahim, and Kowang 2013). All of the major teaching behaviour aspects can be utilised as a baseline for evaluating the teaching quality of teachers (Hadie et al., 2019).

Bolkan and Goodboy (2009) have highlighted that teachers' teaching behaviour can also act as a mediator in the relationship between teachers' transformational leadership practices and students' interest. Their research showed that the positive outcomes of transformational classroom leadership on university students are associated with effective teaching behaviour. These outcomes encompass cognitive learning (acquisition of knowledge and skills), affective learning (attitude towards the educational process, such

Universiti Malaya

as the subject matter and teacher), state motivation (desire to acquire academic knowledge or skills based on the value of classroom activities), and communication satisfaction (acceptability of the communication experience) (Bolkan and Goodboy, 2009).

The foundation of this research is based on the constructivist learning theory. According to this theory, students learn by building new knowledge from their current and past experiences, as noted by Fernando & Marikar (2017), Ormrod (2011), and Resnick (2017). It is crucial for teachers to understand how students acquire new knowledge from their classroom and personal experiences, as emphasized by Ormrod (2011), in alignment with the principles of constructivist learning theory. By gaining insight into students' backgrounds and knowledge resources, teachers can effectively employ a constructivist approach to learning and teaching, as suggested by the constructivist learning framework proposed by Fernando & Marikar (2017) and Resnick (2017).

However, because students must recall and repeat material taught, constructivist theory frequently clashes with educational organisations' teaching theoretical objectives (Dagar & Yadav, 2016). Traditional classroom learning methods, for example, emphasise rote memorization rather than students developing their own solutions to larger, more complicated problems through critical thinking and collaboration (Dagar & Yadav, 2016). Traditional learning methodologies indicate that students will not generate meaning from earlier experiences and apply this knowledge to solve more complicated issues, nor will they obtain a profound understanding of subjects (Dagar & Yadav, 2016; Ormrod, 2011).

Hence, the transformational educator acknowledges that students acquire more accurate knowledge by actively engaging in new experiences and integrating them with their prior experiences, wherein they question and grapple with previously learned knowledge in

Universiti Malaya

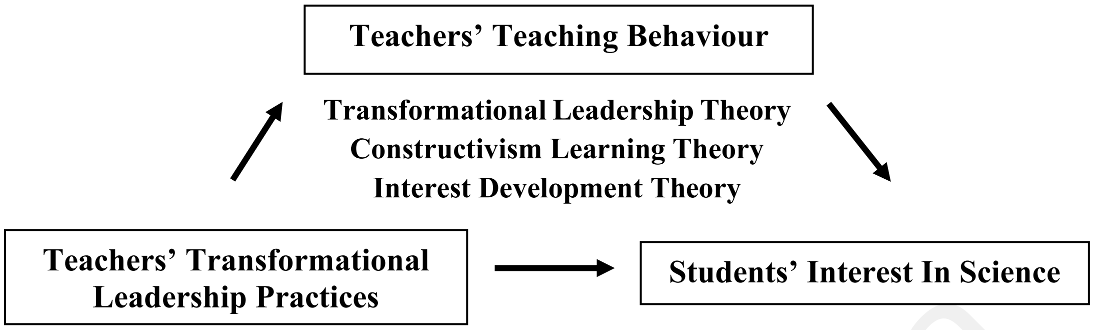
academic and environmental contexts to develop a genuine understanding of concepts, learning, and real-world experiences, both within and beyond the classroom (Alt, 2017; Illeris, 2018; Wilson, 2017). Moreover, the experiences students encounter in their surroundings significantly influence their interpretation and interaction with the world around them (Slavich & Zimbardo, 2012). Constructivism serves as the theoretical framework for this study, guiding the adaptation of transformational teaching theory to students' learning and environmental experiences, and providing a platform for the development of new transformational teaching practices that positively impact students.

Despite the acknowledged benefits of transformational classroom leadership in enhancing the overall quality of the classroom experience for both students and teachers, there remains a gap in the literature when it comes to investigating the relationship between teachers' transformational leadership practices, students' interest in science, and teachers' teaching behaviour. In order to address this gap, the theoretical framework utilized in this study, as illustrated in **Figure 2.1**, was developed to explore whether teachers' transformational leadership practices have a direct impact on students' interest in science, or if this impact is mediated by teachers' teaching behaviour. In this study, the concept of transformational leadership was based on the work of Beauchamp et al. (2010), the model for students' interest in science was adapted from the research of Hassan (2008), and the concept of teachers' teaching behaviour was drawn from the findings of Hadie et al. (2019).

Universiti Malaya

Figure 2.1

The Theoretical Framework Underpinning the Study



2.7 Conceptual Framework of the Study

The conceptual framework utilized in this study is congruent with the theoretical perspectives discussed in the preceding chapter. Prior research has consistently established a robust link between teachers' implementation of transformational leadership practices and its positive impact on students' interest and learning outcomes.

However, the relationship between teachers' transformational leadership practices and students' interest in science has not been thoroughly investigated in the context of private schools, as noted in previous studies. Additionally, literature suggests that teaching behaviour is a significant factor influencing students' interest. Teachers' transformational leadership practices are expected to inspire and motivate students, which may impact their teaching behaviour in the classroom, such as their instructional strategies, feedback, and classroom climate. Students' interest in science is hypothesized to be influenced by their engagement with constructivist learning experiences facilitated by teachers' teaching behaviour. Building on the theoretical foundations discussed earlier, this study posits that teachers' transformational leadership practices can positively impact students' interest in science through the mediating effect of effective teaching behaviour. Thus, in this study,

Universiti Malaya

students' interest in science is proposed as the dependent variable, teachers' transformational leadership practices as the independent variable, and teachers' teaching behaviour as the mediator.

According to Hassan's (2008) research findings, there are several key factors that are highly relevant to students' interest and motivation in science, such as motivation for science, enjoyment of science, anxiety levels, perceived usefulness of science, self-concept of ability, career interest, and ability to make choices. These factors can be assessed and utilized to measure the level of science interest exhibited by students on a balanced scale. For the present study, the definition of transformational leadership proposed by Beauchamp et al. (2010) was adopted, which encompasses four dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. On the other hand, teaching behaviour of teachers refers to specific behaviours exhibited in the classroom as observed by students, which have been proven to result in positive student outcomes, as outlined by Hadie et al. (2019). These behaviours include seven dimensions: clarity, enthusiasm, interaction, organization, disclosure, speech & pacing, and rapport.

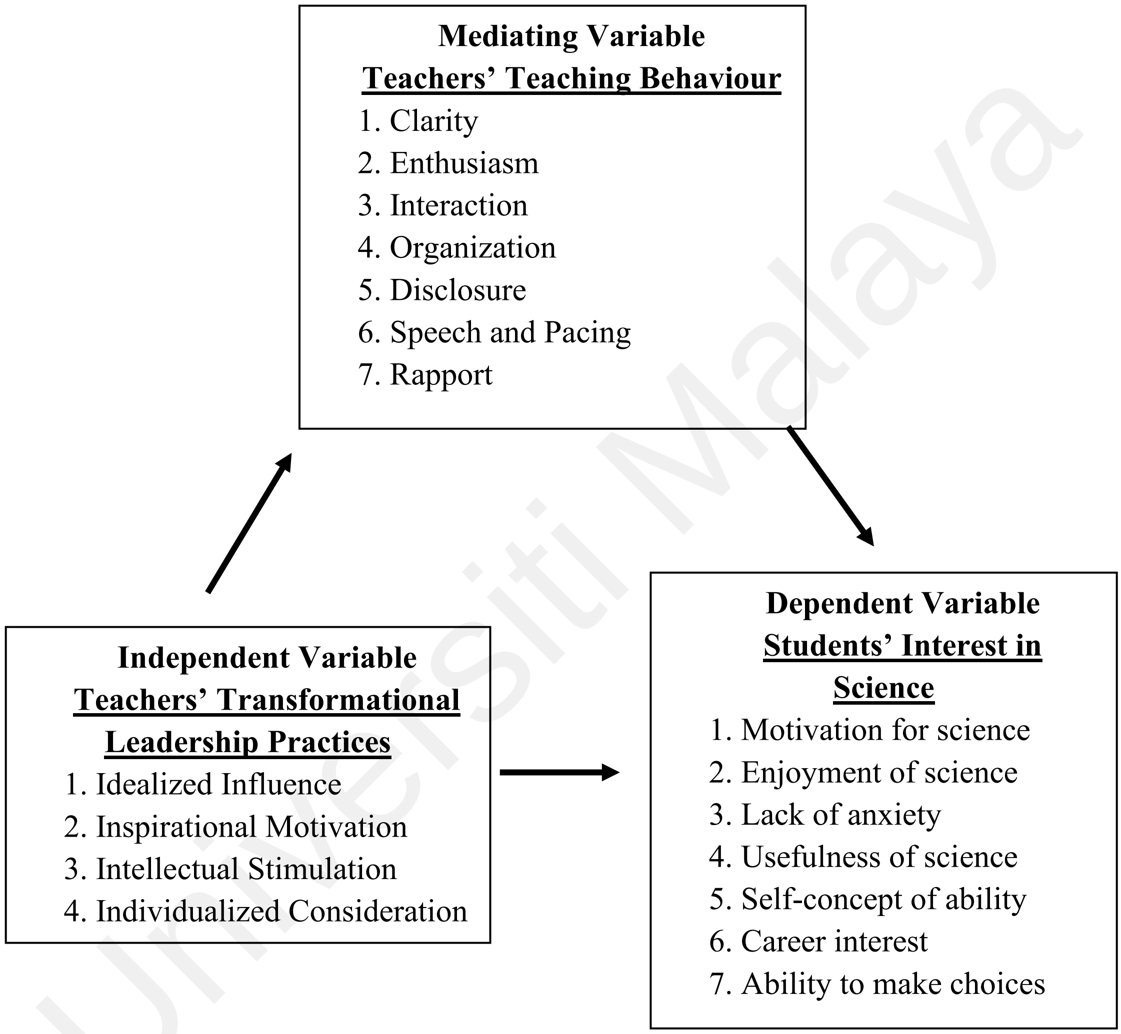
The purpose of this study was to investigate the correlation between teachers' transformational leadership practices, students' interest in science, and teachers' teaching behaviour in private schools located in the Klang Valley, Malaysia. Based on this objective, the researcher proposed the conceptual framework depicted in **Figure 2.2**. The findings of this study are expected to contribute to the understanding of the role of teachers' leadership and teaching practices in promoting students' interest in science and provide implications for educational policy and practice, and potentially inform the

Universiti Malaya

development of interventions aimed at promoting students' interest in science through teachers' leadership and teaching practices.

Figure 2.2

The Conceptual Framework Underpinning the Study



2.8 Summary

In this chapter, an extensive literature review is presented, focusing on the topics of teachers' transformational leadership, students' interest in science, and teachers' teaching behaviour. The review examines previous scholarly research and theoretical perspectives to provide a comprehensive understanding of the relationship between these variables and the role of teaching behaviour as a mediator.

The section on teachers' transformational leadership explores the concept of transformational leadership in educational contexts. It examines the characteristics and behaviours of transformational leaders and their potential impact on teachers' effectiveness and students' outcomes. The review highlights studies that have investigated the influence of transformational leadership on various educational outcomes and identifies the need for further exploration of its relationship with students' interest in science.

The literature review also delves into students' interest in science, exploring the factors that contribute to the development and sustenance of interest in this subject. It examines the role of teachers in fostering students' interest in science and highlights the significance of understanding the mechanisms through which teachers' practices influence students' interest. The review identifies gaps in the existing literature, emphasizing the need to investigate the mediating role of teaching behaviour in this relationship.

Furthermore, the literature review encompasses the topic of teachers' teaching behaviour, examining different approaches and models of effective teaching. It explores the characteristics of effective teaching behaviour and its impact on students' motivation, engagement, and interest in science. The review identifies studies that have explored the relationship between teaching behaviour and students' outcomes, highlighting the need for further investigation into its mediating role between transformational leadership and students' interest in science.

Universiti Malaya

In addition to these key areas, the literature review explores the role of private schools in science education, acknowledging the potential influence of school context on the variables under investigation. It examines research that has compared public and private schools in terms of their teaching practices and quality of education offered, providing a broader understanding of the educational landscape.

The theoretical framework and conceptual framework of the study are also discussed in this chapter. The theoretical framework draws upon relevant theories and models from educational leadership and science education to guide the research investigation. It provides a theoretical lens through which the relationships between teachers' transformational leadership, teaching behaviour, and students' interest in science are examined. The conceptual framework presents a visual representation of the variables and their hypothesized relationships, offering a roadmap for the empirical study.

Building upon the insights gained from this chapter, the upcoming Chapter 3 discussed the research methodology, research design, and data collection methods employed in the current study. The research methodology is aligned with the objectives and research questions of the study, aiming to explore and understand the relationships between teachers' transformational leadership practices, teaching behaviour, and students' interest in science. The research design and data collection methods are carefully selected to gather relevant data that can be analysed to test the hypothesized relationships. Chapter 3 will provide a comprehensive discussion of the research methods employed in this study. It will detail the research design, population, location, sample, and instruments used to collect data. By presenting these methodological aspects, Chapter 3 will offer a comprehensive overview of the approach undertaken in this study, ensuring the rigor and validity of the research findings.

Universiti Malaya

CHAPTER 3

METHODOLOGY

3.1 Introduction

The current chapter elucidates the research design employed in this study, including details on the population and sample, sampling technique, research instruments, validity and reliability of the instruments, study procedure, ethical considerations, pilot test, and data analysis approach. This research methodology has been implemented to address the research questions pertaining to students' perceptions of teachers' transformational leadership practices and their impact on students' interest in science. Additionally, the study explores the potential mediating role of teachers' teaching behaviour in this relationship.

3.2 Research Design

As stated by Creswell (2014), the research design serves as a deliberate framework that delineates the systematic steps involved in conducting research. It serves as a guide for researchers in collecting, analysing, and interpreting data, and drawing inferences about the variables being investigated. In the current study, the aim is to explore the relationship between the aforementioned variables, which include teachers' transformational leadership practices as the independent variable, students' interest in science as the dependent variable, and teachers' teaching behaviour as the potential mediating variable.

In order to investigate the research questions at hand, a non-experimental survey research approach is employed in this study. As described by Djamba (2002), survey research is a quantitative approach that involves posing a series of questions to a group of individuals (respondents) to gather information about their beliefs, views, characteristics, and past or present behaviours. Surveys are effective tools for evaluating attitudes and orientations in large populations within a short timeframe, as noted by Babbie (2013, p. 118), and the results are highly generalizable (Flick, 2015). Moreover, surveys are well-suited for collecting data on phenomena that cannot be observed directly (Jones et al., 2013). The use of a questionnaire administered via the Google Form application further enhances the survey method chosen for this study.

Despite the potential limitations of questionnaire surveys, such as the risk of misunderstanding of questions, low response rates, and dependence on respondents' motivation to complete the questionnaire, the researcher mitigated these concerns by providing a clear explanation of the study's purpose and the three variables being investigated to the respondents, and by sending reminders to prompt their participation. This proactive approach was taken to address and minimize the limitations associated with questionnaire surveys, as highlighted by Bryman (2015).

The research design employed in this study is cross-sectional, which involves collecting data from a sample of population elements at a single point in time, as explained by Babbie (2013). This approach allows for the detection of patterns of association, as noted by Bryman (2008). Considering the need to measure three distinct variables in this study, namely teachers' transformational leadership practices as the independent variable, students' interest in science as the dependent variable, and teachers' teaching behaviour as the mediating variable, the utilization of a cross-sectional survey method is deemed suitable.

The participants in this study consist of students who are enrolled in selected private schools located in the Klang Valley. Klang Valley was chosen due to its high

Universiti Malaya

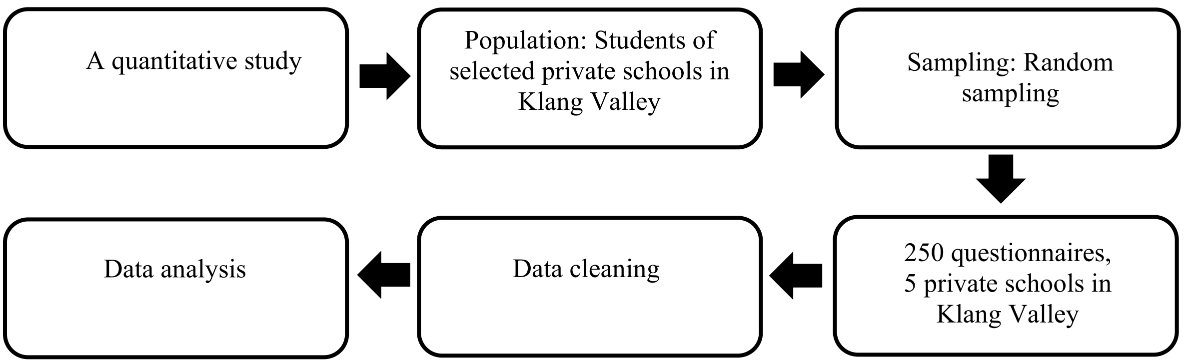
concentration of private schools in Malaysia as reported by the Ministry of Education (MOE, 2022b). Prior to data collection, the students were provided with a brief explanation about the significance of the research, and assurances of confidentiality and anonymity were given before the Google Form questionnaires were shared with them via email and WhatsApp through their respective class teachers. A one-week timeframe was allotted for the students to complete the questionnaires. In total, 250 responses were collected, and all of them were deemed suitable for data analysis.

The data collected from the study undergoes comprehensive analysis, encompassing both descriptive and inferential techniques. Descriptive analysis is employed to gain insights into the demographic profile of the respondents, providing a thorough understanding of their background characteristics. Descriptive statistics, such as mean and standard deviation, are utilized to analyse the first three research questions. Multiple regression analysis is conducted to elucidate the relationships among the variables, while correlation analysis is used to assess the statistical significance of these relationships. The PROCESS Macro for SPSS is employed to investigate the potential influence of the mediating variables. A graphical representation of the research procedures for this study is visually presented in **Figure 3.1**.

Universiti Malaya

Figure 3.1

Procedures of Research for this Study



3.3 Population, Sample and Location of the Study

The study focuses on a specific group of respondents, known as the target population, who share common characteristics that are relevant to the research (Creswell, 2014). In this case, the population of interest consists of students enrolled in private schools located in Klang Valley. Klang Valley is home to a total of 25 private schools, and the sample for this study includes students in forms 1 to 3, ranging in age from 13 to 15 years old. The study selected students from Form 1, 2, and 3 as respondents because these age groups are at a crucial stage in cognitive and academic development. During this period, students are building foundational knowledge and skills, making it an ideal time to evaluate and influence their learning processes and outcomes. Research shows that early secondary school students are at a key point for interventions that can shape their educational paths and effectively address misconceptions (Hakimah et al., 2021). Additionally, engaging students at this stage provides valuable insights into the effectiveness of educational strategies before they move on to more specialized curricula in higher education (Ramalingam, 2013). Choosing these specific forms also ensures a diverse representation of students who are still adjusting to the structured learning environment of secondary school (Artino et al., 2022). The private schools were selected from Klang Valley for the academic year 2021-2022.

3.4 Sampling Method

Sampling is the process of selecting a subset of individuals from a larger population to participate in a study (Chua, 2012). The accuracy and validity of a study heavily depend on the appropriateness of the sampling method used. As Lee et al. (2010) noted, it is essential to carefully select a smaller, representative sample that accurately reflects the population of interest rather than opting for larger, potentially misleading samples chosen without due consideration.

Universiti Malaya

For this study, a multi-stage sampling approach was used, beginning with random sampling followed by cluster sampling, to ensure a representative sample. Initially, random sampling was conducted to select a sample of 250 students, aged 13 to 15 years, from Form 1 to Form 3, enrolled in private secondary schools. According to Schönbrodt & Perugini (2013), a sample size of 240-250 participants is recommended for stable estimates in studies of this nature. Cluster sampling was chosen due to its cost-effectiveness in accounting for the common interests of a larger population.

Out of approximately 4,500 students from 25 private schools in the Klang Valley, researcher first employed random sampling to select 5 schools. Within these selected schools, cluster sampling was then used. Cluster sampling involves dividing the population into naturally occurring groups, or clusters, based on certain characteristics or qualities, and then randomly selecting a subset of these clusters for the study.

To implement cluster sampling, we classified students into clusters based on their grade levels and school classes. From the 5 randomly selected schools, 5 classes per school were randomly chosen, resulting in a total of 25 classes. All students from these 25 classes were included in the sample (**Table 3.1**), ensuring diversity and representativeness.

The focus was on DLP private schools that adhere to the Malaysian national curriculum. The selected sample comprised students from these schools, ensuring that the sample was representative of the population of interest. Data were collected through Google Form questionnaires, and responses from the 250 completed questionnaires were then entered into the Statistical Package for the Social Sciences (SPSS) for analysis.

Universiti Malaya

Table 3.1

Study Sample Overview

School	Number of form 1 to form 3 classes	Classes selected	Number of students selected
A	9	5	50
B	9	5	50
C	9	5	50
D	9	5	50
E	9	5	50
TOTAL	45	25	250

Universiti Malaya

3.5 Instruments of the Study

To collect research data in this study, specialized tools or methods, known as research instruments, were developed for gathering information from students in private schools located in the Klang Valley, Malaysia. The research instrument chosen for this study was a Google Form questionnaire, which was deemed appropriate for use with students based on the insights provided by Höglinger et al. (2014). This choice was made because a questionnaire allows students to respond to questions without feeling coerced and provides them with the flexibility to complete it at their convenience during their free time.

The selection of instruments for this study was based on the research objectives and a review of relevant literature. The Transformational Teaching Questionnaire (TTQ) survey instrument, developed by Beauchamp et al. (2010), was utilized to assess teachers' transformational leadership practices. The Student Interests and Motivation in Science Questionnaire (SIMSQ), developed by Hassan (2008), was used to measure students' interest in science. In addition, the Teacher Behaviour Inventory (TBI), a validated 32-

item tool developed by Hadie et al. (2019), was employed to evaluate teachers' teaching behaviour. Permission to use these instruments was obtained from the original developers via email as shown in Appendix A.

In order to ensure the quality of the questionnaire, the researcher took several steps to enhance its clarity, simplicity, and comprehensibility. The items were meticulously crafted to accurately represent the operational concepts and underwent rigorous validation procedures. The questionnaire as shown in Appendix B was divided into four distinct parts, encompassing a total of 90 items for respondents to provide their answers. These items included both positive and negative statements. Part A of the questionnaire consisted of 5 questions that gathered demographic information from the respondents. Parts B to D required respondents to rate their level of agreement or disagreement with statements related to their science teachers' transformational leadership practices, teaching behaviour, and interest in science. A summary of the research instruments employed in this study can be found in **Table 3.2**.

Table 3.2

Instruments Used Summary

Part	Instrument	Developer	Number of Items
A	Student Demographic Profile	Self	5
B	Transformational Teaching Questionnaire (TTQ)	Beauchamp et al., 2010	16
C	Teacher Behaviour Inventory (TBI)	Hadie et al., 2019	32
D	Student Interests and Motivation in Science Questionnaire (SIMSQ)	Hassan, 2008	37
		TOTAL	**90**

Universiti Malaya

The questionnaire is divided into four parts, each serving a specific purpose as described below:

Part A: Student Demographic Profile. In this section, data pertaining to the demographic profiles of the respondents is collected in order to construct a comprehensive profile of the students who took part in the survey. Demographics encompass various characteristics of the respondents, such as gender, age, grade level, grade in the previous science exam, and participation in any science competition or workshop in the past 12 months. This information is important for identifying potential associations between demographic variables and other study variables (Wyse, 2012; O'Dwyer & Bernauer, 2013). The demographic profile section comprises of 5 questions to collect this information.

Part B: Teachers' Transformational Leadership Practices. This part measures teachers' transformational leadership practices from the perception of students based on the definition of transformational leadership by Beauchamp et al. (2010). The questions are adapted from Beauchamp et al. (2010)'s Transformational Teaching Questionnaire (TTQ) which consists of four dimensions. **Table 3.3** provided below presents the dimensions of teacher's transformational leadership and the number of items associated with each dimension.

Universiti Malaya

Table 3.3

Teacher's Transformational Leadership: Items Count and Their Respective Dimensions

No.	Dimensions	No of Items
1	Idealized Influence	4
2	Inspirational Motivation	4
3	Intellectual Stimulation	4
4	Individualized Consideration	4
	TOTAL	**16**

Part C: Teachers' Teaching Behaviour. This section assesses the specific classroom behaviours of teachers, as perceived by students, which have been shown to have a positive impact on student outcomes, including enthusiasm, clarity, rapport, and interaction (Hadie et al., 2019). The questions are adapted from the Teacher Behaviour Inventory (TBI) developed by Hadie et al. (2019), which includes seven dimensions. The table labelled as **Table 3.4**, displayed below, presents details regarding the quantity of items and their respective dimensions that are associated with the teacher's teaching behaviour.

Table 3.4

Teacher's Teaching Behaviour: Items Count and Their Respective Dimensions

No.	Dimensions	No of Items
1	Clarity	6
2	Enthusiasm	4
3	Interaction	5
4	Organization	5
5	Disclosure	4
6	Speech and Pacing	4
7	Rapport	4
	TOTAL	**32**

Universiti Malaya

Part D: Students' Interest in Science. This section assesses students' level of interest in science based on the Student Interests and Motivation in Science Questionnaire (SIMSQ) developed by Hassan (2008), which includes seven dimensions. According to Hassan (2008), these dimensions, including students' motivation for science, enjoyment of science, lack of anxiety, perception of the usefulness of science, self-concept of ability, career interest, and ability to make choices, are relevant factors in measuring students' interest and motivation in science. The questionnaire uses an equal measure scale to assess the level of science interest exhibited by students. The table labelled as **Table 3.5**, displayed below, presents details regarding the quantity of items and their respective dimensions that are associated with students' interest in science.

Table 3.5

Student's Interest in Science: Items Count and Their Respective Dimensions

No.	Dimensions	No of Items
1	Motivation for science	8
2	Enjoyment of science	6
3	Lack of anxiety	4
4	Usefulness of science	6
5	Self-concept of ability	3
6	Career interest	5
7	Ability to make choices	5
	TOTAL	**37**

3.6 Validity and Reliability of the Instruments

Validity is a critical aspect that researchers must carefully consider when designing or selecting research instruments. It refers to the degree to which an instrument accurately measures what it is intended to measure and effectively fulfils its purpose (Sue et al.,

Universiti Malaya

2015, as cited in Gargiulo & Metcalf, 2016). In this study, the questionnaires underwent content validity, which involves obtaining input from a panel of experts to evaluate the clarity and comprehensibility of the questions (Creswell, 2014). For this particular research, the researcher sought feedback from two education experts who reviewed the pilot study questionnaire to assess the validity of the items included in the questionnaires. The education experts' validation for content validity of the questionnaires is shown in Appendix C.

The feedback from the experts included comments on the use of appropriate language and identification of double-barrelled items in the questionnaire. The questionnaire was subsequently revised based on the suggestions and recommendations provided by the panel of experts. As such, double-barrelled items were rephrased, while "verbal gestures" is used instead of "pausing, speaking slowly, raising voice, and so on", "from time to time" is used instead of "periodically" and "teaching content" is used instead of "teachings" to suit the local education context.

Reliability in research refers to the consistency of measurements for a variable across multiple assessments (Hair et al., 2010). It is assessed by determining the extent to which repeated measurements yield the same results (Chua, 2012, p. 261). High reliability is indicated when subsequent measurements produce consistent results. Chua (2013) suggests that a Cronbach's Alpha coefficient ranging from .65 to .95 is sufficient, while Taber (2018) state that alpha values were described as excellent (0.93-0.94), strong (0.91-0.93), reliable (0.84-0.90), robust (0.81), fairly high (0.76-0.95), high (0.73-0.95), good (0.71-0.91), relatively high (0.70-0.77), slightly low (0.68), reasonable (0.67-0.87), adequate (0.64-0.85), moderate (0.61-0.65), satisfactory (0.58-0.97), acceptable (0.45-0.98), sufficient (0.45-0.96), not satisfactory (0.4-0.55) and low (0.11).

Universiti Malaya

The data obtained from this research were subjected to analysis using SPSS version 21 in order to evaluate the internal consistency of the research instrument. Consistent with the suggestion by Chyung et al. (2018), the scores for questions phrased in a negative manner were reverse-coded to facilitate the aggregation of data and enable statistical analysis. In this particular study, a total of six questions were phrased in a negative manner, and their scores were appropriately reverse-coded, as detailed in **Table 3.6** provided below:

Table 3.6

Original Scores and Reverse-Coded Scores

Original Score	Reverse-Coded Score
1	5
2	4
3	3
4	2
5	1

The initial investigation revealed that the majority of variables exhibited a high degree of internal consistency reliability. Specifically, the Cronbach Alpha values for the dimensions of teachers' transformational leadership practices ranged from .705 to .914, for teachers' teaching behaviour dimensions ranged from .679 to .842, and for students' interest in science dimensions ranged from .662 to .897 for both pilot test (n = 40) and real study (n = 250), as illustrated in **Table 3.7**.

Universiti Malaya

Table 3.7

Reliability Analysis of the Dimensions of the Variables (Cronbach's Alpha Values)

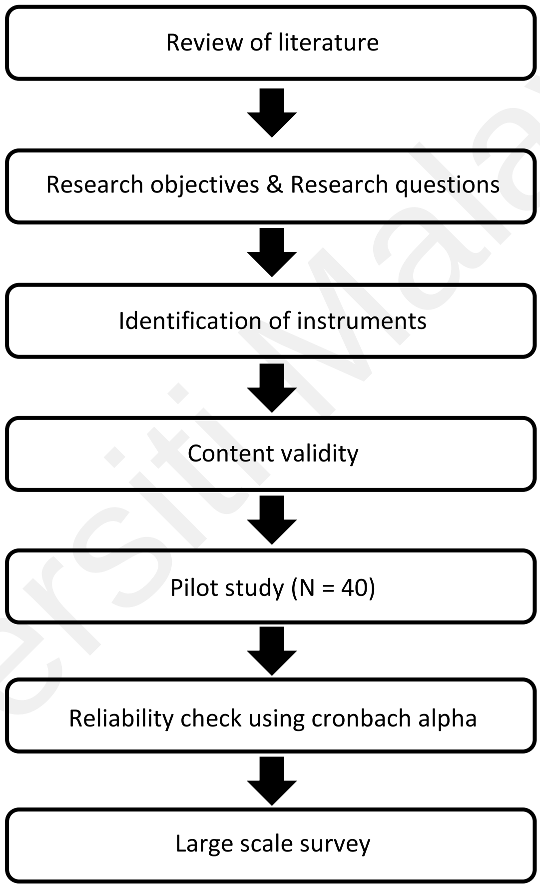
Variables	Dimensions	Items	Cronbach's Alpha Value Pilot study (n = 40)	Cronbach's Alpha Value (n = 250)
Teachers' Transformational Leadership Practices	Idealized Influence	1 to 4	.733	.791
	Inspirational Motivation	5 to 8	.914	.901
	Intellectual Stimulation	9 to 12	.749	.878
	Individualized Consideration	13 to 16	.705	.870
	Total Items	**16**		
Teachers' Teaching Behaviour	Clarity	17 to 22	.747	.836
	Enthusiasm	23 to 26	.712	.809
	Interaction	27 to 31	.806	.831
	Organization	32 to 36	.800	.842
	Disclosure	37 to 40	.782	.804
	Speech and Pacing	41 to 44	.679	.711
	Rapport	45 to 48	.701	.767
	Total Items	**32**		
Students' Interest in Science	Motivation for science	49 to 56	.797	.880
	Enjoyment of science	57 to 62	.700	.897
	Lack of anxiety	63 to 66	.662	.853
	Usefulness of science	67 to 72	.705	.729
	Self-concept of ability	73 to 75	.753	.788
	Career interest	76 to 80	.752	.688
	Ability to make choices	81 to 85	.742	.861
	Total Items	**37**		
TOTAL ITEMS IN QUESTIONNAIRE		**85**		

Universiti Malaya

The researcher's course during the questionnaire development stage is depicted in **Figure 3.2**. The questionnaires were refined based on the valuable suggestions provided by the experts before conducting the pilot study. Minor amendments were made accordingly to ensure their accuracy and effectiveness.

Figure 3.2

Stages in Questionnaire Development



3.7 Procedure of the Study

The main aim of data collection is to obtain accurate, truthful, and reliable information that aligns with the research objectives, data sources, and data availability. Therefore, the methodology used for data collection is of utmost importance.

The sample for this study consists of students from Form 1 to Form 3 classes in the selected private schools. Given the abolishment of PT3 examinations (Ministry of Education, 2022), Form 3 students can be approached as suitable samples for data collection. To ensure the validity of the samples, careful considerations were made during the selection process. The schools chosen for the study were carefully identified based on their academic reputation and the willingness of the principals to participate. Additionally, efforts were made to ensure a diverse representation of schools to capture a wide range of teaching and leadership practices.

Prior to conducting the research in selected private schools, official permission was sought from the school principals. An official letter was sent via email (see Appendix D and Appendix E), outlining the research purpose and requesting consent to conduct the study within their respective schools. Upon receiving consent from the school principals, the link to the Google Form questionnaires was shared with them to be forwarded to the respective class teachers of Form 1 to Form 3 classes. The class teachers, acting as facilitators, introduced the research to the students, explaining the purpose, the importance of their participation, and assuring them of the confidentiality of their information and responses. Students were instructed to carefully read and respond to the questions based on their own perceptions. The students received the Google Form questionnaires via email or their class WhatsApp chat group, forwarded by the respective class teachers. They were given a week to complete the questionnaires.

Achieving a high response rate is crucial for the validity and reliability of the study. To maximize the response rate, the research purpose, importance, and confidentiality of the study were effectively communicated to both the teachers and students, emphasizing the significance of their participation. Timely reminders were sent to both the teachers and

Universiti Malaya

students to ensure they were aware of the questionnaire completion deadline. These reminders served as gentle prompts to encourage participation. The researcher also provided ongoing support to the class teachers, addressing any queries or concerns they had throughout the data collection process. This support helped maintain their engagement and commitment to facilitating student participation.

3.8 Ethical Concerns

Prior to commencing the research, the researcher obtained permission from the developers of the instruments used in the study. This was done through email communication, as evidenced in Appendix A. By seeking permission, the researcher acknowledged and respected the intellectual property rights of the instrument creators. Following that, necessary approvals were sought from the principals of the selected private schools, accompanied by an official letter of request. All the principals granted consent for the study to be carried out in their schools.

Subsequently, the Google Form questionnaires link was shared with the students via their respective class teachers through the class WhatsApp chat group. Adhering to research ethics, before distributing the questionnaires to the participating students, clear information about the research objectives and scope was provided to them. They were also assured that all information and responses provided by them would be treated as confidential, and no students would be recognized. Measures were implemented to ensure that data collected would be used solely for research purposes and handled with strict confidentiality. The students were informed about their voluntary participation in the study and were assured that their involvement was entirely optional. No form of coercion or pressure was exerted to encourage participation.

Universiti Malaya

The researcher also took necessary precautions to protect the privacy and personal data of all participants. Data collection was carried out using Google Forms, which adheres to data protection standards. The researcher ensured that all collected data would be stored securely and used only for the intended research purpose. By addressing these ethical concerns, the study aimed to protect the rights and welfare of all participants, maintain confidentiality, and ensure the integrity and validity of the research findings.

3.9 Pilot Testing

A preliminary pilot study was undertaken to establish the reliability of the research instruments. As elucidated by Leon et al. (2011), a pilot test is a small-scale trial study conducted prior to larger investigations to evaluate the effectiveness of the instruments, study administration techniques, methodology, and suitability of analysis. According to Roopa & Rani (2012), the phrasing of questions in the questionnaire can influence respondents' comprehension and responses. Hence, conducting a pilot study, as advocated by Roopa & Rani (2012), instils the researcher with reassurance and confidence that the questionnaire is pertinent and feasible for the actual research.

As per Browne (1995) and Creswell & Clark (2011), a pilot test with a minimum sample size of 30 is deemed adequate. On December 17, 2021, a pilot test was carried out among 40 students from a private school in Klang Valley who exhibited similar characteristics to the intended respondents of the actual study. These students were purposefully selected for the pilot study. To avoid contamination, respondents from the pilot study were excluded from the main survey to ensure data integrity and reliability.

Universiti Malaya

3.10 Data Analysis

Data analysis encompasses the simultaneous and systematic examination and interpretation of data. This involves examining the data to identify relationships, patterns, trends, and other relevant information. For quantitative data, statistical software such as Statistical Package for the Social Sciences (SPSS) and Analysis of Moment Structures (AMOS) were employed, and both descriptive and inferential statistical techniques were employed to address the eleven research questions of this study. Prior to conducting data analysis, the researcher conducted a test to assess the normal distribution of the data, ensuring the appropriateness of the analytical methods used.

3.10.1 Descriptive Statistics

According to Kaur et al. (2018), descriptive statistics play a crucial role in summarizing data in a structured manner, elucidating the relationship between variables within a sample or population. Descriptive statistics serve as a fundamental component of initial data analysis, laying the groundwork for comparisons of variables through inferential statistical tests. Kaur et al. (2018) further highlighted that descriptive statistics encompass various types of variables, including nominal, ordinal, interval, and ratio, as well as measures of frequency, central tendency (such as means, modes, and medians), dispersion/variation (such as range, interquartile range, and standard deviations), and position. In this study, the researcher utilized frequency distribution and percentage to depict the characteristics of the respondents in relation to demographic variables, including gender, age, grade level, grade in the previous science exam, and attendance/participation in any science competition/science workshops during the last 12 months. Numerical rating scales were employed, and to address research questions one, two, and three, measures such as mean (M) and standard deviation (SD) were calculated, along with item analysis, to provide a comprehensive analysis.

Universiti Malaya

3.10.1.1 Measuring Mean and Standard Deviation

As the researcher worked with data on a ratio scale, the findings were presented using mean (M) and standard deviation (SD) scores, in accordance with the recommendation of Chua (2013). The mean (M) represents the average value of a set of observed values in a study, while the standard deviation measures the extent to which individual scores deviate from the mean in a distribution (Bland, 2006). Additionally, item analysis was conducted by examining the mean and SD of each item in the instrument. These statistical measures were utilized to address research questions one, two, and three, and facilitated the assessment of perceptions pertaining to teachers' transformational leadership practices, students' interest in science, and teachers' teaching behaviour among students in private schools located in the Klang Valley, Malaysia.

The researcher employed a numerical rating scale, ranging from "1" to "5", to assess student perceptions. Following the suggestion of Levin and Rubin (1998), this scale was divided into three levels with equal intervals to interpret the mean scores and measure the levels of teachers' transformational leadership practices, students' interest in science, and teachers' teaching behaviour. As Pallant (2010) noted, categorizing the mean score into three levels facilitates the identification of differences between the levels. The researcher utilized a formula to calculate the equal interval for measurement, as follows:

Formula for equal interval = (Largest value – smallest value) / Number of Level

= (5 – 1)/3 = 1.33

Hence, the interpretation of the mean scores in this study was as follows: mean scores ranging from 1 to 2.33 were categorized as low, scores from 2.34 to 3.67 as moderate, and scores from 3.68 to 5.00 as high.

3.10.2 Inferential Statistics

In this research, inferential statistics is utilized to investigate the relationships among independent variables, dependent variables, and mediator variables. Inferential statistics are employed to make inferences about the generalizability of these relationships from the research sample to the larger population, as elucidated by Chua (2013). The researcher employed various statistical tests, including the t-test, chi-square test, Pearson correlation test, ANOVA test, Spearman rho correlation test, and partial correlation test. Techniques such as Pearson product-moment correlation coefficient, multiple regression, and the PROCESS Macro for SPSS were used to analyse the data and derive conclusions about the relationships among the variables in this quantitative study.

Prior to conducting statistical analysis, it is essential to assess whether the data in the study follows a normal distribution. This is a crucial assumption in multivariate analysis (Khatun, 2021). The normality of the data was examined using the Skewness and Kurtosis test, as recommended by George and Mallery (2016) and Pallant (2013). Skewness is a measure that indicates the degree of asymmetry in a distribution. A distribution is considered asymmetrical when its left and right sides are not mirror images of each other. Skewness can take on three possible values: right or positive skewness, left or negative skewness, or zero skewness. A right-skewed distribution is characterized by a longer tail on the right side of its peak, while a left-skewed distribution has a longer tail on the left side of its peak, as noted by Turney (2022a). On the other hand, kurtosis is a measure of the tailedness or frequency of outliers in a distribution. Excess kurtosis represents the tailedness of a distribution in relation to a normal distribution. Distributions with medium kurtosis, also known as mesokurtic distributions, have medium tails. Distributions with low kurtosis, referred to as platykurtic distributions, have thin tails, while distributions with high kurtosis, known as leptokurtic distributions, have fat tails. Tails, which are the

Universiti Malaya

tapering ends on either side of a distribution, represent the probability or frequency of values that deviate significantly from the mean, commonly referred to as outliers. In simpler terms, tails indicate the occurrence of outliers in a distribution (Turney, 2022b). To be considered normally distributed, the Skewness and Kurtosis values should fall within the range of -1.96 to +1.96 (Chua, 2013).

In addition to the Skewness and Kurtosis test, the normality of the data in this study was also assessed using histograms and normal probability plots. According to Gunawan and Chairani (2019), a histogram, which is a type of bar graph, can be utilized as a graphical tool to assess the normality of data. In a normal distribution, the histogram is expected to have a bell-shaped curve with a single peak in the middle of the distribution, resembling the shape of a bell. Additionally, a normal probability plot can also be used to determine the normality of data, where the data points should align along a straight line if the data follows a normal distribution. If the data obtained from the respondents exhibit a normal distribution, it indicates that the data is suitable for inferential analysis.

3.10.2.1 Pearson Product-Moment Correlation

A correlation coefficient, as a descriptive statistic, provides a summary of sample data without making any inferences about the population, as stated by Bhandari (2022). It is considered a bivariate statistic when it captures the relationship between two variables, and it becomes a multivariate statistic when dealing with more than two variables. In other words, the correlation coefficient serves as a quantitative measure to describe the association between variables in a given sample, without making generalizations about the entire population (Bhandari, 2022). The Pearson product-moment correlation test, denoted by "r", is employed to determine relationships between variables that are measured using interval or ratio scales (Chua, 2013).

Universiti Malaya

According to Prion & Haerling (2014), the correlation coefficient is computed by dividing the covariance of two variables by the product of their standard deviations. This coefficient ranges from -1 to +1, where -1 represents a perfect negative correlation, 0 indicates no correlation, and +1 signifies a perfect positive correlation. The magnitude of the coefficient reflects the strength of the relationship between the variables, with larger absolute values indicating a stronger association. A positive correlation implies that both variables move in the same direction, while a negative Pearson *r* value indicates an opposing relationship between the variables of interest. The interpretation of Pearson *r* results, based on Bhandari's (2022) guidelines as depicted in **Table 3.8**, serves as a general rule of thumb.

The Pearson product-moment correlation analysis was deployed to analyse research question 4 (*Is there any significant relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia?*), research question 5 (*Is there any significant relationship between teachers' transformational leadership practices and teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?*), and research question 6 (*Is there any significant relationship between teachers' teaching behaviour and students' interest in science in Private Schools, Klang Valley, Malaysia?*).

Universiti Malaya

Table 3.8

General Guideline for Interpretation of Strength of Correlation Coefficient (r)

Correlation Coefficient (*r*)	Correlation Strength	Correlation Type
-.7 to -1	Very Strong	Negative
-.5 to -7	Strong	Negative
-.3 to -5	Moderate	Negative
0 to -.3	Weak	Negative
0	None	Zero
0 to .3	Weak	Positive
.3 to .5	Moderate	Positive
.5 to .7	Strong	Positive
.7 to 1	Very strong	Positive

Source: Bhandari (2022)

Universiti Malaya

3.10.2.2 Multiple Regression Analysis

As Berger (2012) suggests, multiple regression is a versatile method for analysing data, suitable for examining the relationship between a quantitative dependent variable (also known as the criterion variable or Y) and other factors expressed as independent or predictor variables (X). It can accommodate nonlinear relationships, both quantitative and qualitative independent variables, and can assess the effects of single or multiple variables, with or without accounting for the effects of other variables. Lynch (2013) further explains that in multiple regression analysis, a linear combination of multiple variables is used to model a single outcome variable. This technique is employed not only to understand factors that contribute to predicting an outcome, but also to establish causal relationships between variables and to comprehend complex relationships that cannot be elucidated through bivariate analyses alone. Through multiple regression analysis, the researcher can determine the relative contribution of each predictor variable to the criterion variable. In the current study, variables such as teachers' transformational leadership practices are considered as predictor variables (X), while students' interest in science is treated as the criterion variable (Y).

In the present investigation, the stepwise multiple regression technique was employed, as recommended by Hilton & Armstrong (2011), to select a subset of predictor variables (X) that best predict the criterion variable (Y). Stepwise multiple regression encompasses two forms: step-up (or forward) and step-down (or backward), as elucidated by Chua (2013). This approach is considered more economical, as it only includes significant predictor variables in the regression analysis, thus mitigating the risk of multicollinearity that could compromise the accuracy of the results.

According to Jeyasushma (2017), it is essential to include the F-value and significance level when reporting the results of multiple regression analysis, as mentioned by Chua (2013). A higher F-value indicates a stronger relationship between the dependent and independent variables. Additionally, Jeyasushma (2017) pointed out that the coefficient of determination (R^2) is a crucial indicator of the proportion of variance in one variable that can be explained by its relationship with another variable. R^2 ranges from 0 to 1, with higher values indicating a more substantial effect. Moreover, the Beta (β) value represents the standardized regression coefficient of the predictor variable in the analysis. Interpretation of both the β and R^2 values should be based on the acceptable effect size, as per the convention modified from Cohen (2013), as illustrated in **Table 3.9**.

Universiti Malaya

Table 3.9

Effect Size for Beta Values and Coefficient of Determination

	Effect size	Effect size class
β	<.05	Too small and meaningless
	.05 to .30	Small
	.31 to .50	Medium
	>.50	Large
R^2	<.20	Too small and meaningless
	.20 to .15	Small
	.16 to .30	Medium
	>.30	Large

Source: Chua (2014)

3.10.2.3 PROCESS Macro for SPSS

The SPSS PROCESS Macro method was utilized in the regression analysis to investigate the mediation of teachers' teaching behaviour on the relationship between teachers' transformational leadership practices and students' interest in science, as addressed in research question 10. The bootstrapping technique was utilized to estimate the mediation effects of paths a, b, c, and c' in the study (Kim et al., 2015), following the approach proposed by Hayes (2012). According to Hayes (2012), the PROCESS Macro is a versatile tool that can generate direct and indirect effects in mediation and mediated moderation models, conditional effects in moderation models, and conditional indirect effects in moderated mediation models with single or multiple mediators (p. 11). It is important to note that all path coefficients in the PROCESS Macro output are unstandardized coefficients, as cautioned by Darlington and Hayes (2017) against reporting standardized coefficients when the independent variable is dichotomous. They argue that reporting standardized coefficients may disrupt the convenient interpretation of the regression coefficient as a mean difference.

Universiti Malaya

The PROCESS Macro, as compared to the Baron and Kenny (1986) method, operates differently by examining all paths regardless of their significance, and thus does not rely solely on significant paths to determine mediation. This is in contrast to the Baron and Kenny method where failure to meet significance on any of the paths would result in rejection of the presence of indirect effects. Additionally, the bootstrapping technique employed in the PROCESS Macro is favoured by statisticians as it does not require the assumption of normally distributed errors for a*b, unlike the Sobel test which relies on normality assumption for the indirect effect (Berger, 2015, p. 3; Tavakoli & Heiney, 2014). Moreover, the PROCESS Macro is suitable for smaller sample sizes (Hair, Hult, Ringle, & Sarstedt, 2014). Researchers such as Shrout and Bolger (2002) and Hayes (2016) have noted that the indirect effect can result in non-normal data, even if the data was initially normally distributed, when related to the product indicator and product effect. The bias-corrected bootstrap confidence intervals used in the PROCESS Macro help minimize bias in results that may arise from non-normal sampling distributions (Hayes, 2013).

Furthermore, the effectiveness of the bootstrapping technique is supported by a study conducted by Koopman, Howe, Hollenbeck, and Sin (2015) which examined articles published in the Journal of Applied Psychology (JAP) between 2006 and 2012. The findings of Koopman et al. (2015) revealed that none of the articles in 2006 and 2007 utilized the bootstrapping method for articles with sample sizes of less than 80. However, between 2010 and 2012, the number of articles utilizing the bootstrapping method increased from three to seven. This underscores the growing recognition and adoption of the bootstrapping technique in recent years. Additionally, as highlighted by Alfons et al.

Universiti Malaya

(2018), the most reliable approach for testing mediating effects with an indirect effect is through a bias-corrected bootstrap confidence interval.

Lastly, the determination of the strength of mediation involves utilizing the Variable Accounted For (VAF) index, which can be computed using the formula VAF = (indirect effect) / (total effect), as outlined by Hair et al. (2021). When VAF values surpass 80%, it indicates complete mediation, while VAF values falling between 20% and 80% suggest partial mediation. On the other hand, VAF values below 20% imply the absence of mediation (Hair et al., 2014, 2017).

3.10.2.4 Structural Equation Modelling (SEM)

Structural Equation Modelling (SEM) is a strong statistical methodology used to explore relationships among multiple variables (Hair et al., 2010; Hoyle, 2014). SEM combines factor analysis and path analysis, utilizing path diagrams to illustrate these relationships, which is beneficial for inferential data analysis (Chua, 2014). This technique often includes latent variables—unobserved constructs inferred from observed data. Unlike most descriptive multivariate procedures, SEM provides a clear conceptualization of theoretical constructs, enhancing its inferential capacity (Byrne, 2016).

The AMOS (Analysis of Moment Structures) software is frequently employed for SEM due to its comprehensive data analysis capabilities (Byrne, 2010). In this study, AMOS version 24 was used to address research question eleven. SEM facilitates the interpretation of complex datasets and supports informed decision-making (Zainudin et al., 2015), while mitigating misleading results by simultaneously considering multiple variables (de Carvalho & Chima, 2014). In SEM, variables are categorized as exogenous (independent) or endogenous (dependent) (Byrne, 2016).

AMOS SEM is particularly valuable in educational research, enabling more accurate analysis of models with multiple dependent and mediating variables than standard statistical methods (Do-Thi & Do, 2022). SEM methodology, which includes AMOS, allows researchers to construct multidimensional models in educational research, applying techniques like correlation, regression, factor analysis, and covariance analysis to validate relationships against experimental data (Panchenko, 2019). Furthermore, SEM is increasingly utilized in social sciences, such as marketing, for developing concepts and theories by examining complex relationships among constructs using techniques like covariance-based SEM with AMOS (Hair et al., 2014).

Evaluating model fit is essential in SEM to ensure model acceptability. Hair et al. (2010) suggest reporting three to four fit indices from each model fit category—absolute fit, incremental fit, and parsimonious fit—to demonstrate adequate model fit. Common absolute fit indices include the Goodness of Fit Index (GFI) and Root Mean Square Error of Approximation (RMSEA), with acceptable values being above .90 and below .08, respectively (Zainudin, 2014). The Comparative Fit Index (CFI), an incremental fit measure, is acceptable at values above .90, with .95 indicating a good fit (Hair et al., 2010). The Chi-Square/Degrees of Freedom ratio is another critical index from the parsimonious fit category (Zainudin, 2014). **Table 3.10** presents the Model Fit Indices along with their acceptable threshold values.

Universiti Malaya

Table 3.10

Summarised Table of Model Fit Indices

Name of category	Name of index	Acceptable level
Absolute fit	Chisq	P > 0.005
	RMSEA	**RMSEA < 0.08**
	GFI *	**GFI > 0.90**
Incremental fit	AGFI	AGFI > 0.90
	CFI *	**CFI > 0.90**
	TLI	TLI > 0.90
	NFI	NFI > 0.90
Parsimonious fit	**Chisq/df ***	**Chi square / df < 5.0**

Source: Zainudin (2014)
Note: *The indexes in bold are referred to in the present study

If a model fails to meet fit criteria, Modification Indices (MI) can improve the model by allowing correlations among residuals of indicator variables (Hermida, 2015). An MI value above 15 indicates redundancy, necessitating further refinement (Zainudin, 2014). By ensuring a good fit, SEM models support the plausibility of hypothesized relationships among variables (Byrne, 2016).

3.11 Brief of Data Analysis

In summary, the variables and corresponding analyses conducted by the researcher for each research question are presented in **Table 3.11** as shown below.

Universiti Malaya

Table 3.11

Statistical Analysis by Research Question

Research Questions	Variables	Analysis
1. What is the level of students' interest in science as perceived by the students in Private Schools, Klang Valley, Malaysia?	Students' Interest in Science	Descriptive Statistic: Mean Score, Percentage, Frequency, Standard Deviation
2. What is the level of teachers' transformational leadership practices in Private Schools, Klang Valley, Malaysia?	Teachers' Transformational Leadership Practices	Descriptive Statistic: Mean Score, Percentage, Frequency, Standard Deviation
3. What is the level of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?	Teachers' Teaching Behaviour	Descriptive Statistic: Mean Score, Percentage, Frequency, Standard Deviation
4. Is there any significant relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia?	Teachers' Transformational Leadership Practices Students' Interest in Science	Inferential Statistic: Pearson *r* Correlation
5. Is there any significant relationship between teachers' transformational leadership practices and teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?	Teachers' Transformational Leadership Practices Teachers' Teaching Behaviour	Inferential Statistic: Pearson *r* Correlation

Universiti Malaya

6.	Is there any significant relationship between teachers' teaching behaviour and students' interest in science in Private Schools, Klang Valley, Malaysia?	Teachers' Teaching Behaviour Students' Interest in Science	Inferential Statistic: Pearson *r* Correlation
7.	Which dimensions of teachers' transformational leadership practices are predictors of students' interest in science in Private Schools, Klang Valley, Malaysia?	IV: Teachers' Transformational Leadership Practices DV: Students' Interest in Science	Inferential Statistic: Multiple Regression Analysis
8.	Which dimensions of teachers' teaching behaviour are predictors of students' interest in science in Private Schools, Klang Valley, Malaysia?	MedV: Teachers' Teaching Behaviour DV: Students' Interest in Science	Inferential Statistic: Multiple Regression Analysis
9.	Which dimensions of teachers' transformational leadership practices are predictors of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?	IV: Teachers' Transformational Leadership Practices MedV: Teachers' Teaching Behaviour	Inferential Statistic: Multiple Regression Analysis
10.	Does teachers' teaching behaviour mediate the relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia?	IV: Teachers' Transformational Leadership Practices DV: Students' Interest in Science MedV: Teachers' Teaching Behaviour	Inferential Statistic: PROCESS Macro for SPSS

Universiti Malaya

11. Do the data linking with teachers' transformational leadership practices, students' interest in science and teachers' teaching behaviour collected from Private Schools, Klang Valley, Malaysia fit in the proposed model?	IV: Teachers' Transformational Leadership Practices DV: Students' Interest in Science MedV: Teachers' Teaching Behaviour	Structural Equation Modelling (SEM) with AMOS

3.12 Summary of Chapter

Chapter 3 provides an overview of the research methods employed in the study, including the research design, population, location, sample, and instrument. Data collection was carried out through a survey method utilizing a questionnaire. To ensure the validity and accuracy of the questionnaire, a pilot study was conducted with 40 students from private schools in the Klang Valley. Data analysis involved descriptive and inferential analyses using SPSS software and SEM with AMOS. It is emphasized that the selection of appropriate methodology is crucial for obtaining clear, precise, and scientifically sound results. The subsequent Chapter 4 will present the findings of the data analysis and discuss the research findings.

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CHAPTER 4

FINDINGS

4.1 Introduction

In this chapter, the outcomes of the research conducted in five private schools randomly selected from the Klang Valley are presented. The study aimed to address eleven research questions and data was collected through Google Form questionnaires. The gathered data was then analysed using SPSS version 21 software and SEM with AMOS to explore the relationships between the variables. The chapter commences with an overview of the demographic characteristics of the respondents, followed by the mean values and standard deviations of the three variables under investigation. Subsequently, various inferential analyses, such as correlations and regressions, were performed and the findings are presented in tables for easy reference.

In summary, this chapter provides comprehensive answers to the research questions delineated below:

1. What is the level of students' interest in science as perceived by the students in Private Schools, Klang Valley, Malaysia?
2. What is the level of teachers' transformational leadership practices in Private Schools, Klang Valley, Malaysia?
3. What is the level of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?
4. Is there any significant relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia?

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5. Is there any significant relationship between teachers' transformational leadership practices and teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?
6. Is there any significant relationship between teachers' teaching behaviour and students' interest in science in Private Schools, Klang Valley, Malaysia?
7. Which dimensions of teachers' transformational leadership practices are predictors of students' interest in science in Private Schools, Klang Valley, Malaysia?
8. Which dimensions of teachers' teaching behaviour are predictors of students' interest in science in Private Schools, Klang Valley, Malaysia?
9. Which dimensions of teachers' transformational leadership practices are predictors of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?
10. Does teachers' teaching behaviour mediate the relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia?
11. Do the data linking with teachers' transformational leadership practices, students' interest in science and teachers' teaching behaviour collected from Private Schools, Klang Valley, Malaysia fit in the proposed model?

4.2 Survey Response Rate

To collect data for this study, Google Form questionnaires were shared with five randomly selected private schools in the Klang Valley via email and WhatsApp. The initial target was to obtain 250 responses, and students were given a week to complete the questions. Ultimately, 250 responses were received, and all of them were deemed usable for data analysis, resulting in a 100% response rate. As stated by Sileyew (2019), a response rate that exceeds 30% is generally deemed acceptable in research studies.

4.3 Normality Test

The data collected for this study was analysed using SPSS software for parametric tests, such as correlation, regression, and analysis of variance. Prior to conducting these tests, it was necessary to test the normality of the data, as recommended by Ghasemi and Zahediasl (2012). Hair et al. (2010) also emphasized the importance of normality testing, as it ensures that the fundamental assumption of inferential analysis is met. In this study, three different normality tests were performed, all of which indicated that the data was normally distributed.

4.3.1 Skewness and Kurtosis

As suggested by Chua (2013), it is recommended that Skewness and Kurtosis values should be within the range of -1.96 to +1.96 for normal distribution. The results of Skewness and Kurtosis for the variables can be found in **Table 4.1**, and they indicate that the data is normally distributed as the values fall within the required range.

Table 4.1

Descriptive Statistics of Participants (N = 250)

Variables	Mean	*SD*	Skewness	Kurtosis
Teachers' Transformational Leadership Practices	3.80	0.862	-.818	.490
Teachers' Teaching Behaviour	3.86	0.634	-.258	-.631
Students' Interest in Science	3.17	0.515	.341	1.000

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The histogram of the data displayed a bell-shaped curve with a single peak in the middle of the distribution. Additionally, the normal probability plot (Q-Q plot) showed data points aligned along a straight line. These results from the normality tests indicate that the data follows a normal distribution.

4.4 Demographic Background

The demographic characteristics of the respondents, including gender, age, grade level, grade in the previous science exam, and attendance or participation in science competitions or workshops, were analysed and presented in tabular form for easy reference.

4.4.1 Gender

Table 4.2 presents the distribution of respondents by gender. The findings reveal that females constitute the majority among the respondents, with 120 out of 250 (48%) being female, while 130 (52%) are male. This indicates that there is a nearly equal representation of male and female students across form 1 to form 3 in private secondary schools, with ages ranging from 13 to 15 years old.

Table 4.2

Respondents' Gender Distribution (N = 250)

Demographic	Characteristics	Frequency	Percentage (%)
Gender	Male	130	52%
	Female	120	48%

4.4.2 Age

The findings indicate that the respondents' ages are distributed across different age groups, with the largest proportion (48.0%) falling into the 15 years old category. The 14 years old group accounts for 35.6% of the respondents, while the 13 years old group comprises only 16.4% of the total respondents, as presented in **Table 4.3**.

Table 4.3

Respondents' Age Distribution (N = 250)

Demographic	Characteristics	Frequency	Percentage (%)
Age	13 years old	41	16.4
	14 years old	89	35.6
	15 years old	120	48.0

4.4.3 Grade Level

As shown in **Table 4.4**, almost half of the respondents were Form 3 students (48%), followed by Form 2 students (35.6%) and Form 1 students (16.4%).

Table 4.4

Respondents' Grade Level Distribution (N = 250)

Demographic	Characteristics	Frequency	Percentage (%)
Grade Level	Form 1	41	16.4
	Form 2	89	35.6
	Form 3	120	48.0

4.4.4 Grade in the Previous Science Exam

The findings from **Table 4.5** reveal that 30.4% of the respondents achieved Grade A in their previous science exam, while 21.6% obtained Grade B. Grade C was obtained by 20.0% of the students, followed by Grade D at 18.4%, and Grade E and Grade F at 4.8% each. The data indicates that the majority of the students (almost 70%) have demonstrated proficiency in science, scoring at least a Grade C in their previous science exam.

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Table 4.5

Respondents' Grade in the Previous Science Exam Distribution (N = 250)

Demographic	Characteristics	Frequency	Percentage (%)
Grade in the previous science exam	Grade A	76	30.4
	Grade B	54	21.6
	Grade C	50	20.0
	Grade D	46	18.4
	Grade E	12	4.8
	Grade F	12	4.8

4.4.5 Students' Attendance or Participation in Any Science Competition or Science Workshop

The students' attendance or participation in any science competition or science workshop was also tabulated in **Table 4.6**. Of the 250 respondents, 163 (65.2%) answered 'No' while the remaining 87 (34.8%) answered 'Yes'. This reflects that most of the students do not attend or participate in any science competition or science workshop.

Participation in science competitions or workshops serves as a motivating factor for students to strive for excellence, offering more than just the prospect of winning a prize. These opportunities provide a platform for students to learn, showcase their talents, evaluate their performance, and discover their own abilities. Moreover, competitions and workshops encourage students to embrace innovative approaches, refine their concepts, and hone their skills.

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Table 4.6

Students' Attendance or Participation in Any Science Competition or Science Workshop (N = 250)

Demographic	Characteristics	Frequency	Percentage (%)
Students' attendance or participation in any science competition or science workshop	Yes	87	34.8
	No	163	65.2

4.5 Data Analysis

In this study, a combination of descriptive and inferential analyses was employed to address the research questions. Descriptive statistics were utilized to provide an overview of the basic characteristics of the collected data for research questions 1 to 3. As Creswell (2014) states, descriptive statistics encompasses measures such as mean, mode, median, variance, standard deviation, and range, which offer insights into the general trends observed in the data (p. 182). Specifically, the mean and standard deviation were the focus of this study, and the results were presented in tabular formats for easy interpretation.

The inferential statistics technique was employed in this study to explore the characteristics of the research subjects and establish the relationship between the dependent and interdependent variables, as highlighted by Chua (2013). Specifically, for research questions 4 to 6, the Pearson product-moment coefficient was utilized to identify any correlation between two sets of interval scale variables. The correlation coefficient (*r*) was used to assess the strength and direction of the relationship, based on Bhandari (2022). A higher coefficient value indicates a stronger relationship between teachers' transformational leadership practices and students' interest in science, as noted by Bhandari (2022).

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Chua (2013) suggests that multiple regression analysis can be employed to detect changes in the independent variable that may influence the dependent variable (p. 286). In this study, research questions 7, 8, and 9 were analysed using multiple regression analysis with the stepwise method. The stepwise method involves adding predictor variables to the regression model that exhibit the strongest correlation with the criterion variable, while excluding those with weak correlations, as suggested by Technologies (2021). By utilizing the stepwise method, the researcher can identify significant predictor variables and generate a regression equation based on their contributions.

For research question 10, the PROCESS Macro for SPSS analysis was employed to investigate the potential mediation of teachers' teaching behaviour in the relationship between teachers' transformational leadership practices and students' interest in science. As cited by Jeyasushma (2017), bootstrapping, as recommended by Hayes (2013), was utilized to evaluate the statistical significance of the indirect effect. This approach was employed to substantiate the significance of any potential reduction in the impact of teachers' transformational leadership practices on students' interest in science.

Finally, the model fit of the collected data was analyzed using Structural Equation Modeling (SEM) with AMOS. This involved examining the model fitness indices. The revised proposed model demonstrated that all fitness indices met the threshold values.

Before addressing the research question, data from students in Form 1, 2, and 3 were examined using correlation analysis, ANOVA, and Chi-Square tests. These analyses aimed to determine whether there are significant correlations or differences among these groups. The correlation analysis was employed to assess the relationships between variables within each form. ANOVA tests were conducted to identify any significant differences in the means across the three forms (Mishra et al., 2019). Additionally, Chi-Square tests were used to evaluate the independence of categorical variables among the groups (Franke et al., 2012). The results indicated that there were no significant differences among the Form 1, 2, and 3 groups. This suggests that the data from these groups can be treated as homogeneous for the purposes of further analysis. Thus, it was appropriate to proceed with analysing the overall data to answer the research question.

4.5.1 Research Question 1

RQ1: What is the level of students' interest in science as perceived by the students in Private Schools, Klang Valley, Malaysia?

The students' interest in science questions were asked based on the seven dimensions by Hassan (2008). The Student Interests and Motivation in Science Questionnaire (SIMSQ) is operationalised by 37 statements on a 5-point scale, whereby 1 represents 'Never' and 5 represents 'Always'. **Table 4.7** shows the level students' interest in science in terms of mean and standard deviation values for the seven dimensions of students' interest in science.

The mean values for the seven dimensions are between 2.07 and 3.91. Among the seven dimensions, enjoyment of science, which refers to the students' enjoyment of science learning experiences (M = 3.91, SD = 0.79) showed the highest mean, followed by usefulness of science which reflects to students' beliefs in the useful application of science for them and for society in general (M = 3.82, SD = 0.66), career interest which is a measure of the development of students' interest in pursuing a career in science (M = 3.34, SD = 0.77), self-concept of ability which deals with students' perception of their achievement in science (M = 3.30, SD = 0.82), ability to make choices which refers to students' empowerment to make decisions about their science learning (M = 2.92, SD = 0.96), motivation for science which refers to the extent to which students are motivated (M = 2.84, SD = 0.86), and finally lack of anxiety (M = 2.07, SD = 0.89) which is at a low level. Lack of anxiety refers to the extent to which students feel less anxious. From the table, the students did not differ much in their perception on their interest in science level. The overall mean value of students' interest in science is moderate (M = 3.17, SD = 0.52) which implies that there is a moderate level of interest in science among students.

Table 4.7

Descriptive Analysis for Students' Interest in Science

Dimensions	**Mean**	***SD***	**Level**
Enjoyment of science	3.91	0.79	High
Self-concept of ability	3.30	0.82	Moderate
Usefulness of science	3.82	0.66	High
Lack of anxiety	2.07	0.89	Low
Ability to make choices	2.92	0.96	Moderate
Motivation for science	2.84	0.86	Moderate
Career interest	3.34	0.77	Moderate
Students' Interest in Science	**3.17**	**0.52**	**Moderate**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

The seven dimensions of students' interest in science are further analysed. The findings of the research show that students who participated in the study are enjoying their science learning experiences as presented in **Table 4.8**. The findings illustrate all the items for the enjoyment of science are high in level (M = 3.91, SD = 0.79). It shows that students find that science classes are not boring (M = 3.75, SD = 0.94), fun (M = 3.79, SD = 0.96) and interesting (M = 3.86, SD = 0.93), students like to go to science classes (M = 3.99,

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SD = 0.99) and science makes them curious (M = 3.84, SD = 1.05). Furthermore, students also enjoy science laboratory work (M = 4.24, SD = 0.96). As can be seen in Table 4.8, item 1 is negatively worded item. This item was reverse-coded before the analysis. Therefore, the interpretation is also in reverse. The overall mean for the enjoyment of science dimension is at 3.91 (SD = 0.79) which relates to how much the students are enjoying their science learning experiences in their current school.

Table 4.8

Items of Enjoyment of Science: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
1r*	Science classes are boring	3.75	0.94	High
2	Science classes are fun	3.79	0.96	High
3	Science classes are interesting	3.86	0.93	High
4	Like to go to science classes	3.99	0.99	High
5	Science makes you curious	3.84	1.05	High
6	Enjoy science laboratory work	4.24	0.96	High
	Overall	**3.91**	**0.79**	**High**

*r = negative items
Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Table 4.9 shows that students studying in private schools in Klang Valley feel that things they studied in the science class been too easy (M = 2.95, SD = 0.95) and feel that the science class make them feel confident (M = 3.46, SD = 0.99) and successful (M = 3.50, SD = 1.01). Overall, students have a moderate level of self-concept of ability (M = 3.30, SD = 0.82). Based on these findings, it can be concluded that students in private schools in Klang Valley have a moderate sense of achievement in science.

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Table 4.9

Items of Self-concept of Ability: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
7	Things you studied in this science class been too easy	2.95	0.95	Moderate
10	This science class made you feel confident	3.46	0.99	Moderate
11	This science class made you feel successful	3.50	1.01	Moderate
	Overall	**3.30**	**0.82**	**Moderate**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

The third dimension of students' interest in science is the usefulness of science as displayed in **Table 4.10** which is at a high level for the students in the sample (M = 3.82, SD = 0.66). The findings show that students feel that things they studied in science class been relevant to another school subject (M = 3.29, SD = 0.95), related to things they have learnt outside school/university (M = 3.32, SD = 0.96), and the students feel that science classes are useful (M = 4.14, SD = 0.94). Besides that, the students find that the things they learn in science class have something to do with the real world (M = 3.85, SD = 1.16). In addition, the students feel that science should be required in school (M = 4.34, SD = 0.97). The students also find that much of science classes are useful in everyday life (M = 3.97, SD = 1.06).

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Table 4.10

Items of Usefulness of Science: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
8	Things you studied in science class been relevant to another school subject	3.29	0.95	Moderate
9	Things you studied in science class related to things you have learnt outside school/university	3.32	0.96	Moderate
16	Science classes are useful	4.14	0.94	High
17r*	The things you learn in science class have nothing to do with the real world	3.85	1.16	High
18	Science should be required in school	4.34	0.97	High
19	Much of science classes are useful in everyday life	3.97	1.06	High
	Overall	**3.82**	**0.66**	**High**

*r = negative items
Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Looking at the lack of anxiety dimension in **Table 4.11**, it indicates the extent to which students feel less anxious, which is at a low level for the students in the sample (M = 2.07, SD = 0.89). Lack of anxiety refers to students' lack of concern and consequently a positive outlook when pursuing science. Students have perceived lowly that the science class made them feel uncomfortable (M = 1.90, SD = 1.04) and moderately that the science class made them unable to understand (M = 2.35, SD = 0.98). Aside from that, students have perceived lowly that the science class made them feel stupid (M = 2.22, SD = 1.15) and made them feel unhappy (M = 1.82, SD = 1.08).

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Table 4.11

Items of Lack of Anxiety: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
12	This science class made you feel uncomfortable	1.90	1.04	Low
13	This science class made you feel unable to understand	2.35	0.98	Moderate
14	This science class made you feel stupid	2.22	1.15	Low
15	This science class made you feel unhappy	1.82	1.08	Low
	Overall	**2.07**	**0.89**	**Low**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Table 4.12 below shows the mean value and standard deviation for the ability to make choices dimension (M = 2.92, SD = 0.96). The dimension comprises of five items, and in item 20 and 21, students rated moderately on choosing topic or project themselves (M = 2.80, SD = 1.18) and on choosing the way they want to learn (M = 2.96, SD = 1.21), respectively. Besides that, the students also rated moderately on selecting the order in which they study science topics (M = 2.81, SD = 1.24), had the chance to work at their own pace (M = 3.35, SD = 1.10) and had the chance to decide when to hand in assignments and take tests (M = 2.66, SD = 1.24). To summarize, the moderate mean value illustrates that students are moderately-empowered to make decisions about their science learning. Allowing students to choose is an important factor in learning. Thus, a feeling of empowerment may motivate students to pursue their goals in science.

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Table 4.12

Items of Ability to Make Choices: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
20	Chosen topic or project yourself	2.80	1.18	Moderate
21	Chosen the way you want to learn	2.96	1.21	Moderate
22	Selected the order in which you study science topics	2.81	1.24	Moderate
23	Had the chance to work at your own pace	3.35	1.10	Moderate
24	Had the chance to decide when to hand in assignments and take tests	2.66	1.24	Moderate
	Overall	**2.92**	**0.96**	**Moderate**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

In terms of motivation for science, done science projects has the highest mean value (M = 3.76, SD = 1.08), followed by watched science-related shows on TV (M = 3.04, SD = 1.15), talked about science topics with friends (M = 3.00, SD = 1.09), worked with science-related hobbies (M = 2.91, SD = 1.24), read books about science topics or scientists (M = 2.74, SD = 1.17), read articles on science-related topics in magazines (M = 2.54, SD = 1.22), read articles on science-related topics in newspapers (M = 2.43, SD = 1.21) and gone to hear people give talks on science (M = 2.34, SD = 1.18). The analysis presented in **Table 4.13** shows the extend students are motivated for science (M = 2.84, SD = 0.86).

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Table 4.13

Items of Motivation for Science: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
25	Read articles on science-related topics in magazines	2.54	1.22	Moderate
26	Read articles on science-related topics in newspapers	2.43	1.21	Moderate
27	Watched science-related shows on TV	3.04	1.15	Moderate
28	Gone to hear people give talks on science	2.34	1.18	Moderate
29	Read books about science topics or scientists	2.74	1.17	Moderate
30	Talked about science topics with your friends	3.00	1.09	Moderate
31	Done science projects	3.76	1.08	High
32	Worked with science-related hobbies	2.91	1.24	Moderate
	Overall	**2.84**	**0.86**	**Moderate**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Table 4.14 displays the descriptive statistics for the career interest dimension, which is a measure of the development of students' interest in pursuing a career in science (M = 3.34, SD = 0.77). As can be seen in **Table 4.14**, item 34 and 37 are negatively worded items. These items were reverse-coded before the analysis. Therefore, the interpretation is also in reverse. "A career in science would be interesting" is ranked the highest by students (M = 3.86, SD = 1.14). Students also alleged moderately that they would like to be a scientist (M = 2.68, SD = 1.23). Aside from that, they would also like a job in a science laboratory (M = 3.45, SD = 1.12) and they would like to work with people who make discoveries in science (M = 3.26, SD = 1.13). They also find that a job as a scientist would be interesting (M = 3.46, SD = 1.18).

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Table 4.14

Items of Career Interest: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
33	I would like to be a scientist	2.68	1.23	Moderate
34r*	I would not like a job in a science laboratory	3.45	1.12	Moderate
35	I would like to work with people who make discoveries in science	3.26	1.13	Moderate
36	A job as a scientist would be interesting	3.46	1.18	Moderate
37r*	A career in science would not be interesting	3.86	1.14	High
	Overall	**3.34**	**0.77**	**Moderate**

*r = negative items
Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

In conclusion, most items in each dimension of students' interest in science have shown the existence of high and moderate level of interest as perceived by the students. As interested students, they are enjoying the science learning experiences and rated highly on the usefulness of science. The students also reported on feeling less anxious about studying science. Adding on, the students also portray moderate level of self-concept of ability, ability to make choices, motivation for science and career interest. Overall, the students' interest in science is merely moderate, which is something that should be looked into to identify what is the cause of it.

Universiti Malaya

4.5.2 Research Question 2

RQ2: What is the level of teachers' transformational leadership practices in Private Schools, Klang Valley, Malaysia?

Table 4.15 presents the mean values and standard deviations for the various dimensions used to measure teachers' transformational leadership practices. A total of 16 questions, adapted from Beauchamp et al.'s (2010) Transformational Teaching Questionnaire (TTQ), were utilized, encompassing four dimensions. The questions were rated on a 5-point scale, with 1 denoting 'Not at all' and 5 indicating 'Frequently'.

As depicted in **Table 4.15**, the mean score for teachers' transformational leadership practices overall was 3.80 (SD = 0.86), indicating that students perceived their science teachers to exhibit a high level of transformational leadership. Furthermore, the mean ratings for all four dimensions fell between 3.65 (SD = 0.95) and 3.99 (SD = 0.91). The results from the table reveal that one of the dimensions, individualized consideration, obtained a higher mean value than the overall score (M = 3.99, SD = 0.91), while intellectual stimulation had the lowest value (M = 3.65, SD = 0.95). Nevertheless, three out of the four transformational leadership dimensions were rated at a high level. Considering the overall mean value, it suggests a high level of perceived teachers' transformational leadership practices by the students, with individualized consideration being the most dominant dimension.

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Table 4.15

Descriptive Analysis for Teachers' Transformational Leadership Practices

Dimensions	Mean	*SD*	Level
Idealized Influence	3.78	0.87	High
Inspirational Motivation	3.79	0.97	High
Intellectual Stimulation	3.65	0.95	Moderate
Individualized Consideration	3.99	0.91	High
Teachers' Transformational Leadership Practices	**3.80**	**0.86**	**High**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

The following tables present the items within each dimension, beginning with **Table 4.16** which showcases the items related to the idealized influence dimension. Findings revealed that students perceived their science teachers as a person that they look up to (M = 3.74, SD = 1.09) and besides treating them in ways that build their respect to the teachers (M = 4.03, SD = 1.07). At the same time, the students find that their science teacher talks about his/her personal values (M = 3.24, SD = 1.17) and behaves as someone that they can trust (M = 4.11, SD = 1.09). From here, we can conclude that the science teachers in private schools in Klang Valley highly demonstrates idealized influence (M = 3.78, SD = 0.87), by fostering trust and respect among the students that they lead, and model ethically desirable behaviours through the demonstration of personally held beliefs.

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Table 4.16

Items of Idealized Influence: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
2	Acts as a person that I look up to	3.74	1.09	High
5	Treats me in ways that build my respect	4.03	1.07	High
12	Talks about his/her personal values	3.24	1.17	Moderate
16	Behaves as someone that I can trust	4.11	1.09	High
	Overall	**3.78**	**0.87**	**High**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Table 4.17 shows the mean values and standard deviation on students' perception of the inspirational motivation dimension (M = 3.79, SD = 0.97). From the table, the science teachers demonstrate highly that they believe in their students (M = 3.78, SD = 1.09). The students also responded highly on the scale for the other three items that indicate: teacher is enthusiastic about what they are capable of achieving (M = 3.71, SD = 1.14); their teacher motivate them to try their hardest (M = 3.92, SD = 1.10) and their teacher is also optimistic about what they can accomplish (M = 3.75, SD = 1.09). The findings show that the science teachers inspire and energize their respective students to achieve their goals.

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Table 4.17

Items of Inspirational Motivation: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
4	Demonstrates that s/he believes in me	3.78	1.09	High
6	Is enthusiastic about what I am capable of achieving	3.71	1.14	High
8	Motivates me to try my hardest	3.92	1.10	High
15	Is optimistic about what I can accomplish	3.75	1.09	High
	Overall	**3.79**	**0.97**	**High**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Science teachers are looked upon moderately when it comes to encouraging their students to see issues from multiple perspectives, and to question the students' own and others' commonly held assumptions as shown in **Table 4.18** for the intellectual stimulation dimension (M = 3.65, SD = 0.95). The students perceived their science teachers in doing so highly by creating lessons that really encourage the students to think (M = 3.84, SD = 1.03), and by providing them with tasks and challenges that get them to think in different ways (M = 3.68, SD = 1.08). The students also reported that their science teachers get them to question their own and others' ideas (M = 3.48, SD = 1.15), as well as encouraging them to look at issues from different sides (M = 3.62, SD = 1.16).

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Table 4.18

Items of Intellectual Stimulation: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
3	Creates lessons that really encourage me to think	3.84	1.03	High
7	Provides me with tasks and challenges that get me to think in different ways	3.68	1.08	High
10	Gets me to question my own and others' ideas	3.48	1.15	Moderate
13	Encourages me to look at issues from different sides	3.62	1.16	Moderate
	Overall	**3.65**	**0.95**	**Moderate**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

In terms of the individualized consideration dimension as displayed in **Table 4.19**, the science teachers are said to show that they care about their respective students (M = 3.92, SD = 1.04). They also try to know every student in the class (M = 4.05, SD = 1.10), and try to help students who might be struggling (M = 4.20, SD = 1.02). In addition, the science teachers recognize the needs and abilities of each student in the class (M = 3.80, SD = 1.14). The overall findings show that the science teachers in private schools in Klang Valley highly demonstrated individualized consideration dimension (M = 3.99, SD = 0.91) by recognizing and acting on the personal and psychological needs of their students, displaying a genuine sense of care and concern, as well as celebrating the successes of their students.

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Table 4.19

Items of Individualized Consideration: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
1	Shows that s/he cares about me	3.92	1.04	High
9	Tries to know every student in the class	4.05	1.10	High
11	Tries to help students who might be struggling	4.20	1.02	High
14	Recognizes the needs and abilities of each student in the class	3.80	1.14	High
	Overall	**3.99**	**0.91**	**High**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

In summary, the analysis indicates that the science teachers in private schools in Klang Valley, as perceived by the students, exhibit a high level of transformational leadership in all four dimensions. Among these dimensions, individualized consideration has the highest mean value, followed by inspirational motivation, idealized influence, and intellectual stimulation. This is evident from the high mean values obtained from the items in each dimension.

4.5.3 Research Question 3

RQ3: What is the level of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?

To determine the students' perception of their teacher's specific classroom behaviours, the questions adapted from Hadie et al. (2019)'s Teacher Behaviour Inventory (TBI) which consists of seven dimensions were used. The instrument had 32 items and were rated on a numerical rating scale of 1 to 5 and anchored endpoints, whereby 1 represents

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'almost never' and 5 represents 'almost always'. **Table 4.20** illustrates a high level of teachers' teaching behaviour as perceived by the students which has an overall mean of 3.86 (SD = 0.63).

Based on the finding, the speech & pacing dimension had the highest mean value (M = 4.00, SD = 0.79), followed by, in descending order, interaction (M = 3.92, SD = 0.78), clarity (M = 3.89, SD = 0.77), organization (M = 3.88, SD = 0.79), disclosure (M = 3.87, SD = 0.80), rapport (M = 3.78, SD = 0.78), and enthusiasm (M = 3.66, SD = 0.86). This shows that students perceived their science teachers' teaching behaviour highly with speech & pacing dimension is the most dominant among all.

Table 4.20

Descriptive Analysis for Teachers' Teaching Behaviour

Dimensions	**Mean**	***SD***	**Level**
Clarity	3.89	0.77	High
Enthusiasm	3.66	0.86	Moderate
Interaction	3.92	0.78	High
Organization	3.88	0.79	High
Disclosure	3.87	0.80	High
Speech & Pacing	4.00	0.79	High
Rapport	3.78	0.78	High
Teachers' Teaching Behaviour	**3.86**	**0.63**	**High**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Looking at the clarity dimension in **Table 4.21**, clarity is defined as methods used to explain or clarify concepts and principles. Students have perceived highly that their science teachers point out practical applications of concepts (M = 3.87, SD = 1.02), answers students' questions thoroughly (M = 4.28, SD = 0.90), explains subject matter in

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familiar conversational language (M = 4.02, SD = 0.94), and summarizes points previously made from time to time (M = 3.97, SD = 1.03). Both “stresses most important points by verbal gestures” (M = 3.56, SD = 1.22) and “suggests ways of memorizing complicated ideas” (M = 3.63, SD = 1.04) are perceived moderately by the students. Overall, the results show a high level of clarity dimension.

Table 4.21

Items of Clarity: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
1	Stresses most important points by verbal gestures	3.56	1.22	Moderate
2	Points out practical applications of concepts	3.87	1.02	High
3	Answers students’ questions thoroughly	4.28	0.90	High
4	Explains subject matter in familiar conversational language	4.02	0.94	High
5	Suggests ways of memorizing complicated ideas	3.63	1.04	Moderate
6	Summarizes points previously made from time to time	3.97	1.03	High
	Overall	**3.89**	**0.77**	**High**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Table 4.22 shows the mean values and standard deviation on teachers’ enthusiasm dimension. From the table, gestures with hands or arms have the highest mean value (M = 3.92, SD = 0.97), followed by moves about while teaching (M = 3.78, SD = 1.05). On the side note, students responded moderately on the scale for two other statements that indicate: exhibits facial gestures or expressions (M = 3.49, SD = 1.12), and gestures with head or body (M = 3.46, SD = 1.16). The findings show that science teachers in private

Universiti Malaya

schools in Klang Valley are moderately exhibiting the usage of nonverbal behaviour to solicit their students' attention and interest (M = 3.66, SD = 0.86).

Table 4.22

Items of Enthusiasm: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
7	Moves about while teaching	3.78	1.05	High
8	Gestures with hands or arms	3.92	0.97	High
9	Gestures with head or body	3.46	1.16	Moderate
10	Exhibits facial gestures or expressions	3.49	1.12	Moderate
	Overall	**3.66**	**0.86**	**Moderate**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Teachers are viewed upon highly when it comes to their techniques used to foster students' participation in class as shown in **Table 4.23** for the interaction dimension (M = 3.92, SD = 0.78). The teachers do so by encouraging their students to ask questions or make comments during teachings (M = 3.92, SD = 1.03), praises students for good ideas (M = 3.90, SD = 0.96), asking questions of class as a whole (M = 3.95, SD = 1.01), as well as asking if students understand before proceeding to next topic (M = 4.27, SD = 0.94). They also present challenging, thought-provoking ideas to their students (M = 3.54, SD = 1.10).

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Table 4.23

Items of Interaction: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
11	Encourages students to ask questions or make comments during teachings	3.92	1.03	High
12	Praises students for good ideas	3.90	0.96	High
13	Asks questions of class as a whole	3.95	1.01	High
14	Presents challenging, thought-provoking ideas	3.54	1.10	Moderate
15	Asks if students understand before proceeding to next topic	4.27	0.94	High
	Overall	**3.92**	**0.78**	**High**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

In terms of teachers' organization dimension as displayed in **Table 4.24**, the science teachers are said to highly demonstrating ways of organizing or structuring subject matter of the lesson (M = 3.88, SD = 0.79). Based on the finding, teachers "clearly indicates transition from one topic to the next" had the highest mean value (M = 3.97, SD = 0.96) followed by, in descending order, putting outline of teaching on blackboard / whiteboard / overhead projector screen (M = 3.94, SD = 1.07), giving preliminary overview of teaching at the beginning of class (M = 3.88, SD = 0.92), using headings and subheadings to organize teaching content (M = 3.84, SD = 1.04), and stating objectives of each teaching (M = 3.77, SD = 1.04).

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Table 4.24

Items of Organization: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
16	Uses headings and subheadings to organize teaching content	3.84	1.04	High
17	Puts outline of teaching on blackboard / whiteboard / overhead projector screen	3.94	1.07	High
18	Clearly indicates transition from one topic to the next	3.97	0.96	High
19	Gives preliminary overview of teaching at the beginning of class	3.88	0.92	High
20	States objectives of each teaching	3.77	1.04	High
	Overall	**3.88**	**0.79**	**High**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Table 4.25 shows the mean for teachers' disclosure dimension (M = 3.87, SD = 0.80), which is defined as explicitness concerning subject requirements and grading criteria, and the mean values for the items under this dimension, in which three of the items are rated highly. The students' responses indicate that their science teachers advise students as to how to prepare for tests or exams (M = 4.08, SD = 0.97), tells students exactly what is expected of them on tests, homework or assignments (M = 3.72, SD = 1.06), reminds students of test dates or assignment deadlines (M = 4.06, SD = 0.96). In addition, teachers also provide sample exam questions to their students (M = 3.62, SD = 1.06). From the findings, it can be summarized that teachers in private schools in Klang Valley highly exhibit disclosure dimension in their teaching behaviour.

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Table 4.25

Items of Disclosure: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
21	Advises students as to how to prepare for tests or exams	4.08	0.97	High
22	Provides sample exam questions	3.62	1.06	Moderate
23	Tells students exactly what is expected of them on tests, homework or assignments	3.72	1.06	High
24	Reminds students of test dates or assignment deadlines	4.06	0.96	High
	Overall	**3.87**	**0.80**	**High**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Looking at the next dimension - speech & pacing (M = 4.00, SD = 0.79) which is defined as characteristics of voice and rate of information presentation, teachers are rated highly as shown in Table 4.26 on speaking clearly (M = 4.24, SD = 0.89), and speaking at appropriate pace (M = 4.18, SD = 0.95). As can be seen in **Table 4.26**, item 27 and 28 are negatively worded items. These items were reverse-coded before the analysis. Therefore, the interpretation is also in reverse. The teachers also do not stutter, mumble or slur words (M = 3.97, SD = 1.19), and do not appear to speak in monotone (M = 3.60, SD = 1.22).

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Table 4.26

Items of Speech & Pacing: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
25	Speaks clearly	4.24	0.89	High
26	Speaks at appropriate pace	4.18	0.95	High
27r*	Voice lacks proper modulation (speaks in monotone)	3.60	1.22	Moderate
28r*	Stutters, mumbles or slurs words	3.97	1.19	High
	Overall	**4.00**	**0.79**	**High**

*r = negative items
Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

Aside from that, science teachers also offer to help students with problems. This item has the highest mean value (M = 4.12, SD = 0.92) compared to the other three items that fall under the rapport dimension. In addition, based on **Table 4.27**, science teachers show tolerance of other points of view (M = 3.91, SD = 0.99). Students ranked moderately on their science teachers on "announces availability for consultation outside of class" (M = 3.41, SD = 1.12), and "talks with students before or after class" (M = 3.66, SD = 1.05). Overall, students rated highly on the quality of interpersonal relations between teacher and students (M = 3.78, SD = 0.78). The mean values and standard deviations are shown in **Table 4.27**.

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Table 4.27

Items of Rapport: Mean, SD and Level

Item	Item description	Mean	*SD*	Level
29	Announces availability for consultation outside of class	3.41	1.12	Moderate
30	Offers to help students with problems	4.12	0.92	High
31	Shows tolerance of other points of view	3.91	0.99	High
32	Talks with students before or after class	3.66	1.05	Moderate
	Overall	**3.78**	**0.78**	**High**

Note: Mean – Low level = 1.00 – 2.33; Moderate level = 2.34 – 3.67; High level = 3.68 – 5.00

In summary, the analysis reveals that teachers' teaching behaviour in private schools in Klang Valley, as perceived by students, exhibit a high mean value in almost all dimensions. The speech & pacing dimension has the highest mean value, while enthusiasm is rated at a moderate level with the lowest mean value. Overall, the analysis indicates that students have a positive perception of their science teachers' teaching behaviour, which plays a crucial role in student outcomes, as effective teaching behaviour is instrumental in fostering student engagement and interest in the subject.

4.5.4 Research Question 4

RQ4: Is there any significant relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia?

The correlation strength, as interpreted by Bhandari (2022) table, is presented in **Table 3.8**, which provides guidelines for interpreting the magnitude of correlation coefficient (*r*).

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The study findings suggest a significant positive relationship between teachers' transformational leadership practices and students' interest in science, with a correlation coefficient of $r = .565$ ($p < .01$), as indicated in **Table 4.28**. The correlation value suggests a strong positive association between the two variables, indicating that as teachers' transformational leadership practices increase, students' interest in science also tends to increase.

Table 4.28

Pearson Correlation Matrix Between Teachers' Transformational Leadership Practices and Students' Interest in Science

Variables		**Students' Interest in Science**
Teachers' Transformational Leadership Practices	Pearson Correlation	.565**
	Sig. (2-tailed)	.000
	N	250

**Correlation is significant at the 0.01 level (2-tailed)

Upon conducting correlation analysis between each dimension of teachers' transformational leadership practices and students' interest in science, as perceived by students, the findings suggest a range of correlation strengths from strong to moderate, as depicted in **Table 4.29**. The results also indicate that all dimensions of teachers' transformational leadership practices have a significant relationship with students' interest in science. The dimension of intellectual stimulation shows the strongest correlation with students' interest in science ($r = .584$, $p < .01$), followed by inspirational motivation ($r = .535$, $p < .01$), idealized influence ($r = .525$, $p < .01$), and individualized consideration ($r = .465$, $p < .01$), which reveals a significant and moderate strength of correlation.

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Table 4.29

Correlation Analysis Between Dimension of Teachers' Transformational Leadership Practices and Students' Interest in Science

Dimensions	Students' Interest in Science
Intellectual Stimulation	.584**
Inspirational Motivation	.535**
Idealized Influence	.525**
Individualized Consideration	.465**

**Correlation is significant at the 0.01 level (2-tailed)

In summary, the results indicate that the correlation between the dimensions of teachers' transformational leadership practices and students' interest in science ranges from moderate to strong. Nonetheless, the overall association between teachers' implementation of transformational leadership practices and students' interest in science exhibits a robust positive correlation coefficient.

Subsequently, Pearson product moment correlation was used to determine the relationship between all the four dimensions of teachers' transformational leadership practices and the seven dimensions of students' interest in science. Teachers' transformational leadership practices consisted of four dimensions such as idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration (Beauchamp et al., 2010). On the other hand, students' interest in science consisted of seven dimensions such as motivation for science, enjoyment of science, lack of anxiety, usefulness of science, self-concept of ability, career interest, and ability to make choices (Hassan, 2008). **Table 4.30** provides a detailed correlation analysis between the four dimensions of teachers' transformational leadership practices and the seven dimensions of students' interest in science.

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Table 4.30

Correlation Analysis Between Dimension of Teachers' Transformational Leadership Practices and Dimension of Students' Interest in Science

Dimensions	**Motivation for science**	**Enjoyment of science**	**Lack of anxiety**	**Usefulness of science**	**Self-concept of ability**	**Career interest**	**Ability to make choices**
Intellectual Stimulation	.382**	.687**	.312**	.514**	.596**	.383**	.402**
Inspirational Motivation	.310**	.698**	.367**	.551**	.572**	.364**	.336**
Idealized Influence	.333**	.659**	.336**	.506**	.530**	.368**	.342**
Individualized Consideration	.233**	.651**	.357**	.542**	.492**	.325**	.276**

**Correlation is significant at the 0.01 level (2-tailed)

Each dimension of teachers' transformational leadership practices shows significant positive correlations with the various aspects of students' interest in science, indicating a strong relationship between these variables.

Intellectual stimulation dimension, which involves encouraging students to think critically and creatively, shows a range of correlations. It has a strong correlation with enjoyment of science ($r = .687$, $p < .01$), usefulness of science ($r = .514$, $p < .01$) and self-concept of ability ($r = .596$, $p < .01$), indicating that students who perceive their teachers as intellectually stimulating tend to have higher enjoyment of science, higher perception of the usefulness of science and higher confidence in their scientific abilities. Additionally, it has moderate correlations with motivation for science ($r = .382$, $p < .01$), lack of anxiety ($r = .312$, $p < .01$), career interest ($r = .383$, $p < .01$), and ability to make choices ($r = .402$, $p < .01$). This indicates that as teachers engage students intellectually, students' motivation for science increases, with reduced anxiety towards science among students. The moderate correlation also indicates that intellectual stimulation by teachers is linked to a higher interest in science-related careers and positively affects students' ability to make informed choices related to science.

Inspirational motivation dimension, which involves inspiring and motivating students by articulating a compelling vision, shows strong positive correlations with several student interest dimensions. It has the highest correlation with enjoyment of science ($r = .698$, $p < .01$), and strong correlations with self-concept of ability ($r = .572$, $p < .01$), usefulness of science ($r = .551$, $p < .01$), and moderate correlations with motivation for science ($r = .310$, $p < .01$), lack of anxiety ($r = .367$, $p < .01$), career interest ($r = .364$, $p < .01$), and ability to make choices ($r = .336$, $p < .01$). A strong correlation of enjoyment of science ($r = .698$, $p < .01$), self-concept of ability ($r = .572$, $p < .01$) and usefulness of science ($r = .551$, $p < .01$) suggests that students' enjoyment of science, self-concept of their scientific abilities and perceiving science as more useful significantly increases when teachers provide inspirational motivation. The moderate correlation of motivation for science ($r = .310$, $p < .01$), lack of anxiety ($r = .367$, $p < .01$), career interest ($r = .364$, $p < .01$) and ability to make choices ($r = .336$, $p < .01$) indicate that inspirational motivation positively influences students' motivation for science, students' interest in science-related careers, students' decision-making abilities regarding science, and reduces students' anxiety about science.

Idealized influence dimension, which involves acting as a role model and earning students' trust and respect, also shows a range of positive correlations. The strongest correlation is with enjoyment of science ($r = .659$, $p < .01$), followed by self-concept of

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ability ($r = .530$, $p < .01$), and strong correlations with usefulness of science ($r = .506$, $p < .01$), and moderate correlations with motivation for science ($r = .333$, $p < .01$), lack of anxiety ($r = .336$, $p < .01$), career interest ($r = .368$, $p < .01$), and ability to make choices ($r = .342$, $p < .01$). A strong positive correlation of enjoyment of science ($r = .659$, $p < .01$), self-concept of ability ($r = .530$, $p < .01$) and usefulness of science ($r = .506$, $p < .01$) indicates that idealized influence greatly enhances students' enjoyment of science, students' confidence in their scientific abilities and in helping students perceive science as more useful. The moderate positive correlation of motivation for science ($r = .333$, $p < .01$), lack of anxiety ($r = .336$, $p < .01$), career interest ($r = .368$, $p < .01$), and ability to make choices ($r = .342$, $p < .01$) show that teachers' idealized influence moderately increases students' motivation for science, students' interest in science-related careers and students' ability to make choices related to science, aside from reducing anxiety about science.

Individualized consideration dimension, which involves providing personalized support and attention to students, shows significant positive correlations across all students' interest in science dimensions. It has strong correlations with enjoyment of science ($r = .651$, $p < .01$), usefulness of science ($r = .542$, $p < .01$), and moderate correlations with lack of anxiety ($r = .357$, $p < .01$), self-concept of ability ($r = .492$, $p < .01$), career interest ($r = .325$, $p < .01$), and weak correlations with motivation for science ($r = .233$, $p < .01$), and ability to make choices ($r = .276$, $p < .01$). The strong correlation of enjoyment of science ($r = .651$, $p < .01$) and usefulness of science ($r = .542$, $p < .01$) indicate that individualized consideration greatly enhances students' enjoyment of science and increases students' perception of the usefulness of science. The moderate positive correlation of lack of anxiety ($r = .357$, $p < .01$), self-concept of ability ($r = .492$, $p < .01$) and career interest ($r = .325$, $p < .01$) show that individualized consideration reduces

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students’ anxiety about science, moderately increases students' self-concept of their scientific abilities and positively influences students’ interest in science-related careers. The weak correlation of motivation for science ($r = .233, p < .01$) and ability to make choices ($r = .276, p < .01$) suggest that individualized consideration from teachers positively influence students' motivation for science as well as positively affects students’ decision-making abilities regarding science.

Overall, the results demonstrate significant positive correlations between the dimensions of teachers' transformational leadership practices and various aspects of students' interest in science, with correlation strengths ranging from weak to strong. This indicates that teachers' transformational leadership practices are positively associated with enhancing students' interest and engagement in science.

4.5.5 Research Question 5

RQ5: Is there any significant relationship between teachers’ transformational leadership practices and teachers’ teaching behaviour in Private Schools, Klang Valley, Malaysia?

As per **Table 4.31**, the findings reveal a significant and strong positive correlation ($r = .797, p < .01$) between the level of teachers' transformational leadership practices and their teaching behaviour. This implies that when science teachers demonstrate transformational leadership practices, their teaching behaviour tends to increase positively.

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Table 4.31

Pearson Correlation Matrix Between Teachers' Transformational Leadership Practices and Teachers' Teaching Behaviour

Variables		**Teachers' Teaching Behaviour**
Teachers' Transformational Leadership Practices	Pearson Correlation	.797**
	Sig. (2-tailed)	.000
	N	250

**Correlation is significant at the 0.01 level (2-tailed)

The Pearson product-moment coefficient analysis was utilized to determine the strength of the relationship between the dimensions of teachers' transformational leadership practices and teachers' teaching behaviour, as shown in **Table 4.32**. The findings reveal strong and positive relationships among these dimensions. The correlation coefficients (r) are in ascending order from intellectual stimulation ($r = .712$, $p < .01$) to individualized consideration ($r = .779$, $p < .01$). Similarly, idealized influence ($r = .725$, $p < .01$) and inspirational motivation ($r = .760$, $p < .01$) also exhibit significant and strong relationships with teachers' teaching behaviour.

Table 4.32

Correlation Analysis Between Dimension of Teachers' Transformational Leadership Practices and Teachers' Teaching Behaviour

Dimensions	**Teachers' Teaching Behaviour**
Individualized Consideration	.779**
Inspirational Motivation	.760**
Idealized Influence	.725**
Intellectual Stimulation	.712**

**Correlation is significant at the 0.01 level (2-tailed)

Universiti Malaya

In conclusion, the results of the analysis reveal a significant impact of teachers' transformational leadership practices on their teaching behaviour. Strong correlations were observed for each pair of relationships, indicating that when science teachers exhibit transformational leadership practices, it positively influences their teaching behaviour.

Pearson's product-moment correlation was then employed to explore the relationship between the four dimensions of teachers' transformational leadership practices and the seven dimensions of their teaching behaviour. The four dimensions of transformational leadership practices include idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration (Beauchamp et al., 2010). Conversely, the seven dimensions of teaching behaviour encompass clarity, enthusiasm, interaction, organization, disclosure, speech & pacing, and rapport (Hadie et al., 2019). A comprehensive correlation analysis between these dimensions is presented in **Table 4.33**.

Table 4.33

Correlation Analysis Between Dimension of Teachers' Transformational Leadership Practices and Dimension of Teachers' Teaching Behaviour

Dimensions	**Clarity**	**Enthusiasm**	**Interaction**	**Organization**	**Disclosure**	**Speech and Pacing**	**Rapport**
Intellectual Stimulation	.683**	.401**	.703**	.626**	.625**	.263**	.693**
Inspirational Motivation	.721**	.379**	.752**	.697**	.653**	.343**	.723**
Idealized Influence	.698**	.414**	.685**	.637**	.592**	.338**	.704**
Individualized Consideration	.740**	.397**	.746**	.680**	.673**	.415**	.722**

**Correlation is significant at the 0.01 level (2-tailed)

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The results indicate significant positive correlations between the dimensions of transformational leadership and teaching behaviour, demonstrating varying degrees of strength.

Clarity, a dimension of teaching behaviour that refers to how clearly teachers convey information, exhibits a strong positive correlation with all four leadership dimensions. It is most strongly correlated with individualized consideration ($r = .740$, $p < .01$), indicating that when teachers show personalized attention to their students, their clarity in teaching improves. Inspirational motivation ($r = .721$, $p < .01$), idealized influence ($r = .698$, $p < .01$), and intellectual stimulation ($r = .683$, $p < .01$) also show strong correlations with clarity, suggesting that inspirational and intellectually stimulating leadership styles enhance teachers' ability to communicate clearly.

Enthusiasm, reflecting the teachers' passion and energy in the classroom, has its highest correlation with idealized influence ($r = .414$, $p < .01$). Although the correlations with other leadership dimensions such as intellectual stimulation ($r = .401$, $p < .01$), inspirational motivation ($r = .379$, $p < .01$), and individualized consideration ($r = .397$, $p < .01$) are moderate, they are still significant, indicating that transformational leadership practices contribute to more enthusiastic teaching.

Interaction, which measures the quality of teacher-student interactions, shows strong positive correlations with individualized consideration ($r = .746$, $p < .01$) and inspirational motivation ($r = .752$, $p < .01$). This suggests that teachers who are attentive to individual student needs and who inspire their students tend to foster better interactions in the classroom. Intellectual stimulation ($r = .703$, $p < .01$) and idealized influence ($r = .685$, p

$< .01$) also significantly enhance interaction, underlining the importance of a stimulating and influential leadership approach.

Organization, referring to how well teachers plan and structure their lessons, is strongly correlated with all four leadership dimensions. The highest correlation is with inspirational motivation ($r = .697$, $p < .01$), followed by individualized consideration ($r = .680$, $p < .01$), idealized influence ($r = .637$, $p < .01$), and intellectual stimulation ($r = .626$, $p < .01$). This indicates that inspirational and intellectually engaging leadership helps teachers organize their lessons more effectively.

Disclosure, which involves teachers sharing personal experiences and information, shows a strong correlation with individualized consideration ($r = .673$, $p < .01$). Other dimensions such as inspirational motivation ($r = .653$, $p < .01$), intellectual stimulation ($r = .625$, $p < .01$), and idealized influence ($r = .592$, $p < .01$) also have significant correlations, suggesting that transformational leadership encourages teachers to be more open and sharing in the classroom.

Speech and pacing, measuring the teachers' control over the flow and delivery of their speech, has the weakest correlations overall but still significant. It is most correlated with individualized consideration ($r = .415$, $p < .01$), followed by inspirational motivation ($r = .343$, $p < .01$), idealized influence ($r = .338$, $p < .01$), and intellectual stimulation ($r = .263$, $p < .01$). This indicates that personalized attention and inspirational leadership slightly enhance teachers' speech delivery and pacing.

Finally, rapport, which measures the relationship between teachers and students, shows strong positive correlations with all four leadership dimensions. Inspirational motivation

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($r = .723$, $p < .01$) and individualized consideration ($r = .722$, $p < .01$) have the highest correlations, indicating that teachers who inspire and individually support their students build better rapport. Intellectual stimulation ($r = .693$, $p < .01$) and idealized influence ($r = .704$, $p < .01$) also significantly contribute to better rapport.

In summary, these findings reveal that transformational leadership practices are significantly related to various dimensions of teaching behaviour. Individualized consideration and inspirational motivation, in particular, are crucial for enhancing clarity, interaction, organization, and rapport in the classroom. Even aspects with weaker correlations, like speech and pacing, still benefit from transformational leadership, highlighting its overall positive impact on teaching effectiveness.

4.5.6 Research Question 6

RQ6: Is there any significant relationship between teachers' teaching behaviour and students' interest in science in Private Schools, Klang Valley, Malaysia?

Table 4.34 presents evidence of a statistically significant association between the level of teachers' teaching behaviour and students' interest in science, with a correlation coefficient of .568 ($p < .01$). The positive and strong correlation coefficient suggests that a favourable teaching behaviour exhibited by science teachers is associated with an increase in students' interest in science.

Universiti Malaya

Table 4.34

Pearson Correlation Matrix Between Teachers' Teaching Behaviour and Students' Interest in Science

Variables		**Students' Interest in Science**
Teachers' Teaching Behaviour	Pearson Correlation	.568**
	Sig. (2-tailed)	.000
	N	250

**Correlation is significant at the 0.01 level (2-tailed)

Furthermore, **Table 4.35** provides an overview of the correlations between all seven dimensions of teachers' teaching behaviour and students' interest in science. These correlations were found to be statistically significant, ranging from weak to strong in strength. The results highlight that among the seven dimensions, the rapport dimension ($r = .605$, $p < .01$) exhibited the strongest association with students' interest in science, followed by the organization dimension ($r = .548$, $p < .01$), clarity dimension ($r = .545$, $p < .01$), interaction dimension ($r = .522$, $p < .01$), and disclosure dimension ($r = .500$, $p < .01$). The enthusiasm dimension ($r = .353$, $p < .01$) and "speech & pacing" dimension ($r = .111$, $p < .01$), on the other hand, revealed significantly positive correlations at a moderate and weak strength, respectively.

Universiti Malaya

Table 4.35

Correlation Analysis Between Dimension of Teachers' Teaching Behaviour and Students' Interest in Science

Dimensions	**Students' Interest in Science**
Rapport	.605**
Organization	.548**
Clarity	.545**
Interaction	.522**
Disclosure	.500**
Enthusiasm	.353**
Speech & Pacing	.111**

**Correlation is significant at the 0.01 level (2-tailed)

In summary, based on the results presented, it can be inferred that the strength of the correlations observed indicates a significant role of teachers' teaching behaviour and its various dimensions in shaping students' interest in science. Additionally, rapport dimension, organization dimension, clarity dimension, interaction dimension, and disclosure dimension showed strong correlations while the other dimensions, namely enthusiasm dimension and "speech & pacing" dimension indicated a moderate and weak strength, respectively.

Pearson's product-moment correlation was then employed to explore the relationship between the seven dimensions of teachers' teaching behaviour and the seven dimensions of students' interest in science. The teaching behaviour dimensions included clarity, enthusiasm, interaction, organization, disclosure, speech & pacing, and rapport (Hadie et al., 2019). Conversely, the dimensions of students' interest in science encompassed motivation for science, enjoyment of science, lack of anxiety, usefulness of science, self-

Universiti Malaya

concept of ability, career interest, and ability to make choices (Hassan, 2008). **Table 4.36** presents a comprehensive correlation analysis between these dimensions.

Table 4.36

Correlation Analysis Between Dimension of Teachers' Teaching Behaviour and Dimension of Students' Interest in Science

Dimensions	**Motivation for science**	**Enjoyment of science**	**Lack of anxiety**	**Usefulness of science**	**Self-concept of ability**	**Career interest**	**Ability to make choices**
Rapport	.378**	.715**	.364**	.597**	.594**	.457**	.396**
Organization	.355**	.664**	.368**	.604**	.502**	.399**	.368**
Clarity	.305**	.697**	.355**	.606**	.570**	.385**	.312**
Interaction	.292**	.655**	.388**	.580**	.522**	.379**	.367**
Disclosure	.278**	.572**	.284**	.535**	.475**	.291**	.414**
Enthusiasm	.253**	.366**	.187**	.362**	.320**	.197**	.288**
Speech & Pacing	.033**	.420**	.553**	.421**	.218**	.268**	.081**

**Correlation is significant at the 0.01 level (2-tailed)

Rapport, which reflects the quality of the teacher-student relationship, showed a significant positive correlation with all dimensions of students' interest in science. The strongest correlations were with enjoyment of science ($r = .715$, $p < .01$), usefulness of science ($r = .597$, $p < .01$) and self-concept of ability ($r = .594$, $p < .01$). This suggests that a good rapport between teachers and students is crucial for fostering a positive attitude towards science.

Organization, or how well teachers plan and structure their lessons, had a substantial impact across multiple dimensions of students' interest in science. It demonstrated strong positive correlations with enjoyment of science ($r = .664$, $p < .01$), usefulness of science ($r = .604$, $p < .01$), and self-concept of ability ($r = .502$, $p < .01$). These findings imply that well-organized teaching not only boosts students' enthusiasm but also helps students understand the relevance of science in practical terms aside from improving students' confidence in their abilities.

The effectiveness of teachers' communication, referred to as clarity in teaching, showed a strong correlation with students' enjoyment of science ($r = .697$, $p < .01$), perceived usefulness of science ($r = .606$, $p < .01$), and their self-concept of ability ($r = .570$, $p < .01$). This suggests that when teachers communicate information clearly and concisely, it significantly enhances students' enjoyment of science, helps them recognize the practical relevance of the subject, and boosts their confidence in their own abilities.

Interaction, assessing the quality of engagement between teachers and students, demonstrated strong positive correlations with several aspects of students' interest in science. It was highly correlated with students' enjoyment of science ($r = .655$, $p < .01$), indicating that effective interactions significantly enhance students' pleasure in learning the subject. Additionally, there was a robust correlation with the perceived usefulness of science ($r = .580$, $p < .01$), suggesting that meaningful teacher-student interactions help students see the practical applications and relevance of science in real-world contexts. Furthermore, the correlation with students' self-concept of ability ($r = .522$, $p < .01$) highlights that these interactions also play a crucial role in boosting students' confidence in their scientific abilities. Thus, high-quality interactions not only make science more enjoyable and relevant but also foster a stronger sense of competence among students.

Universiti Malaya

The act of disclosure, where educators share personal anecdotes and insights, showed strong positive associations with students' attitudes towards science. Specifically, there was a significant correlation between disclosure and both students' enjoyment of science ($r = .572$, $p < .01$) and their perception of the usefulness of science ($r = .535$, $p < .01$). These findings underscore how teachers' openness and personal engagement can enhance students' overall appreciation and practical relevance of scientific knowledge.

Enthusiasm, which indicates the level of passion and energy demonstrated by teachers, exhibited moderate positive correlations with enjoyment of science ($r = .366$, $p < .01$), usefulness of science ($r = .362$, $p < .01$), and self-concept of ability ($r = .320$, $p < .01$). This suggests that when teachers display enthusiasm, students tend to experience greater enjoyment in science, perceive it as more useful, and have higher confidence in their academic abilities.

Speech & Pacing, which refers to the control over the delivery and timing of speech, had weaker but still significant correlations, particularly with enjoyment of science ($r = .420$, $p < .01$), lack of anxiety ($r = .553$, $p < .01$) and usefulness of science ($r = .421$, $p < .01$). This indicates the importance of effective communication pace in influencing emotional responses and perceived practical value in scientific contexts.

In conclusion, the results demonstrate that various dimensions of teachers' teaching behaviour significantly influence different aspects of students' interest in science. Particularly, rapport, organization, and clarity play vital roles in enhancing students' motivation, enjoyment, and understanding of science, while interaction and disclosure also positively contribute to their interest and engagement in the subject.

4.5.7 Research Question 7

RQ7: Which dimensions of teachers' transformational leadership practices are predictors of students' interest in science in Private Schools, Klang Valley, Malaysia?

Multiple regression analysis was carried out to investigate which dimensions act as a predictor on the dependent variable, students' interest in science. **Table 4.37** shows the results of stepwise multiple regression analysis for the sample size 250. There were four dimensions of teachers' transformational leadership practices; among these dimensions, intellectual stimulation dimension was the only significant predictor on students' interest in science. In addition, there was correlation between the criterion variable, students' interest in science and predictor variable, intellectual stimulation.

Table 4.37

Multiple Regression (Stepwise) between Teachers' Transformational Leadership Practices and Students' Interest in Science

Variable	**Standardized Coefficients β**	**t**	**p**
Intellectual Stimulation	.416	3.970	0.000
Idealized Influence	.127	1.134	0.258
Inspirational Motivation	.210	1.715	0.088
Individualized Consideration	-.147	-1.275	0.203

Note: R^2 = .354; Adjusted R^2 = .344; F = 33.585; p = 0.000;
Dependent variable: Students' Interest in Science

The outcome of the multiple regression analysis, as presented in **Table 4.38**, reveals that the prediction model included only one of the four predictors, which accounted for 34.1% of the variance (R^2 = .341) in students' interest in science. This predictor, as indicated by

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the standardized coefficient beta, is the intellectual stimulation dimension (β = .584, p = .000 < .05), which was found to have a significant and large effect on students' interest in science. The other three dimensions, namely inspirational motivation, idealized influence, and individualized consideration, were excluded from the regression model as their effects were not statistically significant on the criterion variable.

Therefore, the multiple regression model for this study is:

Students' Interest in Science = .584 (Intellectual Stimulation)

Furthermore, to examine the presence of multicollinearity among the variables, collinearity tolerance and variance inflation factor (VIF) were calculated. The collinearity tolerance value was found to be 1.000, which is below the threshold of 2.0 as recommended by Chua (2014), and the VIF value was also 1.000, which is below the threshold of 10.00 as suggested by Hair et al. (2010). Indicators of multicollinearity are observed when the VIF exceeds the range of 5 to 10, or when the condition indices surpass the range of 10 to 30, as noted by Kim (2019). These results indicate that there were no multicollinearity issues among the predictor variables in this study.

Table 4.38

Multiple Regression Analysis for Effects of Teachers' Transformational Leadership Practices on Students' Interest in Science

Model	**Standardized Coefficients β**	**t**	**p**	**Collinearity Diagnosis**	
				Tolerance	**VIF**
Intellectual Stimulation	.584	11.331	0.000	1.000	1.000

Note: R^2 = .341; Adjusted R^2 = .338; F = 128.403; p = 0.000;
Dependent variable: Students' Interest in Science

Universiti Malaya

The results of the ANOVA test (F-test) presented in **Table 4.39** reveal a statistically significant relationship between intellectual stimulation and students' interest in science [F (1, 248) = 128.403, p = .000] at a significance level of $p < .05$. The multiple regression analysis further indicates that the predictor variable explains 34.1% of the variance in the students' interest in science variable. This implies that the remaining 65.9% of the variance cannot be predicted by teachers' transformational leadership practices alone, as other unexamined factors may also be influencing students' interest in science.

Table 4.39

Multiple Regression Analysis (Stepwise): ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	22.500	1	22.500	128.403	.000
Residual	43.456	248	.175		
Total	65.956	249			

Note: a) Dependent Variable: Students' Interest in Science
b) Predictors: (Constant), Intellectual Stimulation

Table 4.40 provides a detailed summary of the standardized coefficients (β) derived from the multiple regression analysis, focusing on the impact of teachers' transformational leadership practices on various dimensions of students' interest in science. The table includes four dimensions of transformational leadership: Intellectual Stimulation, Inspirational Motivation, Idealized Influence, and Individualized Consideration, and their correlations with seven dimensions of students' interest in science: Motivation for Science, Enjoyment of Science, Lack of Anxiety, Usefulness of Science, Self-Concept of Ability, Career Interest, and Ability to Make Choices.

Universiti Malaya

Table 4.40

Summary of Standardized Coefficients (β) from Multiple Regression Analysis of Teachers' Transformational Leadership Practices and Dimensions of Students' Interest in Science

Dimensions	**Motivation for science**	**Enjoyment of science**	**Lack of anxiety**	**Usefulness of science**	**Self-concept of ability**	**Career interest**	**Ability to make choices**
Intellectual Stimulation	.362	.287	.034	.137	.388	.203	.381
Inspirational Motivation	.119	.306	-.229	.235	.312	.141	.101
Idealized Influence	.201	.102	-.068	.011	.052	.150	.104
Individualized Consideration	-.319	.077	-.126	.222	-.124	-.081	-.195

Dependent variable: Dimensions of Students' Interest in Science

The dimension intellectual stimulation showed a significant positive correlation with several aspects of students' interest in science. Specifically, it had a strong positive effect on students' motivation for science (β = .362), enjoyment of science (β = .287), self-concept of ability (β = .388), career interest (β = .203), and ability to make choices (β = .381). This indicates that when teachers challenge and intellectually stimulate their students, it substantially enhances their motivation, enjoyment, confidence, career interest, and decision-making ability related to science.

Inspirational motivation, another dimension of transformational leadership, also demonstrated notable positive effects, though to a slightly lesser extent. It was positively correlated with enjoyment of science (β = .306), self-concept of ability (β = .312), and

Universiti Malaya

usefulness of science (β = .235). This suggests that when teachers inspire and motivate their students, it enhances their enjoyment and perceived usefulness of science, as well as their self-confidence in their scientific abilities.

Idealized influence, which involves teachers acting as role models, had positive but relatively weaker correlations with most dimensions of students' interest. It showed a small positive correlation with motivation for science (β = .201), enjoyment of science (β = .102), career interest (β = .150) and ability to make choices (β = .104), indicating that teachers who exhibit strong moral and ethical standards can still positively influence students' motivation, enjoyment, career interest and ability to make choices in science, albeit to a lesser extent compared to other leadership dimensions.

Lastly, individualized consideration, which refers to the personalized attention teachers give to students, had a mixed impact. It had a negative correlation with motivation for science (β = -.319) and ability to make choices (β = -.195), suggesting that excessive individual attention might sometimes undermine students' intrinsic motivation and decision-making abilities. However, it had a minor positive impact on usefulness of science (β = .222) and enjoyment of science (β = .077), indicating that individualized attention might help students appreciate the practical aspects of science and modestly boost their enjoyment of science.

In summary, the analysis revealed that among the four dimensions of transformational leadership, intellectual stimulation had the most substantial positive impact across multiple dimensions of students' interest in science. inspirational motivation and idealized influence also contributed positively, though to a lesser degree, while individualized consideration had a more complex and sometimes negative relationship with students'

Universiti Malaya

interest in science. These findings underscore the importance of intellectually stimulating and inspiring teaching practices in fostering a robust interest in science among students.

4.5.8 Research Question 8

RQ8: Which dimensions of teachers' teaching behaviour are predictors of students' interest in science in Private Schools, Klang Valley, Malaysia?

Multiple regression analysis was carried out to investigate which dimensions act as a predictor on the dependent variable, students' interest in science. **Table 4.41** shows the results of stepwise multiple regression analysis for the sample size 250. There were seven dimensions of teachers' teaching behaviour; among these dimensions, clarity dimension and rapport dimension were the significant predictors on students' interest in science. In addition, there was correlation between the criterion variable, students' interest in science and predictor variables, clarity and rapport.

Table 4.41

Multiple Regression (Stepwise) between Teachers' Teaching Behaviour and Students' Interest in Science

	Standardized Coefficients		
Variable	**β**	**t**	**p**
Clarity	.198	2.245	0.026
Rapport	.385	4.466	0.000
Organization	.139	1.534	0.126
Interaction	-.001	-0.008	0.994
Disclosure	.049	0.590	0.556
Enthusiasm	.008	0.125	0.901
Speech & Pacing	-.179	-3.272	0.001

Note: R^2 = .424; Adjusted R^2 = .407; F = 25.413; p = 0.000;
Dependent variable: Students' Interest in Science

The results of the multiple regression analysis, as presented in **Table 4.42**, indicate that the prediction model included two out of the seven predictors, explaining 38.9% of the variance ($R^2 = .389$) in students' interest in science. These predictors, as indicated by the standardized coefficient beta, are clarity dimension ($\beta = .221$, $p = .003 < .05$) and rapport dimension ($\beta = .444$, $p = .000 < .05$). Further examination of the results reveals that rapport dimension had a large effect on students' interest in science, while clarity dimension showed a moderate effect. The other five dimensions - enthusiasm, interaction, organization, disclosure, and "speech & pacing" - were excluded from the regression model as their effects were not statistically significant on the criterion variable based on the research analysis.

Thus, the multiple regression model for this study is:

Students' Interest in Science = .444 (Rapport) + .221 (Clarity)

Furthermore, to assess multicollinearity among the variables, collinearity tolerance and variance inflation factor (VIF) were examined. The collinearity tolerance value was found to be .470, which is below the threshold of 2.0 (Chua, 2014), and the VIF value was 2.129, which is below the threshold of 10.00 (Hair et al., 2010). Hence, the results suggest that there were no issues of multicollinearity among the predictor variables in this study.

Universiti Malaya

Table 4.42

Multiple Regression Analysis for Effects of Teachers' Teaching Behaviour on Students' Interest in Science

Model	Standardized Coefficients β	t	p	Collinearity Diagnosis Tolerance	VIF
Clarity	.221	3.049	0.003	0.470	2.129
Rapport	.444	6.124	0.000	0.470	2.129

Note: R^2 = .389; Adjusted R^2 = .384; F = 78.773; p = 0.000;
Dependent variable: Students' Interest in Science

The results of the ANOVA test (F-test) presented in **Table 4.43** demonstrate a statistically significant relationship between clarity and rapport dimensions with students' interest in science [$F(2, 247) = 78.773$, $p = .000$] at a significance level of $p < .05$. The multiple regression analysis indicates that the combined contribution of these two predictor variables accounts for 38.9% of the variance in students' interest in science. This suggests that the remaining 61.1% of the variance cannot be predicted by teachers' teaching behaviour alone, as there may be other factors not examined in this study that could influence students' interest in science.

Table 4.43

Multiple Regression Analysis (Stepwise): ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	25.686	2	12.843	78.773	.000
Residual	40.270	247	.163		
Total	65.956	249			

Note: a) Dependent Variable: Students' Interest in Science
b) Predictors: (Constant), Rapport, Clarity

Universiti Malaya

Table 4.44 presents the summary of standardized coefficients (β) from the multiple regression analysis, examining the relationship between various dimensions of teachers' teaching behaviour and the multiple dimensions of students' interest in science. The analysis identified seven dimensions of teaching behaviour: Rapport, Organization, Clarity, Interaction, Disclosure, Enthusiasm, and Speech & Pacing. These were analysed against seven dimensions of students' interest in science: Motivation for Science, Enjoyment of Science, Lack of Anxiety, Usefulness of Science, Self-Concept of Ability, Career Interest, and Ability to Make Choices.

Table 4.44

Summary of Standardized Coefficients (β) from Multiple Regression Analysis of Teachers' Teaching Behaviour and Dimensions of Students' Interest in Science

Dimensions	**Motivation for science**	**Enjoyment of science**	**Lack of anxiety**	**Usefulness of science**	**Self-concept of ability**	**Career interest**	**Ability to make choices**
Rapport	.304	.380	-.119	.202	.378	.380	.201
Organization	.218	.148	-.135	.194	-.020	.158	.085
Clarity	.043	.286	.037	.196	.315	.061	-.019
Interaction	-.047	.035	-.123	.015	.017	.021	.082
Disclosure	-.063	-.009	.084	.070	.037	-.151	.213
Enthusiasm	.086	-.094	.063	-.032	-.040	-.062	.077
Speech & Pacing	-.223	.122	-.468	.175	-.051	.104	-.299

Dependent variable: Dimensions of Students' Interest in Science

Rapport, which reflects the quality of the teacher-student relationship, was a significant predictor across multiple dimensions of students' interest in science. It had a positive and substantial influence on students' motivation for science (β = .304), enjoyment of science (β = .380), usefulness of science (β = .202), self-concept of ability (β = .378), and career interest (β = .380). This suggests that a strong rapport between teachers and students enhances students' motivation, enjoyment, perception of usefulness, self-confidence, and career interest in science.

Organization, indicating how well teachers plan and structure their lessons, showed a notable impact on several aspects of students' interest. It had a positive effect on motivation for science (β = .218), enjoyment of science (β = .148), usefulness of science (β = .194), and career interest (β = .158). These findings imply that well-organized teaching contributes to higher levels of student engagement and interest in science.

Clarity in teaching, which involves the effectiveness of communication, was another strong predictor. It positively influenced enjoyment of science (β = .286), usefulness of science (β = .196), and self-concept of ability (β = .315). This indicates that clear and concise teaching can significantly enhance students' enjoyment, perceived usefulness, and confidence in their scientific abilities.

Interaction, which measures the quality of teacher-student engagement, had weaker but still positive correlations. It showed minor positive impacts on enjoyment of science (β = .035), career interest (β = .021), and ability to make choices (β = .082). This suggests that while interaction is important, its direct impact on these dimensions may be less pronounced compared to other behaviours.

Disclosure, reflecting teachers' sharing of personal experiences and information, had mixed results. It showed minor negative correlations with motivation for science (β = -

Universiti Malaya

.063), enjoyment of science ($\beta = -.009$), and career interest ($\beta = -.151$), suggesting that sharing personal anecdotes might not significantly enhance students' motivation, enjoyment, or career aspirations in science. However, it had positive correlations with lack of anxiety ($\beta = .084$), usefulness of science ($\beta = .070$), self-concept of ability ($\beta = .037$), and ability to make choices ($\beta = .213$). This indicates that while personal disclosures might not strongly motivate or entertain students, they can reduce anxiety, help students see the practical value of science, improve their confidence in their abilities, and enhance their decision-making skills. Teachers' personal sharing might make students feel more comfortable and relatable, thus positively impacting their self-concept and decision-making abilities related to science.

Enthusiasm, or the energy and passion teachers bring to their teaching, had varied effects on students' interest in science. It had a minor positive impact on motivation for science ($\beta = .086$), indicating that enthusiastic teaching can slightly increase students' drive to engage with science. Similarly, it positively influenced lack of anxiety ($\beta = .063$), suggesting that an enthusiastic approach can help reduce students' anxiety about the subject, and ability to make choices ($\beta = .077$), implying that students may feel more empowered to make decisions in an energetic and passionate learning environment. However, enthusiasm had a negative impact on several other dimensions: enjoyment of science ($\beta = -.094$), usefulness of science ($\beta = -.032$), self-concept of ability ($\beta = -.040$), and career interest ($\beta = -.062$). This suggests that while enthusiasm can boost motivation and reduce anxiety, it may also overwhelm some students, reducing their enjoyment and perceived relevance of science, as well as their confidence in their abilities and interest in pursuing a science-related career. It is possible that overly enthusiastic teaching might lead to a disconnect if students find it difficult to keep up with the pace or if the enthusiasm is not aligned with the students' interests and understanding.

Speech & Pacing, referring to the control over delivery and timing, had predominantly negative correlations. It negatively affected motivation for science (β = -.223), lack of anxiety (β = -.468), self-concept of ability (β = -.051), and ability to make choices (β = -.299). However, it showed minor positive effects on enjoyment of science (β = .122), usefulness of science (β = .175), and career interest (β = .104). This indicates that poor control over speech and pacing during lessons can significantly reduce students' motivation and confidence in their scientific abilities, increase their anxiety, and impair their decision-making skills. When teachers struggle with delivering content clearly and at an appropriate pace, students may find it harder to stay motivated and confident, and they may feel more anxious and less capable of making informed choices. On the other hand, some students might still find the subject enjoyable and see its usefulness, possibly due to other teaching factors that offset the negative impacts of speech and pacing issues. Additionally, the slight positive effect on career interest suggests that despite these challenges, students may still see potential career value in science, potentially influenced by other aspects of the teaching environment.

In summary, the multiple regression analysis highlights that among the seven dimensions of teachers' teaching behaviour, rapport, clarity, and organization were the most significant predictors of various aspects of students' interest in science. Effective teaching strategies that foster a strong rapport, clear communication, and well-organized lessons are crucial for enhancing students' motivation, enjoyment, and confidence in science.

Universiti Malaya

4.5.9 Research Question 9

RQ9: Which dimensions of teachers' transformational leadership practices are predictors of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?

Multiple regression analysis was carried out to investigate which dimensions act as a predictor on the dependent variable, teachers' teaching behaviour. **Table 4.45** shows the results of stepwise multiple regression analysis for the sample size 250. There were four dimensions of teachers' transformational leadership practices; among these dimensions, individualized consideration dimension, inspirational motivation dimension and intellectual stimulation dimension were the significant predictors on teachers' teaching behaviour. In addition, there was correlation between the criterion variable, teachers' teaching behaviour and predictor variables, individualized consideration, inspirational motivation and intellectual stimulation.

Table 4.45

Multiple Regression (Stepwise) between Teachers' Transformational Leadership Practices and Teachers' Teaching Behaviour

Variable	**Standardized Coefficients β**	**t**	**p**
Intellectual Stimulation	.156	2.012	0.045
Idealized Influence	.078	0.941	0.348
Inspirational Motivation	.202	2.230	0.027
Individualized Consideration	.417	4.879	0.000

Note: R^2 = .646; Adjusted R^2 = .641; F = 112.004; p = 0.000;
Dependent variable: Teachers' Teaching Behaviour

The multiple regression analysis results presented in **Table 4.46** reveal that the prediction model included three out of the four predictors, accounting for 64.5% of the variance (R^2

Universiti Malaya

= .645) in teachers' teaching behaviour. These predictors, as indicated by the standardized coefficient beta, are the individualized consideration dimension ($\beta = .449$, $p = .000 < .05$), inspirational motivation dimension ($\beta = .213$, $p = .019 < .05$), and intellectual stimulation dimension ($\beta = .188$, $p = .008 < .05$). Further examination of the results indicates that the individualized consideration dimension had a large effect on teachers' teaching behaviour, while both the inspirational motivation and intellectual stimulation dimensions showed a moderate effect. The dimension of idealized influence was excluded from the regression model as it did not show a significant effect on the criterion variable.

Therefore, the multiple regression model for this study is:

Teachers' Teaching Behaviour = .449 (Individualized Consideration) + .213 (Inspirational Motivation) + .188 (Intellectual Stimulation)

In addition, to assess multicollinearity among the variables, collinearity tolerance and variance inflation factor (VIF) were examined. The collinearity tolerance values were found to be .235 for Individualized Consideration, .178 for Inspirational Motivation, and .294 for Intellectual Stimulation. These values are all below the threshold of 2.0 (Chua, 2014). Similarly, the VIF values were 4.251 for Individualized Consideration, 5.627 for Inspirational Motivation, and 3.396 for Intellectual Stimulation, all of which are below the threshold of 10.00 (Hair et al., 2010). Thus, the results indicate that there were no issues of multicollinearity among the predictor variables in this study.

Universiti Malaya

Table 4.46

Multiple Regression Analysis for Effects of Teachers' Transformational Leadership Practices on Teachers' Teaching Behaviour

Model	Standardized Coefficients B	t	p	Collinearity Diagnosis	
				Tolerance	VIF
Individualized Consideration	.449	5.731	0.000	0.235	4.251
Inspirational Motivation	.213	2.364	0.019	0.178	5.627
Intellectual Stimulation	.188	2.680	0.008	0.294	3.396

Note: R^2 = .645; Adjusted R^2 = .641; F = 149.113; p = 0.000;
Dependent variable: Teachers' Teaching Behaviour

The results of the ANOVA test (F-test) in **Table 4.47** reveal a statistically significant relationship between the dimensions of individualized consideration, inspirational motivation, and intellectual stimulation with teachers' teaching behaviour [F (3, 246) = 149.113, p = .000] at a significance level of $p < .05$. The multiple regression analysis indicates that the combination of these three predictor variables explains 64.5% of the variance in teachers' teaching behaviour. This suggests that the remaining 35.5% of the variance cannot be predicted by teachers' transformational leadership practices alone, as other factors not examined in this study may also contribute to it.

Universiti Malaya

Table 4.47

Multiple Regression Analysis (Stepwise): ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	64.496	3	21.499	149.113	.000
Residual	35.468	246	.144		
Total	99.964	249			

Note: a) Dependent Variable: Teachers' Teaching Behaviour
b) Predictors: (Constant), Individualized Consideration, Inspirational Motivation, Intellectual Stimulation

Table 4.48 presents the standardized coefficients (β) from the multiple regression analysis, detailing the influence of four dimensions of teachers' transformational leadership practices on six dimensions of teachers' teaching behaviour. The transformational leadership dimensions include Intellectual Stimulation, Inspirational Motivation, Idealized Influence, and Individualized Consideration. The dimensions of teaching behaviour analysed are Clarity, Enthusiasm, Interaction, Organization, Disclosure, Speech and Pacing, and Rapport.

Universiti Malaya

Table 4.48

Summary of Standardized Coefficients (β) from Multiple Regression Analysis of Teachers' Transformational Leadership Practices and Dimensions of Teachers' Teaching Behaviour

Dimensions	Clarity	Enthusiasm	Interaction	Organization	Disclosure	Speech and Pacing	Rapport
Intellectual Stimulation	.160	.169	.207	.078	.251	-.184	.184
Inspirational Motivation	.169	-.051	.295	.357	.158	.014	.209
Idealized Influence	.104	.185	-.026	.059	-.116	.075	.149
Individualized Consideration	.382	.156	.351	.259	.439	.482	.273

Dependent variable: Dimensions of Teachers' Teaching Behaviour

Intellectual stimulation demonstrated significant positive correlations across multiple teaching behaviour dimensions. It had a notable impact on interaction (β = .207), disclosure (β = .251), rapport (β = .184), and enthusiasm (β = .169), indicating that teachers who intellectually stimulate their students are likely to engage more effectively, communicate personal experiences, build better relationships, and exhibit enthusiasm in their teaching. This dimension also showed moderate influence on clarity (β = .160) and organization (β = .078).

Inspirational motivation, another dimension of transformational leadership, had strong positive effects on several teaching behaviours. It significantly influenced interaction (β = .295), organization (β = .357), rapport (β = .209), and clarity (β = .169), suggesting that teachers who inspire and motivate their students tend to interact more effectively, organize their lessons better, build stronger rapport, and communicate more clearly. However, it had a slight negative impact on enthusiasm (β = -.051), indicating that while inspirational motivation enhances organizational skills, interaction quality, rapport, and clarity, it might sometimes lead to reduced enthusiasm. This negative impact could stem from the possibility that overly focusing on motivational aspects may occasionally cause teachers to overlook the emotional energy and passion needed to maintain high enthusiasm levels. This suggests that while inspiring students is crucial, it is important for teachers to balance this with maintaining their enthusiasm to keep the classroom environment lively and engaging.

Idealized influence, which involves teachers acting as role models, generally showed weaker correlations with teaching behaviours. It had minor positive effects on enthusiasm (β = .185) and rapport (β = .149), indicating a modest influence on these behaviours. This suggests that while teachers who serve as role models can slightly enhance their enthusiasm and ability to build rapport with students, the overall impact is relatively limited. Its effect on other dimensions such as clarity (β = .104), organization (β = .059), disclosure (β = -.116), interaction (β = -.026), and speech and pacing (β = .075) was minimal. This minimal impact implies that while the role-modelling aspect of transformational leadership is important, it does not significantly enhance how clearly teachers communicate, how well they organize their lessons, how much personal information they share, how they interact with students, or how effectively they manage the delivery and timing of their speech. This indicates that being a role model alone might not be sufficient to drive improvements in these specific teaching behaviours, and other dimensions of transformational leadership might play a more critical role in these areas.

Universiti Malaya

Individualized consideration, reflecting personalized attention to students, showed the most substantial positive correlations across all dimensions of teaching behaviour. It had a strong positive impact on rapport ($\beta = .273$), disclosure ($\beta = .439$), clarity ($\beta = .382$), and interaction ($\beta = .351$). This indicates that personalized attention from teachers significantly enhances their ability to build relationships, share personal experiences, communicate clearly, and engage effectively with students. By tailoring their approach to meet the individual needs of students, teachers can foster a more inclusive and supportive classroom environment, which in turn strengthens rapport and interaction. Furthermore, individualized consideration also positively influenced enthusiasm ($\beta = .156$), organization ($\beta = .259$), and speech and pacing ($\beta = .482$). This highlights its comprehensive impact on various aspects of teaching behaviour. Personalized attention helps teachers to maintain a high level of enthusiasm, as they are more attuned to the unique interests and motivations of their students. It also aids in better organization of lessons, as understanding individual student needs allows for more effective planning and structuring of classroom activities. Additionally, the significant positive effect on speech and pacing suggests that teachers who give personalized attention are better able to adjust their delivery and timing to suit the learning pace of each student, leading to a more effective and engaging learning experience overall. This comprehensive impact underscores the critical importance of individualized consideration in enhancing the quality and effectiveness of teaching behaviour.

In summary, the multiple regression analysis reveals that among the four dimensions of transformational leadership, individualized consideration had the most substantial positive effect on all aspects of teaching behaviour, followed by inspirational motivation and intellectual stimulation. idealized influence had the weakest overall impact. These findings underscore the importance of personalized attention, inspiration, and intellectual

Universiti Malaya

stimulation in enhancing various dimensions of teachers' teaching behaviour, thereby contributing to a more effective and engaging teaching environment.

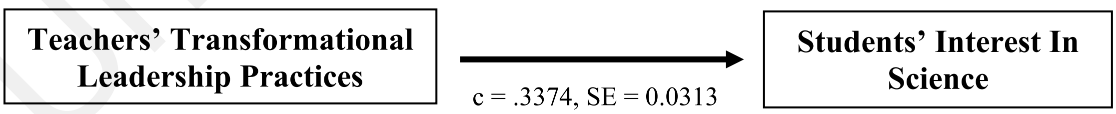
4.5.10 Research Question 10

RQ10: Does teachers' teaching behaviour mediate the relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia?

The initial mediation test focused on research question 10, examining whether teachers' teaching behaviour mediates the relationship between teachers' transformational leadership practices and students' interest in science. The results revealed that students' interest in science was regressed with teachers' transformational leadership practices, yielding a coefficient corresponding to path c as depicted in **Figure 4.1**. The unstandardized regression coefficient for this total effect was: $c = .3374$, $SE = 0.0313$, $p < .05$.

Figure 4.1

Total Effect Between (path c)



Furthermore, the analysis revealed that teachers' transformational leadership practices significantly predicted teachers' teaching behaviour (path a), with the unstandardized regression coefficient $a = .5859$, $SE = 0.0282$, $p < .05$. Additionally, teachers' teaching behaviour significantly predicted students' interest in science (path b), with $b = .2627$, $SE = 0.0686$, $p < .05$. The direct effects of teachers' transformational leadership practices on

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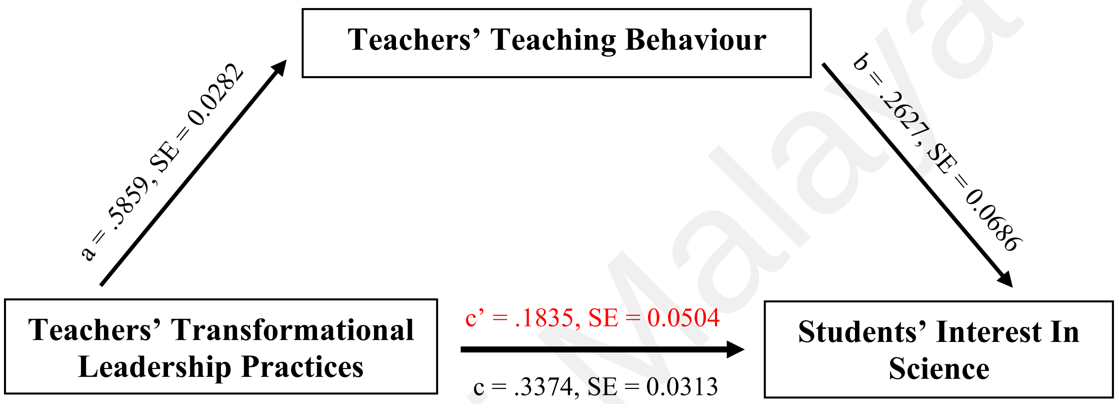
students’ interest in science through teachers’ teaching behaviour (path c') are presented in the mediation model as depicted in **Figure 4.2**.

Figure 4.2

Direct Effects of Teachers’ Transformational Leadership Practices on Students’ Interest in Science via Teachers’ Teaching Behaviour (path c’)



In the current study, mediation analyses were conducted using 5000 bootstrapped samples with bias-corrected and accelerated 95% confidence intervals. The results revealed that the indirect coefficient was significant, with (a.b) = .1539, SE = 0.0405, $p < .05$, and a 95% confidence interval of .0717 - .2371, as presented in **Table 4.49**. According to the criteria set by Hayes and Preacher (2010), a mediation is considered significant if zero does not fall within the confidence interval. Thus, in this study, the indirect effect was found to be statistically significant.

The mediating effect can be calculated as the difference between the total effect and the direct effect, denoted as c - c' = 0.3374 - 0.1835 = 0.1539. As stated by Ferguson (2009), effect size reflects the strength of the relationship between variables. In this investigation, the effect size is determined to be moderate, with a value of 0.1539 (Ferguson, 2009).

In the final step, the strength of the mediation is assessed using the Variable Accounted For (VAF) index, as explained by Hair et al. (2013). The VAF is calculated as VAF = ab/(c'+ab). In this study, the VAF for the indirect effect is determined to be 45.6%, indicating that teachers' teaching behaviour partially mediates the relationship between teachers' transformational leadership practices and students' interest in science. The results suggest that transformational leadership practices of teachers can positively impact students' interest in science through their teaching behaviour. Specifically, when science teachers exhibit high levels of transformational leadership practices, it can be predicted that students' interest in science will also be high, facilitated by the teachers' effective teaching behaviour.

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Table 4.49

Bootstrap Results of the Total, Direct, and Indirect Effects of the Mediation Analysis (N = 250; 5000 Bootstrap Samples)

Pathways	**Unstandardized coefficient**	**SE**	**P (two-tailed)**	**95% Confidence Interval**	
				CI Lower Level	**CI Upper Level**
Total effect (unmediated, path c) TTLP→ SIC	.3374	.0313	0.000	.2758	.3990
Direct effect (mediated, path c') TTLP→ SIC	.1835	.0504	0.003	.0842	.2828
Indirect effects					
TTLP→TTB (path a)	.5859	.0282	0.000	.5303	.6414
TTB→ SIC (path b)	.2627	.0686	0.002	.1276	.3978
TTLP-TTB-SIC (a*b)	. 1539	.0405	0.000	.0717	.2371

Note: TTLP: Teachers' Transformational Leadership Practices; SIC: Students' Interest in Science; TTB: Teachers' Teaching Behaviour

Universiti Malaya

4.5.11 Research Question 11

RQ11: Do the data linking with teachers' transformational leadership practices, students' interest in science and teachers' teaching behaviour collected from Private Schools, Klang Valley, Malaysia fit in the proposed model?

The current study aims to investigate the link between teachers' transformational leadership practices and students' interest in science, with teachers' teaching behaviour serving as a mediator.

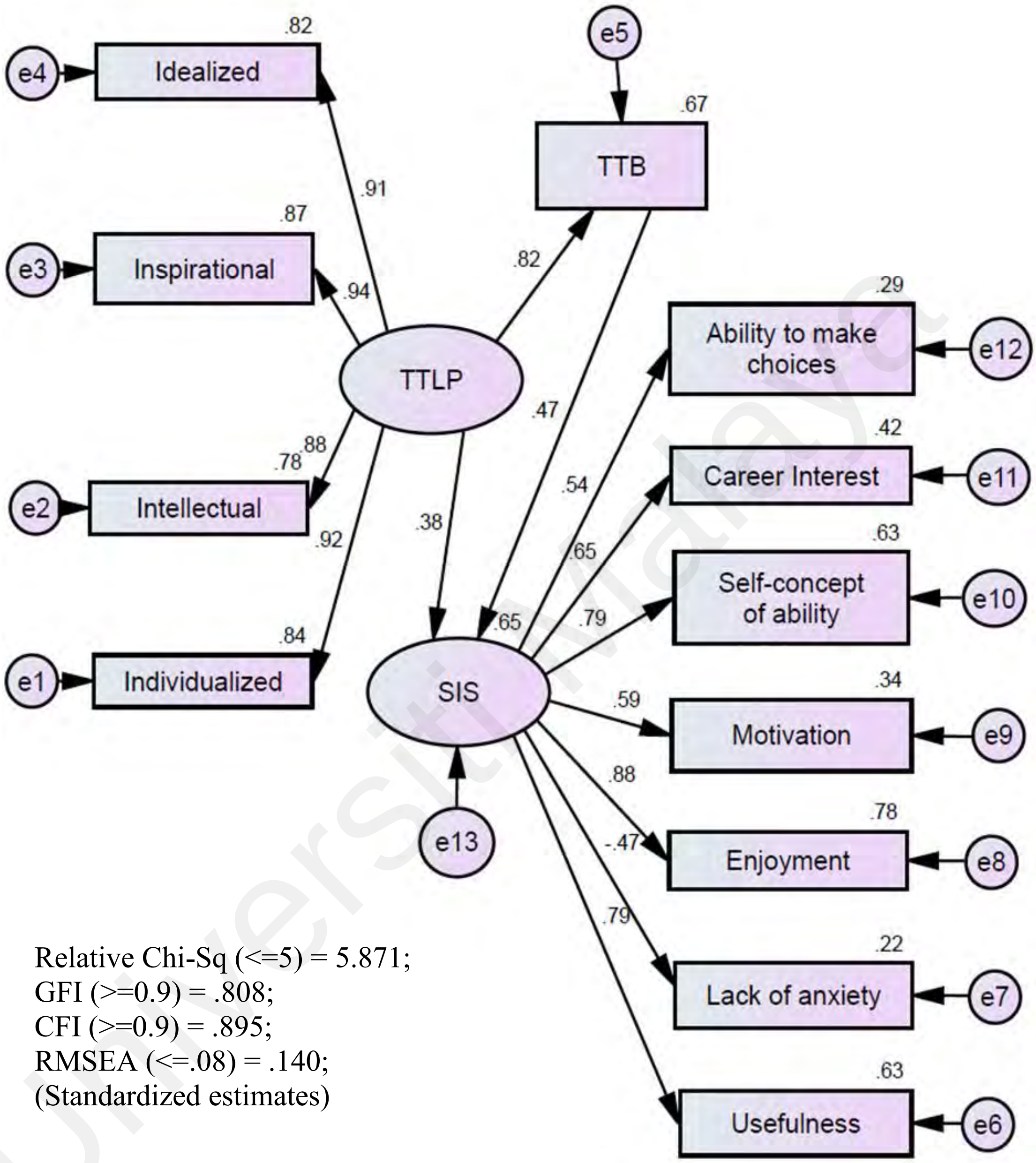
Previous mediation analysis using Process Macro for SPSS revealed that teachers' teaching behaviour partially mediates the relationship between teachers' transformational leadership practices and students' interest in science. To further explore this research question, SEM with AMOS was employed to assess the fit of the proposed model with the collected data. Model-testing was performed to determine the goodness-of-fit between the proposed model and the sample data (Byrne, 2010).

As shown in **Figure 4.3**, the four fitness indices for this study—Goodness of Fit Index (GFI), Comparative Fit Index (CFI), Root Mean Square of Error Approximation (RMSEA), and Chi Square/Degrees of Freedom—did not meet the required thresholds for an acceptable fit.

Consequently, re-specification of the model was undertaken, as recommended by Byrne (2010), to "find a model that is both substantively meaningful and statistically well fitting" (p. 8).

Figure 4.3

The Proposed Structural Model



Relative Chi-Sq (<=5) = 5.871;
GFI (>=0.9) = .808;
CFI (>=0.9) = .895;
RMSEA (<=.08) = .140;
(Standardized estimates)

Note :
TTLP = Teachers' Transformational Leadership Practices
TTB = Teachers' Teaching Behaviour
SIS = Students' Interest in Science

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Five adjustments were made to the initial structural model based on the modification indices (MI) listed in **Table 4.50**. Chua (2014) suggests that linking variables can reduce the probability of the chi-squared test's significance, thereby enhancing the alignment of the model with the collected data. The rationale for these model re-specifications is detailed in Chapter Five.

Table 4.50

Modifications Based on Modification Indices

Modification Number	Parameter	MI	Par Change
1	Usefulness of science – Lack of anxiety (e6-e7)	12.932	-.078
2	Enjoyment of science – Ability to make choices (e8-e12)	25.730	-.116
3	Motivation for science – Self-concept of ability (e9-e10)	15.566	0.096
4	Motivation for science – Career interest (e9-e11)	24.283	0.134
5	Motivation for science – Ability to make choices (e9-e12)	73.801	0.317

The revised structural model, depicted in **Figure 4.4**, shows that all fitness indices have met the required thresholds as indicated in **Table 4.51**. This outcome suggests that the revised structural model is a good fit for the data gathered from private schools in Klang Valley, Malaysia.

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Table 4.51

Model Fitness Measurement

Category	Name of fitness index	Acceptable value	Test value
Absolute fit	GFI	> .90	.907
	RMSEA	< .080	.090
Incremental fit	CFI	> .90	.961
Parsimonious fit	Chisq/df	df < 5.0	3.019

The standardized beta value for the relationship between teachers' transformational leadership practices (TTLP) and students' interest in science (SIS) is 0.41. This indicates that a one standard deviation increase in TTLP corresponds to a 0.41 standard deviation increase in SIS. The squared multiple correlation for SIS is 0.65, meaning that 65% of the variance in students' interest in science can be explained by teachers' transformational leadership practices. Conversely, this also implies that 35% of the variance in students' interest in science is due to other factors not investigated in this study.

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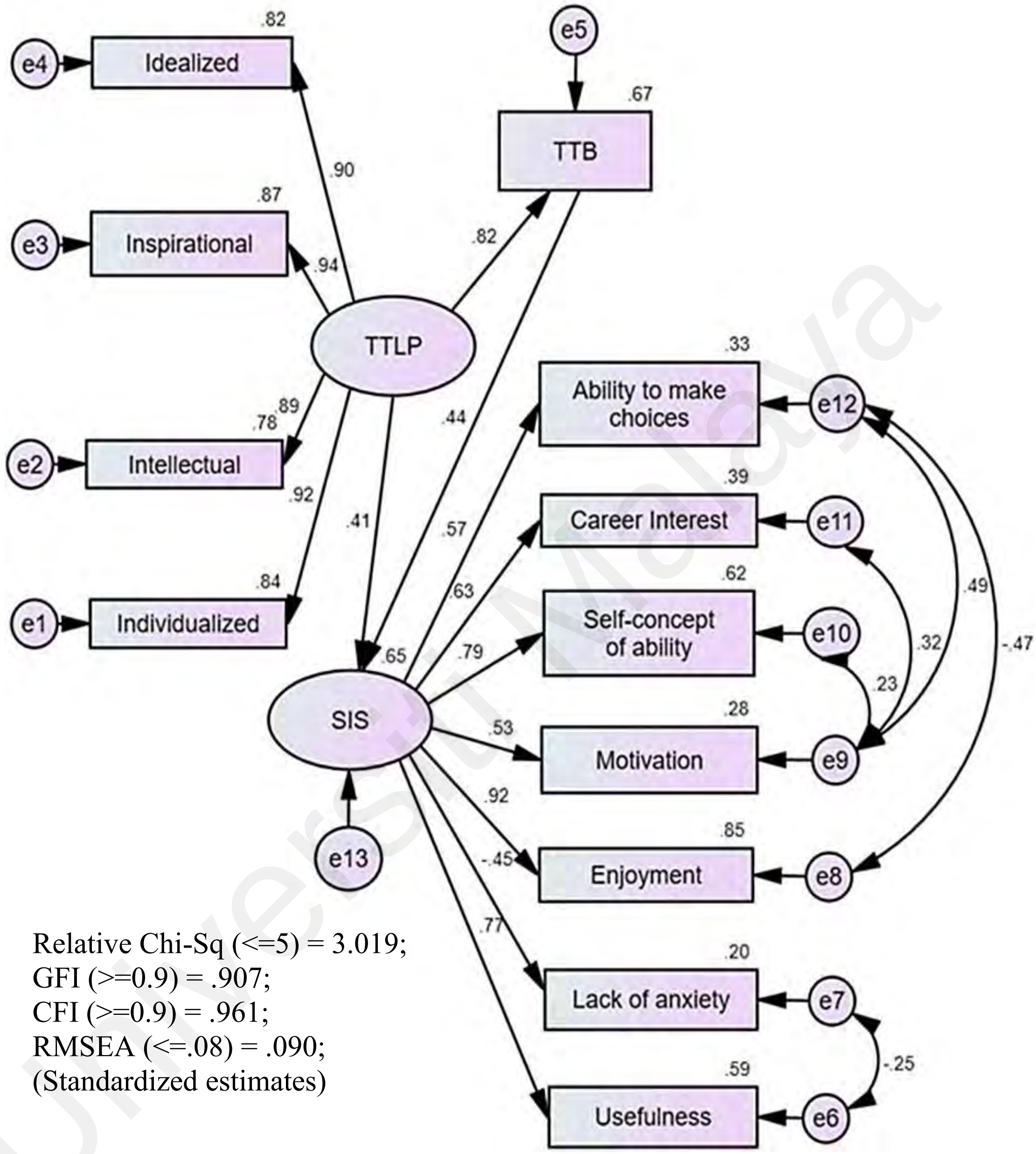
Figure 4.4

The Re-specified Structural Model



Relative Chi-Sq (<=5) = 3.019;
GFI (>=0.9) = .907;
CFI (>=0.9) = .961;
RMSEA (<=.08) = .090;
(Standardized estimates)

Note :
TTLP = Teachers' Transformational Leadership Practices
TTB = Teachers' Teaching Behaviour
SIS = Students' Interest in Science

Universiti Malaya

4.6 Summary of the Research Findings

A concise overview of the results pertaining to each of the research questions is provided in **Table 4.52**.

Table 4.52

Summary of the Research Findings

Research Questions	Findings
1. What is the level of students' interest in science as perceived by the students in Private Schools, Klang Valley, Malaysia?	Students in private schools, Klang Valley, Malaysia showed moderate level (M = 3.17, SD = 0.52) interest in science.
2. What is the level of teachers' transformational leadership practices in Private Schools, Klang Valley, Malaysia?	Teachers in private schools, Klang Valley, Malaysia showed high level (M = 3.80, SD = 0.86) of transformational leadership practices.
3. What is the level of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?	Students in private schools, Klang Valley, Malaysia highly perceived (M = 3.86, SD = 0.63) their teachers' teaching behaviour.
4. Is there any significant relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia?	There is a statistically significant positive correlation which is strong ($r = .565$, $p < .01$) between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia.
5. Is there any significant relationship between teachers' transformational leadership practices and teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?	There is a statistically significant positive correlation which is strong ($r = .797$, $p < .01$) between teachers' transformational leadership practices and teachers' teaching behaviour in

Universiti Malaya

		Private Schools, Klang Valley, Malaysia.
6.	Is there any significant relationship between teachers' teaching behaviour and students' interest in science in Private Schools, Klang Valley, Malaysia?	There is a statistically significant positive correlation which is strong ($r = .568$, $p < .01$) between teachers' teaching behaviour and students' interest in science in Private Schools, Klang Valley, Malaysia.
7.	Which dimensions of teachers' transformational leadership practices are predictors of students' interest in science in Private Schools, Klang Valley, Malaysia?	Intellectual stimulation dimension ($\beta = .584$, $p = .000 < .05$) is the teachers' transformational leadership practices dimension that is statistically significant predictor of students' interest in science in Private Schools, Klang Valley, Malaysia.
8.	Which dimensions of teachers' teaching behaviour are predictors of students' interest in science in Private Schools, Klang Valley, Malaysia?	Clarity ($\beta = .221$, $p = .003 < .05$) and rapport ($\beta = .444$, $p = .000 < .05$) are the two teachers' teaching behaviour dimensions that are statistically significant predictors of students' interest in science in Private Schools, Klang Valley, Malaysia.
9.	Which dimensions of teachers' transformational leadership practices are predictors of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia?	Individualized consideration ($\beta = .449$, $p = .000 < .05$), inspirational motivation ($\beta = .213$, $p = .019 < .05$) and intellectual stimulation ($\beta = .188$, $p = .008 < .05$) are the three teachers' transformational leadership practices dimensions that are statistically significant predictors of teachers' teaching behaviour in Private Schools, Klang Valley, Malaysia.

Universiti Malaya

10. Does teachers' teaching behaviour mediate the relationship between teachers' transformational leadership practices and students' interest in science in Private Schools, Klang Valley, Malaysia?	There is a positive and partial mediating effect of teachers' teaching behaviour on the relationship between teachers' transformational leadership practices and students' interest in science.
11. Do the data linking with teachers' transformational leadership practices, students' interest in science and teachers' teaching behaviour collected from Private Schools, Klang Valley, Malaysia fit in the proposed model?	The fitness indexes of the proposed structural model do not achieve the level of fitness required for RMSEA, GFI, CFI, and Relative Chisq/df. Thus, a re-specified structural model was established for this study.

Universiti Malaya

4.7 Summary of Chapter

This chapter provides an analysis and presentation of the findings from the investigation of eleven research questions pertaining to teachers' transformational leadership practices, teachers' teaching behaviour, and students' interest in science. It commences with the presentation of the demographic profiles of the respondents. Descriptive analysis of mean levels is employed to analyse research questions one to three. Pearson product-moment correlation analysis is applied to research questions four to six, which focus on the relationships among the variables. Subsequently, multiple regression techniques are used for the analysis of research questions seven to nine, while the PROCESS Macro for SPSS method is employed for research question ten. To evaluate the model fit, the Structural Equation Modelling (SEM) technique was applied. This involved examining the model's fitness indices. The adjusted proposed model demonstrated that all fitness indices met the required threshold values. The following chapter presents the discussions and implications of the study. Suggestions from the study by the researcher will also be presented, followed by suggestions for future research and conclusion.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Introduction

The results and conclusions from the study on teachers' transformational leadership practices, teachers' teaching behaviour, and students' interest in science in private schools in the Klang Valley, Malaysia, are summarized in this chapter. The analysis outlined in Chapter 4's findings and outcomes serve as the foundation for the discussion. An overview of the results is presented first. The implications of the study's findings are then discussed, along with suggestions from the study and suggestions for future research. Finally, a conclusion is drawn based on the results and discussions.

5.2 Summary of Findings

The objective of this research is to explore the correlation between teachers' practices of transformational leadership and students' interest in science in private schools located in Klang Valley. This investigation aims to determine the direct and indirect effects of teachers' transformational leadership practices on students' interest in science, with the mediation of teachers' teaching behaviour. Additionally, the study examines students' perceptions of their teachers' transformational leadership practices, teaching behaviour, and their own interest in science.

The conceptual framework for this study was constructed by incorporating relevant constructs from established measures, including the Transformational Teaching Questionnaire (Beauchamp et al., 2010), Student Interests and Motivation in Science Questionnaire (Hassan, 2008), and the validated 32-item Teacher Behaviour Inventory (Hadie et al., 2019). Furthermore, a comprehensive review of existing literature on the

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relationship among the three variables under investigation, namely teachers' transformational leadership practices, students' interest in science, and teachers' teaching behaviour, was conducted to further bolster the conceptual framework.

The teachers' transformational leadership practices variable is the independent variable in this study. It consists of four dimensions: (i) idealized influence, (ii) inspirational motivation, (iii) intellectual stimulation, and (iv) individualized consideration.

The next variable is the dependent variable, which is the students' interest in science. It comprises of (i) motivation for science, (ii) enjoyment of science, (iii) lack of anxiety, (iv) usefulness of science, (v) self-concept of ability, (vi) career interest, and (vii) ability to make choices.

Finally, the third variable is the teachers' teaching behaviour. Teachers' teaching behaviour is the mediating variable and has seven dimensions. These include: (i) clarity, (ii) enthusiasm, (iii) interaction, (iv) organization, (v) disclosure, (vi) speech & pacing, and (vii) rapport.

The questionnaire underwent a pilot testing phase with 40 students from a private school in Klang Valley. The results of the pilot test indicate that the questionnaire demonstrates sufficient internal consistency and can be utilized for the actual study.

This study was guided by eleven research questions, and data were collected using a quantitative approach through the Google Form application questionnaire. The analysis was conducted using SPSS software version 21, employing descriptive and inferential statistical methods including Pearson product-moment correlation coefficient, multiple

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regression, and the PROCESS Macro for SPSS to examine the mediation effect of teachers' teaching behaviour. To evaluate the model, Structural Equation Modelling (SEM) was employed.

The study's significant findings indicate that students in private schools in Klang Valley generally held moderate perceptions of their interest in science, with minimal differences observed. However, students reported high perceptions of their teachers' practice of transformational leadership and teaching behaviour. These findings are presented in tables.

The analysis using Pearson product-moment correlation revealed significant positive correlations among teachers' transformational leadership practices, students' interest in science, and teachers' teaching behaviour. Multiple regression analysis was conducted to identify the most influential predictor variable for students' interest in science. The results indicated that the intellectual stimulation dimension of teachers' transformational leadership practices was a significant predictor, explaining 34.1% of the variance (R^2 = .341) in students' interest in science. This dimension had a large effect on students' interest in science. The other three dimensions of teachers' transformational leadership practices, namely inspirational motivation, idealized influence, and individualized consideration, were not significant in the regression model and were excluded. Furthermore, tests for collinearity tolerance and variance inflation factor (VIF) revealed no multicollinearity issues among the predictor variables in the study.

Additionally, it was discovered that the dimensions of clarity and rapport were the predictors of students' interest in science, accounting for 38.9% of the variance (R^2 = .389). The clarity dimension had a moderate effect on the students' interest in science, but

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the rapport dimension had a larger effect. The other five dimensions of teachers' teaching behaviour, which are enthusiasm, interaction, organization, disclosure, and "speech & pacing" were all left out of the regression model since their effects on the criterion variable were insignificant. There were no concerns with multicollinearity amongst the predictor variables in this study, according to the results of the VIF and collinearity tolerance tests.

Next, individualized consideration dimension, inspirational motivation dimension, and intellectual stimulation dimension were discovered to be the predictors of teachers' teaching behaviour, each of which accounted for 64.5% of the variance (R^2 = .645) in teachers' teaching behaviour. While both the both inspirational motivation dimension and intellectual stimulation dimension exhibited a moderate effect, the individualized consideration dimension had a more significant impact on teachers' teaching behaviours. As the idealized influence dimension impact on the criterion variable is not substantial, the research investigation eliminated the idealized influence dimension from the regression model. The VIF test for multicollinearity and collinearity tolerance likewise showed that there were no problems with multicollinearity amongst the predictor variables in this investigation.

The results of the subsequent research demonstrated that the relationship between teachers' transformational leadership practices and students' interest in science is mediated by teachers' teaching behaviours. The analysis revealed that the indirect effect of the mediation was statistically significant using the mediation analyses based on 5000 bootstrapped samples. Further analysis used the Variable Accounted For (VAF) index to assess the mediation's strength. The findings indicated that the association between teachers' transformational leadership techniques and students' interest in science is

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partially mediated by teachers' teaching behaviours. The study found that students' interest in science in Klang Valley’s private schools is significantly influenced by teachers’ transformational leadership practices and teachers’ teaching behaviour.

Finally, the relationships between the variables were visually represented through Structural Equation Modelling (SEM), which facilitated a clearer understanding of the theory being examined. After making adjustments based on the suggestions from the Modification Indices table, the model fit indices met the required threshold values. This outcome demonstrated that the revised model accurately represents the data collected from private schools in Klang Valley, Malaysia.

5.3 Discussion

The discussions that followed revolve on the level and students’ perception of their interest in science, teachers' transformational leadership practices, and teachers' teaching behaviour in private schools, Klang Valley, Malaysia. The discussion is addressed in line with the study's research questions.

5.3.1 Level of Students’ Interest in Science as Perceived by the Students in Private Schools, Klang Valley, Malaysia

- *Research Question 1*

Based on international studies conducted in the past, it has been observed that secondary school students in several Western European countries demonstrate limited enthusiasm towards science and technology, as evidenced by research conducted by Sjøberg and Schreiner (2005) as well as the Organisation for Economic Co-operation and Development (OECD, 2007). Conversely, Griethuijsen et al. (2015) cited that in many non-European countries, especially in developing nations, there continues to be a high

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level of interest in science and technology among students. Griethuijsen et al. (2015) further reported that students in the UK, Netherlands, Turkey, Lebanon, India, and Malaysia displayed greater interest in school science, careers associated with science, and science-related extracurricular activities compared to students in Western Europe. Nevertheless, research also indicates that interest, motivation, and attitudes towards science tend to decline among lower secondary school students, as reported by Osborne et al. (2003) and Potvin & Hasni (2014).

As per the findings of this research, students enrolled in private schools in the Klang Valley region have self-reported a moderate level of interest in science, with a mean score of 3.17 and a standard deviation of 0.52. The results indicate that most students neither strongly expressed interest nor strong disinterest towards the subject. The moderate level of interest among private school students in the Klang Valley raises concerns, as research suggests that interest plays a crucial role in enhancing learners' motivation and improving the overall quality of learning outcomes (Li, 2018; Triarisanti & Purnawarman, 2019).

In a study conducted by Triarisanti & Purnawarman (2019) in Indonesia, the relationship between interest, motivation, and learning outcomes was examined among college students enrolled in the Language and Art Appreciation subject. The findings revealed that higher levels of interest and motivation were positively correlated with improved learning outcomes, as evidenced by higher final exam grades. The authors concluded that interest and motivation played a significant role in determining students' learning outcomes in the subject. Similarly, research conducted by Ernawati et al. (2022) using regression analysis also concluded that students' interest in learning and attitudes towards science subjects influenced their learning outcomes.

Universiti Malaya

A different research conducted by Hulleman & Harackiewicz (2009) delved into the factors that impacted the interest of first-year high-school students in pursuing science courses and careers in the future. The findings revealed that personal relevance, rather than just obtaining good grades, played a more significant role in predicting students' interest in further science courses and future science careers. Similarly, a study conducted by Newell et al. (2015) suggested that high-quality after-school programs that focus on science have the potential to improve students' knowledge and attitudes towards science, thereby fostering enthusiasm and academic readiness for additional science coursework. Moreover, a research conducted by Chan & Norlizah (2018) investigated the level of students' motivation towards science learning and their science achievement in ten secondary schools in Pahang, Malaysia. The findings revealed that students who exhibited moderate levels of motivation towards science learning achieved mid-low levels of achievement in their science subjects. Furthermore, the study found a significant correlation between students' motivation towards science learning and their science achievement. This finding is consistent with the research conducted by Leong et al. (2018), which also concluded that students with higher intrinsic motivation tend to perform better compared to those with lower intrinsic motivation. This trend was observed in four different countries, namely the United States, England, Malaysia, and Singapore.

Science education is pivotal in fostering critical thinking skills and cultivating a deep comprehension of scientific concepts that have practical applications in daily life (Bailin, 2002; Vieira & Tenreiro-Vieira, 2016). As such, it is imperative to identify the factors that influence students' interest in science and implement measures to enhance it. It may be worthwhile for educators to explore and implement more effective strategies aimed at

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fostering students' interest in science, with the ultimate goal of promoting engagement and motivation in this subject.

A potential determinant of students' moderate interest in science could be the pedagogical approach employed in schools. As noted by Anderhag (2015), students' interest in science can be influenced by their perceptions of the subject matter, instructional methods, and the overall learning environment. If students view science as challenging or unappealing, it may result in diminished interest in the subject. This suggests that reevaluating and refining the way science is taught, with a focus on enhancing students' perceptions and engagement, could be a crucial step in promoting greater interest and motivation towards science among students.

Hence, it is imperative for educators to foster innovative and captivating instructional methods that can effectively capture students' attention and ignite their interest in science. For instance, investigations conducted by Wang et al. (2015), Baber & Qureshi (2021), and Gunu et al. (2022) have demonstrated that the implementation of inquiry-based learning, which encourages students to ask questions and explore scientific concepts, can significantly enhance their interest in science. Furthermore, research has indicated that traditional lecture-style approaches to science instruction may result in disengagement and lack of interest among students (Teppo et al., 2021). Instead, a more interactive and hands-on approach, such as project-based learning, has been shown to foster increased interest and engagement in science among students (Sladek et al., 2011; Swarat et al., 2012; Hugerat, 2016). Thus, educators should consider adopting innovative and student-centred teaching strategies to cultivate a greater sense of curiosity and enthusiasm towards science among their students.

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Additionally, it is crucial to recognize the significant role of parents and peers in shaping students' attitudes towards science. A research study conducted in Malaysia revealed that active parental involvement and encouragement in science-related activities can have a substantial impact on their children's attitudes and interest in science (Halim et al., 2018; Yılmaz et al., 2018). Similarly, peer influence has been identified as a significant factor in shaping students' attitudes towards science, with positive interactions among peers being associated with increased interest in the subject matter (Eisenkopf, 2010; Ganotice & King, 2014). Therefore, it is important to acknowledge the combined influence of both parents and peers in fostering a positive attitude and interest in science among students. Another potential factor that may account for the moderate level of interest in science observed among students in private schools in the Klang Valley region is the limited exposure to real-world applications of science. Existing research has demonstrated that providing students with opportunities to experience real-world applications of science, such as through field trips and visits to scientific institutions, can significantly boost their interest and motivation in the subject matter (Behrendt & Franklin, 2014; Jocz et al., 2014). Hence, incorporating real-world applications of science into the curriculum and providing hands-on learning experiences may be essential in enhancing students' interest in science in this context.

Another potential aspect that could be influencing the moderate level of interest in science among students in private schools in Klang Valley is the strong emphasis on academic performance and exam outcomes within the private school environment (Opare, 1999). The pressure to excel in exams and achieve high grades may lead students to view science as merely another subject they need to study and pass, rather than a subject they can genuinely enjoy and explore. The focus on exams and grades may diminish their intrinsic motivation to engage with science as a subject of interest, and instead prioritize a

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performance-oriented mindset. Therefore, fostering a more holistic approach to science education that values curiosity, exploration, and enjoyment of the subject may be crucial in enhancing students' interest in science in this context.

The significance of generating and maintaining students' interest in science cannot be understated, particularly in the context of the Dual Language Programme (DLP) in private schools in Malaysia. This study's findings align with prior research that underscores the critical role of interest in bolstering learners' motivation and optimizing the quality of their learning outcomes (Li, 2018; Triarisanti & Purnawarman, 2019). When students are genuinely captivated by the subject matter of science, they are more inclined to be motivated to learn, proactively engage in class discussions, and take ownership of their own learning journey. This underscores the significance of nurturing and sustaining students' interest in science as a pivotal factor in ensuring the success and effectiveness of the DLP in the private school setting in Malaysia.

It is imperative to acknowledge that maintaining students' interest in science is not only crucial for their academic achievement, but also for the sustainability of the DLP in private schools in Malaysia in the long run. A decrease in students' interest in science can adversely affect their motivation to learn, resulting in disengagement, diminished academic performance, and even potential dropouts. As such, prioritizing efforts to foster and sustain students' interest in science should be a fundamental aspect of the DLP curriculum in private schools in Malaysia. This underscores the significance of proactively promoting and nurturing students' interest in science to ensure the continued viability and effectiveness of the DLP in the private school setting in Malaysia.

Universiti Malaya

In summary, the moderate level of interest in science observed among private school students in Klang Valley can be attributed to multiple factors, including teaching approaches, parental and peer influence, and limited exposure to real-world applications. To address this issue, implementing interactive and hands-on teaching methods, involving parents in science-related activities, and providing opportunities for real-world experiences can potentially boost students' interest and engagement in science. Furthermore, fostering a positive classroom environment that encourages curiosity, exploration, and inquiry-based learning can also contribute to enhancing students' interest in science. It is hoped that innovative and engaging teaching approaches by educators can capture students' attention and increase their interest in science, thus establishing a solid foundation for their future academic and professional endeavours. The research findings emphasize the significance of improving students' interest in science, as it can significantly impact their academic achievement. Given the concern about the sustainability of the DLP, strategies to enhance students' interest in science should be prioritized to ensure their motivation and engagement in the learning process, resulting in improved learning outcomes and long-term success of the DLP in private schools in Malaysia. Moreover, policymakers should consider implementing measures to promote interest in science among students in private schools in Klang Valley.

5.3.2 Level of Teachers' Transformational Leadership Practices in Private Schools, Klang Valley, Malaysia

- *Research Question 2*

The findings of the study revealed that students in private schools in Klang Valley perceived a high level of transformational leadership practiced by their science teachers, with a mean score of 3.80 (SD = 0.86). This suggests that students viewed their science teachers as being highly proficient in implementing transformational leadership practices.

Universiti Malaya

These results are promising, as existing research has consistently shown that transformational leadership has a positive impact on various aspects of student development, including engagement, motivation, and academic achievement (Leithwood & Jantzi, 2000; Bolkan & Goodboy, 2009; Zhao et al., 2021; Ko et al., 2022).

The four dimensions that encompass a teacher's transformational leadership practices are as follows: (i) Idealized Influence, which pertains to the extent to which the teacher is perceived as a role model by their students; (ii) Inspirational Motivation, which involves the ability of the teacher to inspire and motivate students towards achieving their goals; (iii) Intellectual Stimulation, which entails the ability of the teacher to challenge students to think critically and creatively; and (iv) Individualized Consideration, which refers to the degree to which the teacher is capable of providing personalized attention and support to each individual student (Beauchamp et al., 2010).

The feedback provided by students in private schools in Klang Valley regarding their science teacher's transformational leadership practices is highly positive, indicating that these teachers excel in embodying the four dimensions of transformational leadership. The mean ratings for all four dimensions, ranging from 3.65 (SD = 0.95) to 3.99 (SD = 0.91), suggest that teachers are successful in demonstrating idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. Specifically, teachers serve as effective role models (idealized influence) and are able to inspire and motivate their students (inspirational motivation). They also challenge their students to think critically and creatively (intellectual stimulation) and provide personalized attention and support to each student (individualized consideration). Notably, individualized consideration received the highest mean rating among the four

Universiti Malaya

dimensions (M = 3.99, SD = 0.91), indicating that teachers excel in providing personalized attention to their students.

A research article published in the Journal of Learning and Individual Differences revealed that the implementation of transformational leadership practices, such as inspiring and motivating students, promoting intellectual stimulation, and providing individualized consideration, were significantly correlated with positive motivational states and performance outcomes, including engagement, creativity, and task performance (Pachler et al., 2019).

An experimental study published in the International Journal of Early Childhood Special Education demonstrated that transformational leadership practices were associated with positive outcomes for students. The study involved 541 undergraduates and 3 graduate student instructors, and the results indicated that the implementation of transformational leadership practices had a beneficial impact on student outcomes (Vinu et al., 2022).

These results align with prior research on the topic of transformational leadership in the field of education. A comprehensive meta-analysis published in the Journal of Asia Pacific Education Review revealed a positive association between transformational leadership practices and various outcomes, including teacher job satisfaction, school effectiveness as perceived by teachers, and student achievement. These findings suggest that transformational leadership plays a significant role in promoting effective schools (Chin, 2007).

These results imply that the favourable evaluations provided by students in Klang Valley private schools regarding their science teachers' utilization of transformational leadership

Universiti Malaya

practices are likely to yield positive outcomes, such as improved academic achievement, motivation, and interest in science. Through their ability to inspire and motivate students, provide individualized attention, and promote intellectual stimulation, these teachers are likely to cultivate a positive learning environment and foster a sense of engagement and belonging among their students within the school community.

In sum, the findings from these studies indicate that private schools in Klang Valley are delivering high-quality science education through their competent and effective science teachers who demonstrate transformational leadership practices. As a result, students' motivation, engagement, and academic achievement are positively influenced. These teachers' ability to embody the four dimensions of transformational leadership is likely to cultivate a culture of learning and a sense of belonging within the school community among their students. Future research could explore the potential replication and scalability of these practices in diverse educational settings to benefit a wider range of students.

5.3.3 Students' Perception of Teachers' Teaching Behaviour in Private Schools, Klang Valley, Malaysia

- *Research Question 3*

The education system in Malaysia has undergone significant changes over time, with a strong emphasis on enhancing the quality of education provided to students. Private schools in the Klang Valley region have emerged as a popular choice among parents who are seeking to provide their children with a high-quality education. The present research study has revealed that students in private schools in Klang Valley have given high ratings (M = 3.86, SD = 0.63) to their science teachers' teaching methods. This finding suggests that the teaching approaches employed by science teachers in these schools are effective

Universiti Malaya

in engaging and educating their students, resulting in high levels of student satisfaction with their teachers' teaching behaviours. These findings are consistent with research conducted in other countries, such as a study by Shah (2011), which found that students who rated their teachers' teaching behaviours highly performed better academically compared to those who did not. This study also highlighted that higher levels of positive teacher behaviours were associated with higher academic achievement among students (Shah, 2011).

In a study conducted by Xu and Qi (2019), the researchers examined the potential mediating role of self-efficacy in the relationship between teacher-student relationships and academic achievement among eighth-grade students in 762 secondary schools across 104 districts and counties in mainland China's Z province. The results revealed a significant positive association between positive teacher-student relationships and higher academic achievement. These findings suggest that mathematics teachers in Chinese secondary schools are successful in establishing strong relationships with their students, which in turn contribute to improved academic performance.

Furthermore, a qualitative study conducted by Jasmi and Hin (2014) investigated the relationship between student-teacher interactions and academic motivation among students in a public boarding school in Peninsular Malaysia. The results indicated that academic motivation was positively influenced by teachers who demonstrated genuine care, provided continuous support, built trust, were approachable, and had high expectations for students' achievements. These findings suggest that the positive ratings given by students to their science teachers' teaching behaviour in private schools in the Klang Valley may be attributed to the teachers' ability to provide support and establish

Universiti Malaya

positive relationships with their students, which aligns with the findings of the Jasmi and Hin (2014) study.

As per the findings, Hadie et al. (2019) identified seven dimensions of Teachers' Teaching Behaviour, and among them, the speech & pacing dimension was rated the highest by students, with a mean value of M = 4.00 and a standard deviation of SD = 0.79. The other six dimensions - interaction, clarity, organization, disclosure, rapport, and enthusiasm - were ranked in descending order with interaction (M = 3.92, SD = 0.78), clarity (M = 3.89, SD = 0.77), organization (M = 3.88, SD = 0.79), disclosure (M = 3.87, SD = 0.80), rapport (M = 3.78, SD = 0.78), and enthusiasm (M = 3.66, SD = 0.86). All of these dimensions are crucial indicators of effective teaching behaviour. These findings highlight that students highly perceive their science teachers' teaching behaviour, with the speech & pacing dimension being particularly significant.

When it comes to Clarity, science teachers in private schools located in the Klang Valley region have been observed to employ various techniques to elucidate complex scientific concepts and principles to their students. These techniques encompass the utilization of analogies, language, phrases, and relatable experiences that resonate with today's students, aiming to enhance their understanding of intricate scientific concepts (Cherif et al., 2015). Cherif et al. (2015) concluded that the use of analogical thinking and analogy as instructional tools motivates learners, accelerates the learning process, and deepens their comprehension. Furthermore, a study conducted by Eltanahy & Forawi (2019) revealed that science teachers in a private school in Dubai utilized inquiry-based learning, which has been shown to be effective in engaging students and promoting critical thinking skills. Inquiry-based learning embodies a student-centric approach that encourages learners to actively construct new knowledge through scientific inquiry. This finding is

Universiti Malaya

consistent with Tal et al. (2006), who stated that "inquiry-based instruction and successful inquiry learning and teaching in project-based science (PBS) are effective teaching practices for urban schools." Additionally, inquiry-based teaching is considered more desirable and effective for teaching science subjects compared to traditional methods that often lead to rote memorization and lack of interest in exploring science (Ng, 2010). It is plausible that the utilization of inquiry-based learning by science teachers in private schools in the Klang Valley could contribute to the high ratings of Clarity reported by students.

In the realm of Enthusiasm, science teachers in private schools located in the Klang Valley region have been observed to employ nonverbal behaviours to capture the attention and interest of their students. These teachers were noted to utilize a variety of verbal and nonverbal cues, such as displaying high energy, enthusiasm, and passion, in order to actively engage their students and foster a positive learning environment (Mitchell, 2013). The significance of teacher enthusiasm cannot be understated, as it has been linked to positive student outcomes, including improved academic achievement, test performance, recall, on-task behaviour, attitudes toward learning, intrinsic motivation, feelings of vitality, and ratings of teacher effectiveness (Mitchell, 2013). Furthermore, Sherub Gyeltshen & Gyeltshen (2022) conducted a study that found a significant association between positive teacher-student relationships and higher academic achievement. This suggests that enthusiastic and supportive teachers are capable of creating a conducive learning environment for their students. These findings emphasize the crucial role of teacher enthusiasm in promoting positive student outcomes and highlight the importance of fostering a positive teacher-student relationship in educational settings.

Universiti Malaya

In relation to the dimension of Interaction, science teachers in private schools located in the Klang Valley region have been observed to employ diverse strategies aimed at encouraging student participation in the classroom. These strategies include facilitating group discussions and implementing collaborative learning techniques, which have been found to be effective in promoting active learning and engagement among students, as evidenced by Hardman (2016).

In relation to the dimension of Organization, science teachers in private schools located in the Klang Valley region have been observed to utilize effective techniques for structuring the subject matter of their lessons. These techniques include the use of headings and subheadings to organize lesson content, clear indication of transitions between topics, providing a preliminary overview of the lesson at the beginning of class, and reviewing previously covered topics at the start of each class to ensure that students have a solid understanding of the main concepts and objectives of the lesson, as documented by Hadie et al. (2019).

In terms of the dimension of Disclosure, science teachers in private schools situated in the Klang Valley region have been noted for their explicit communication of subject requirements and grading criteria to their students. This level of transparency is believed to contribute to the positive ratings of Disclosure provided by students. Teachers in these schools were observed to provide clear guidelines and expectations for assignments and assessments, which helped students to clearly understand what was expected of them and how their work would be evaluated, as documented by Hadie et al. (2019).

In terms of Speech & Pacing, science teachers in private schools located in the Klang Valley region have been noted for their effective use of voice characteristics and pacing

Universiti Malaya

in their instruction. These aspects of their teaching style are believed to contribute to the positive ratings of Speech & Pacing provided by students. Teachers in these schools were observed to utilize a clear and concise speaking style, along with appropriate pacing, to facilitate student comprehension and engagement with the lesson content, as documented by Hadie et al. (2019).

Lastly, in terms of Rapport, it has been observed that private school science teachers in the Klang Valley region are adept at establishing positive relationships with their students. Such positive teacher-student relationships have been shown to have a significant impact on students' academic achievement, as evidenced by research conducted by Sherub Gyeltshen & Gyeltshen (2022). These teachers were observed to employ strategies such as encouragement and praise, creating a supportive and engaging learning environment (Sun, 2021). This could explain why students in private schools in the Klang Valley region rate their science teachers highly in terms of Rapport. Taş et al. (2018) found that science teachers who provide support to students positively predict students' task value and academic self-concept in science, leading to higher levels of engagement in science. The researchers further emphasized the importance of science teachers listening to their students, treating them fairly, and assisting them in problem-solving, as these factors can serve as motivation for students to learn science and increase their engagement in the science classroom.

The favourable perception of students regarding the teaching behaviour of their science teachers in private schools located in the Klang Valley region holds paramount importance for the sustainability of the DLP. As one of the limited number of schools in Malaysia that provide DLP, particularly in the urban Klang Valley area, the presence of qualified and proficient science teachers who are adept at delivering lessons in English confers a significant advantage in attracting parents to enrol their children in private schools. The high levels of satisfaction expressed by students with respect to their science teachers' teaching behaviour may serve as a catalyst for positive word-of-mouth referrals from students and parents alike, further bolstering the reputation of private schools that offer DLP.

Moreover, proficient teaching behaviour plays a pivotal role in fostering active engagement of students in the learning process and facilitating their acquisition of essential knowledge and skills in the field of science. When students perceive their science teachers as engaging, clear in their communication, well-organized, and enthusiastic, it can significantly influence their motivation to learn, participation in the classroom, and overall academic performance. Such positive perceptions among students can, in turn, contribute to the success of the DLP by promoting student achievement and retention in private schools, thereby reinforcing the importance of effective teaching behaviour in the context of DLP implementation.

In summary, the findings of this study indicate that private school science teachers in the Klang Valley exhibit effective teaching behaviour that engages and educates their students, as evidenced by the high ratings provided by students. The utilization of diverse teaching methods, clear communication, positive teacher-student relationships, and teacher support are identified as key factors contributing to this effectiveness. These results also suggest that private schools in the Klang Valley are delivering high-quality education to their students, as reflected in the high levels of student satisfaction with their science teachers' teaching behaviour. The effective teaching methods employed by science teachers, as perceived by students, are crucial for the sustainability of the DLP in private schools in Malaysia. Having qualified and competent science teachers who can

Universiti Malaya

deliver lessons in English provides a significant advantage in attracting parents to enrol their children in private schools, particularly in the urban Klang Valley area. The positive perception of students towards their science teachers' teaching behaviour contributes to the success of the DLP by promoting student achievement and retention in private schools. These findings may have implications for policymakers and education administrators in Malaysia as they strive to enhance the quality of education in both public and private schools.

5.3.4 Relationship Between Teachers' Transformational Leadership Practices and Students' Interest in Science in Private Schools, Klang Valley, Malaysia

- *Research Question 4*

The fourth research inquiry sought to examine the potential correlation between teachers' utilization of transformational leadership practices and students' level of interest in science in private schools located in the Klang Valley. Investigating the connection between teachers' transformational leadership practices and students' interest in science is a pertinent area of study in today's fast-paced world, where science and technology play pivotal roles in driving economic growth and development. The study's results revealed a robust positive correlation between teachers' employment of transformational leadership practices and students' level of interest in science within private schools in the Klang Valley region of Malaysia. This finding holds significant implications for science teachers and administrators in private schools, underscoring the pivotal role of transformational leadership practices in fostering students' interest in science.

The results of the correlation analysis revealed a noteworthy association ($r = .565$) between teachers' implementation of transformational leadership practices and students' level of interest in science. The significance of this correlation implies that as teachers' utilization of transformational leadership practices increases, so does students' interest in science. These findings highlight the efforts made by teachers in private schools located in the Klang Valley to enhance students' interest in science, with a recognition of the need to meet school efficiency requirements and improve student achievement. The results pertaining to Research Question 2 further support these findings, indicating that students perceive their science teachers as engaging in transformational leadership practices. This aligns with prior research that has consistently shown the positive impact of transformational leadership on student motivation and engagement in learning (Leithwood & Jantzi, 2000; Bolkan & Goodboy, 2009; Zhao et al., 2021). Transformational leadership is a leadership style that emphasizes inspiration and motivation, with a focus on helping followers reach their full potential. Notably, this leadership style is known for its ability to stimulate creativity, promote innovation, encourage critical thinking, and foster teamwork among followers (Bass & Riggio, 2006). These practices have been shown to yield positive results in terms of employee motivation, job satisfaction, and productivity across various settings, including educational contexts (Leithwood & Sun, 2012). By adopting transformational leadership practices, teachers are more likely to cultivate a classroom environment that encourages students to explore their interests and develop a passion for learning.

Numerous studies have provided evidence of the positive effects of transformational leadership practices on students' academic performance and engagement (Leithwood & Jantzi, 2000; Gill et al., 2011; Balwant, 2016; Balwant et al., 2018). These findings have been observed across various fields, including science education, where teachers' utilization of transformational leadership practices can effectively motivate students to actively participate in scientific inquiry, develop a genuine curiosity for science, and recognize the relevance of science in their daily lives (Elliott & Asghar, 2014). For

Universiti Malaya

instance, a study conducted in county schools in Kirinyaga, Kenya revealed that teachers' implementation of transformational leadership practices had a positive impact on students' academic performance (Muriuki et al., 2022). Similarly, a study conducted in Laredo, Texas found that teachers' utilization of transformational leadership practices significantly predicted students' positive attitudes towards science (Miller, 2021). These findings further highlight the beneficial effects of transformational leadership practices in promoting students' academic achievement and fostering positive attitudes towards science.

One plausible rationale for the findings of this study is that teachers in private schools are motivated by the imperative to uphold high academic standards within their institutions. Given that private schools often depend on tuition fees paid by parents, maintaining a reputation for academic excellence is paramount to retain existing students and attract new enrolments (Yaacob et al., 2015). Teachers may be cognizant of this expectation and thus implementing transformational leadership practices as a means to cultivate students' interest in science, as heightened interest in science has been associated with improved academic performance.

Moreover, in the highly competitive landscape of the Klang Valley's private schools, teachers may be utilizing transformational leadership practices as a strategic approach to distinguish their schools from others and entice more student enrolments. By fostering a positive and engaging classroom atmosphere through their leadership practices, teachers can bolster students' interest in science, which can serve as a compelling criterion for parents when selecting a school for their children.

Universiti Malaya

Additionally, it is noteworthy that private schools often enjoy greater autonomy in shaping their curriculum and instructional approaches as compared to public schools. This increased flexibility may enable teachers in private schools to implement transformational leadership practices with greater effectiveness. The ability to tailor the curriculum and instructional methods to the unique needs of their students may empower teachers in private schools to create a more dynamic and student-centred learning environment, which in turn can have a positive influence on students' interest in science.

The findings of this study have practical implications for science educators in private schools. Embracing transformational leadership practices can enable teachers to establish a constructive and stimulating learning environment that fosters a genuine interest in science among students. This may entail incorporating hands-on activities, promoting student-led discussions and research, and cultivating a collaborative and inclusive classroom atmosphere (Elliott & Asghar, 2014). By adopting these practices, teachers can not only enhance students' academic performance but also equip them with the skills and mindset needed to thrive in a fast-evolving global economy.

It is noteworthy to mention that although there is a strong overall relationship between teachers' transformational leadership practices and students' interest in science, the dimension of individualized consideration within transformational leadership exhibited the least correlation ($r = .465$) with students' interest in science. This implies that while individualized consideration may have significance in transformational leadership, it may not be as pivotal in fostering students' interest in science compared to other dimensions such as intellectual stimulation, inspirational motivation, or idealized influence. However, science teachers in private schools in the Klang Valley should still take this aspect into consideration. It is important to acknowledge that this study only established

Universiti Malaya

a correlation between teachers' transformational leadership practices and students' interest in science, indicating that other factors could also contribute to students' interest in science. For instance, students' personal interests and experiences beyond the classroom may also play a role in shaping their interest in science.

In summary, the significant correlation between teachers' utilization of transformational leadership practices and students' interest in science implies that teachers in private schools in the Klang Valley are actively implementing these practices to augment students' interest in science. This may be motivated by the desire to ensure high academic achievement, student retention, and attract more parents to enrol their children in fee-paying private schools. The robust perception of students regarding their science teachers' engagement in transformational leadership further validates this finding. Employing transformational leadership practices may serve as a strategic approach for private schools to differentiate themselves and create a positive learning environment that fosters students' interest in science. The outcomes of this study underscore the significance of incorporating transformational leadership practices in fostering students' interest in science in private schools in the Klang Valley, Malaysia. It is recommended that science teachers in private schools in the Klang Valley take note of these findings and consider integrating transformational leadership practices into their pedagogical approaches to enhance student engagement and learning in science, potentially leading to improved academic outcomes in this subject area. Future research could explore the effective implementation of transformational leadership practices in science education across all private schools in Malaysia and their potential application in other educational contexts.

Universiti Malaya

5.3.5 Relationship Between Teachers' Transformational Leadership Practices and Teachers' Teaching Behaviour in Private Schools, Klang Valley, Malaysia

- *Research Question 5*

The results of this study, as perceived by students in private schools, reveal a positive and statistically significant association between teachers' utilization of transformational leadership practices and their teaching behaviour. These findings align with previous research that has demonstrated a robust connection between teachers' transformational leadership practices and teaching outcomes (Noland, 2005; Zhao et al., 2021). This study provides valuable insights into the significance of transformational leadership practices in the field of education and underscores the importance of dimensions such as individualized consideration, inspirational motivation, idealized influence, and intellectual stimulation in shaping teachers' teaching behaviour, particularly in the context of private schools in Malaysia that offer the DLP and conduct lessons in English.

The robust and significant correlation ($r = .797$) found between teachers' transformational leadership practices and their teaching behaviour underscores the critical role of transformational leadership in the field of education. The findings suggest that teachers who demonstrate the four dimensions of transformational leadership practices are more likely to inspire their students, foster creativity, and motivate them to strive for their goals. As such, adopting a transformational leadership approach can serve as a source of motivation and inspiration for teachers, leading to improved performance and positive outcomes for students.

Moreover, the most robust correlation was observed in the individualized consideration dimension of transformational leadership practices and teachers' teaching behaviour (r =

Universiti Malaya

.779), suggesting that teachers who exhibit a high level of individualized consideration are more inclined to tailor their teaching to the unique needs and learning styles of their students. This finding underscores the significance of personalized learning and underscores the importance for teachers to cultivate a supportive and inclusive learning environment that addresses the diverse needs of their students. This aligns with the results of a study by Lee et al. (2021), which proposed that teachers' consideration of task goals and students' characteristics may impact their intention to implement learner-centred pedagogy, ultimately influencing students' outcomes. Thus, the findings indirectly suggest that individualized consideration plays a crucial and positive role in students' outcomes, leading to improved teaching behaviour.

The dimensions of inspirational motivation (r = .760), idealized influence (r = .725), and intellectual stimulation (r = .712) within the framework of transformational leadership practices were also found to have a significant correlation with teachers' teaching behaviour. These findings are in line with prior research that has highlighted the importance of these dimensions in shaping teachers' attitudes, characteristics, and qualities (Button, 2003).

The results of this study imply that private schools located in the urban Klang Valley region, which provide the DLP and conduct lessons in English, may face a pressing need for competent and qualified science teachers who are proficient in English. Private schools that offer DLP are relatively scarce in Malaysia, particularly in the urban Klang Valley area (SchoolAdvisor.my., 2021), and this can be a significant advantage in attracting parents to enrol their children in private schools. Given the value of English proficiency in the global context (Suliman et al., 2020), parents may specifically seek out

Universiti Malaya

private schools that offer DLP as a means to enhance their children's English language skills and prepare them for future international opportunities.

To maintain the DLP and address the demand for qualified and competent science teachers who can effectively conduct lessons in English (Suliman et al., 2020), private schools should prioritize the development and promotion of effective transformational leadership practices among their science teachers. This will help ensure that the schools have highly qualified science teachers who are capable of delivering lessons in English and, consequently, sustain the DLP. The findings of this study also hold significant implications for schools and educational institutions aiming to improve their teaching practices. School leaders can utilize these findings to design targeted professional development programs that focus on enhancing teachers' transformational leadership skills. By equipping teachers with the necessary tools and support, schools can create a positive and conducive learning environment that fosters student achievement and success.

To summarize, the findings of this study conducted in private schools offering DLP in the urban Klang Valley area in Malaysia provide compelling evidence of a positive and significant correlation between teachers' transformational leadership practices and their teaching behaviour. The study underscores the importance of dimensions such as individualized consideration, inspirational motivation, idealized influence, and intellectual stimulation in shaping teachers' teaching practices and improving their instructional approaches. The urgent need for qualified and competent science teachers who can deliver lessons in English to sustain the DLP and attract more parents to enrol their children in private schools is evident from the study findings. As such, private schools should prioritize the development and promotion of transformational leadership practices among their science teachers to ensure the long-term sustainability of the DLP. These findings hold significant implications for educational leaders seeking to enhance teachers' teaching behaviour and improve student outcomes.

5.3.6 Relationship Between Teachers' Teaching Behaviour and Students' Interest in Science in Private Schools, Klang Valley, Malaysia

- *Research Question 6*

Science education plays a crucial role in developing a scientific mindset and knowledge in students, which are essential for their future careers and personal growth (Taking Science to School, 2007). In this context, the role of science teachers in shaping students' interest in science cannot be ignored.

The findings of this study indicate a significant and positive association between teachers' teaching behaviour and students' interest in science, with a strong correlation coefficient (r = .568). These results emphasize the crucial role of qualified and competent science teachers who can deliver lessons in English in private schools in Malaysia, particularly in the urban Klang Valley area where the availability of private schools offering DLP is limited (SchoolAdvisor.my., 2021), to ensure the sustainability of the DLP. The findings suggest that the quality of teaching provided by science teachers directly affects students' interest in the subject. These findings align with previous research conducted in other countries, which also reported a positive relationship between teachers' teaching behaviour and students' interest in science, as evidenced by studies conducted by Logan and Skamp (2013) and Teppo et al. (2021). For instance, Frommelt et al. (2021) found that teacher enthusiasm and supportive instructional practices were significant predictors of student motivation in Mathematics classrooms. Peng (2021) also reported that teacher enthusiasm played a significant role in student success and engagement in Chinese EFL

Universiti Malaya

classes. Similarly, Sasway and Kelly (2020) found that instructors played a crucial role in building students' confidence and maintaining their interest in science. Furthermore, Fricke et al. (2012) revealed that effective teaching, including the use of classroom management skills, can influence teacher-student interactions and the amount of academic learning time, which in turn impact students' individual development of interest.

This study also underscores that specific dimensions of teachers' teaching behaviour exhibit a stronger correlation with students' interest in science. Notably, the rapport dimension was found to have the highest association with students' interest in science, with a correlation coefficient of .605. This finding is consistent with previous research that highlights the significance of teacher-student relationships in influencing academic outcomes, as demonstrated by studies conducted by Xu and Qi (2019) and Sherub Gyeltshen and Gyeltshen (2022). When teachers establish a positive rapport with their students, they create an environment conducive to learning, where students feel valued, respected, and free to express their ideas and opinions related to science. Such a positive teacher-student relationship fosters student interest and engagement in the subject, promoting a sense of ownership and investment in their learning journey.

The dimensions of organization ($r = .548$) and clarity ($r = .545$) were also found to be strongly correlated with students' interest in science. These dimensions pertain to the structure and delivery of teaching materials, which play a crucial role in creating a clear and comprehensible learning experience for students (Hadie et al., 2019). This finding aligns with previous research that underscores the importance of clear and organized instruction in fostering students' interest and academic achievement, as highlighted by Adeyemo (2012). When teachers are able to effectively communicate and present the subject matter in a clear and organized manner, students are more likely to develop a

Universiti Malaya

positive attitude towards science and be motivated to learn further. This underscores the significance of well-structured and organized lessons, accompanied by clear explanations and instructions, in fostering students' interest and comprehension of science concepts.

The dimensions of interaction ($r = .522$) and disclosure ($r = .500$) were also found to have a positive association with students' interest in science, albeit to a lesser extent compared to the previously mentioned dimensions. These dimensions pertain to the ability of teachers to engage and communicate with their students, demonstrating care, respect, and understanding, as well as their willingness to share personal experiences and perspectives (Hadie et al., 2019). Previous research has indicated that such teacher-student interactions can foster positive attitudes towards science, as shown by studies conducted by Telli et al. (2010) and Smart (2014). This suggests that teachers who actively engage students in discussions, encourage questions, and share relevant personal experiences or examples can contribute to fostering students' interest in science. These dimensions underscore the significance of creating opportunities for students to actively participate and interact in the learning process, which can enhance their interest and motivation in science.

It is important to highlight that the enthusiasm dimension, while positively correlated with students' interest in science ($r = .353$), displayed a moderate level of correlation. This suggests that while a teacher's enthusiasm can be infectious and motivational, it may not be the most influential factor in promoting students' interest in science. However, it underscores the significance of teachers' passion and enthusiasm for the subject in creating an engaging and motivating learning environment. On the other hand, the "speech & pacing" dimension exhibited a weak correlation with students' interest in science ($r = .111$). This finding implies that teachers' speech patterns and pace of delivery may not have a significant impact on their students' interest in science. Nonetheless, it is

Universiti Malaya

still important for teachers to be mindful of their communication style and pace to ensure that students can effectively follow the lessons.

The results of this research highlight the urgent requirement for proficient and skilled science teachers who are capable of delivering lessons in English in private schools in Malaysia, as noted by Suliman et al. (2020). Private schools that offer DLP, particularly in the urban Klang Valley region, can capitalize on the robust link between teachers' teaching behaviour and students' interest in science to attract more parents to enrol their children in private schools. When parents perceive that the quality of science education is exceptional and fosters a genuine interest in the subject, they are more inclined to opt for private schools with DLP for their children's educational needs. This underscores the importance of high-quality science instruction and its potential impact on parents' decision-making in choosing private schools (Yaacob et al., 2015).

In summary, the results of this study underscore the critical role of proficient and skilled science teachers who are capable of delivering lessons in English in private schools in Malaysia, in order to ensure the sustainability of DLP and promote students' interest in science. The study provides compelling evidence that teachers' teaching behaviour significantly influences students' interest in science. Specifically, the dimensions of teachers' rapport, organization, clarity, interaction, and disclosure are identified as crucial factors in fostering students' interest in science. These findings can serve as a guide for science teachers in adopting effective teaching strategies that can enhance their students' interest in the subject. Moreover, private schools offering DLP in the urban Klang Valley area can leverage these findings to attract more parents to enroll their children. The implications of these findings extend beyond private schools in Klang Valley, Malaysia,

Universiti Malaya

and may have relevance in other educational contexts as well, indicating the broader significance of this research for the teaching and learning of science.

5.3.7 Influence of Teachers' Transformational Leadership Practices on Students' Interest in Science in Private Schools, Klang Valley, Malaysia

- *Research Question 7*

The statistical analysis utilizing the Pearson product-moment correlation coefficient demonstrated noteworthy and moderate correlations between the four dimensions of teachers' transformational leadership practices and students' interest in science. Subsequent stepwise multiple regression analysis revealed that out of the four dimensions, only intellectual stimulation exhibited a significant and positive influence on students' interest in science in private schools located in the Klang Valley, explaining 34.1% of the variance. These findings highlight the importance of teachers' ability to intellectually stimulate students in promoting their interest in science in this specific educational setting.

These findings align with prior research that has emphasized the significance of intellectual stimulation in transformational leadership. Bolkan et al. (2011) highlighted that "communicating intellectual stimulation transforms the nature of the classroom by fostering student motivation and influencing their approaches to studying." Similarly, Beauchamp et al. (2010) defined intellectual stimulation as encouraging individuals to view issues from multiple perspectives and critically question commonly held assumptions, which can stimulate creativity, innovation, and a willingness to challenge established norms among followers.

Universiti Malaya

Moreover, a research conducted by Bolkan (2015) revealed that intellectual stimulation had a positive impact on students' intrinsic motivation, and this effect was mediated by affective learning and student engagement. The author proposed that when teachers employ intellectual stimulation, it can enhance affective learning and student engagement, ultimately resulting in higher levels of intrinsic motivation among students.

In the realm of science education, the dimension of intellectual stimulation in transformational leadership holds immense potential. By urging students to challenge assumptions and approach scientific problems from diverse perspectives, teachers can facilitate a deeper comprehension of scientific concepts and ignite students' curiosity about science. Intellectual stimulation entails fostering critical thinking, problem-solving, and creative skills among students. Teachers who create a classroom environment that promotes intellectual stimulation, where students are encouraged to question, analyse, and apply their knowledge to real-world scenarios, can significantly impact students' interest in science. When students are actively engaged in higher-order cognitive processes and are encouraged to explore and discover, they are more likely to cultivate a profound sense of curiosity and passion for science.

This finding further underscores the significance of prioritizing the development of critical thinking and problem-solving skills within science classrooms in private schools in the Klang Valley. Teachers who incorporate inquiry-based learning, hands-on activities, and open-ended questions into their lessons can create a dynamic learning environment that encourages students to engage in critical thinking, analyse information, and generate their own ideas. Such an approach can result in increased interest in science. The findings of this study are in line with current educational research and literature that emphasize the importance of promoting critical thinking skills in science education.

Universiti Malaya

Science is a subject that demands students to think critically, analyse evidence, and apply scientific principles to real-world situations. When students are provided with opportunities to actively engage in higher-order thinking skills through intellectually stimulating activities, they are more likely to develop a deeper understanding and appreciation for science.

In the context of DLP implementation in private schools in the Klang Valley, the favourable impact of intellectual stimulation on students' interest in science is particularly noteworthy. DLP, which aims to develop bilingualism and biliteracy in students through instruction in both English and the local language, can benefit from the incorporation of intellectual stimulation in the English medium of instruction. This approach not only enhances students' language proficiency but also nurtures their interest in science. English is widely recognized as the language of science, and proficiency in English is crucial for students to access and comprehend scientific information, as well as to communicate effectively in the global scientific community. By incorporating intellectual stimulation strategies in the English medium of instruction, DLP educators can optimize students' language skills while simultaneously promoting their curiosity and interest in science.

Additionally, the results of this study indicate that private schools in the Klang Valley that offer DLP can capitalize on the positive impact of intellectual stimulation on students' interest in science as a unique selling proposition. Parents who are seeking top-quality education for their children may be drawn to private schools that prioritize critical thinking, problem-solving, and creative skills in their science curriculum. The emphasis on intellectual stimulation in science classrooms can serve as an indication to parents that their children will receive a comprehensive education that not only focuses on language proficiency but also nurtures their curiosity and competency in science. This can be a

Universiti Malaya

significant advantage in the competitive landscape of private schools in the Klang Valley, where parents are seeking holistic educational opportunities for their children.

In summary, the results of this study underscore the significant and positive impact of intellectual stimulation on students' interest in science within private schools in the Klang Valley that offer DLP. Educators who cultivate an intellectually stimulating classroom environment by prioritizing critical thinking, problem-solving, and creative skills can effectively foster students' curiosity and engagement in science. Private schools in the Klang Valley that offer DLP can leverage this positive influence of intellectual stimulation as a unique selling proposition to attract parents who are seeking a high-quality education that nurtures their children's interest and competency in science, while also promoting language proficiency. Teachers and school leaders can strategically utilize intellectual stimulation to encourage students to think critically, challenge assumptions, and consider diverse perspectives, thereby promoting a heightened interest in science among students.

5.3.8 Influence of Teachers' Teaching Behaviour on Students' Interest in Science in Private Schools, Klang Valley, Malaysia

- *Research Question 8*

The results of the Pearson product-moment correlation coefficient analysis revealed a statistically significant positive correlation between all seven dimensions of teachers' teaching behaviour and students' interest in science.

The findings of the stepwise multiple regression analysis revealed that out of the seven dimensions of teachers' teaching behaviour, namely clarity and rapport, had a statistically significant positive impact on students' interest in science in private schools in Klang

Universiti Malaya

Valley. These two dimensions, which encompass methods used to explain or clarify concepts and principles, as well as the quality of interpersonal relations between teachers and students, explained 38.9% of the variance in students' interest in science (Hadie et al., 2019).

The results of this study align with previous research, indicating that both clarity and rapport dimensions of teachers' teaching behaviour have a positive influence on students' interest in science. For example, Bolkan (2016) found that clear instruction can facilitate deep processing of classroom information, leading to improved student learning. The author suggested that clear explanations reduce students' extraneous cognitive load, which can help reduce anxiety and confusion and ultimately foster greater interest in science. When teachers use clear and effective explanations, students are more likely to understand and engage with the subject matter. Teachers who present information in a clear and organized manner, use appropriate language and explanations, and provide relatable examples and illustrations can facilitate students' understanding of science concepts, which in turn can nurture their interest in the subject. When students have a clear understanding of the content being taught, they are more likely to engage with the material and develop a deeper interest in science.

Similarly, Taş et al. (2018) found that teacher-student rapport positively influenced students' engagement in science. The authors reported that science teacher support positively predicted students' task value and academic self-concept in science, which can increase students' engagement in science. Teachers who establish a positive and supportive relationship with their students, show genuine care and concern, and create a classroom environment that is conducive to learning can significantly impact students' interest in science. When students feel comfortable, respected, and valued in the

Universiti Malaya

classroom, they are more likely to be motivated and engaged in the learning process, including developing an interest in science. Moreover, the finding that rapport had a large effect on students' interest in science, while clarity had a moderate effect, suggests that the quality of interpersonal relationships between teachers and students may be particularly important in fostering students' interest in science.

The results of this study underscore the significance of teachers' ability to communicate science concepts clearly and establish positive rapport with students in promoting their interest in science within the context of DLP in private schools in Klang Valley. As DLP involves instruction in both English and the local language, teachers who are proficient in communicating science concepts clearly and effectively in English, while also building positive rapport with students in both languages, can play a crucial role in fostering students' interest in science. Clear communication in English can enhance students' language proficiency, while positive rapport can create a supportive classroom environment that encourages active participation in science lessons, and fosters a sense of ownership and enthusiasm for the subject among students.

The findings of this study also indicate that private schools in Klang Valley that offer DLP can consider prioritizing the enhancement of teachers' clarity and rapport skills through targeted professional development programs. By providing teachers with training and support to improve their communication skills, both in English and the local language, as well as fostering positive relationships with students, schools can enhance the effectiveness of their teachers in promoting students' interest in science. This can be achieved through various strategies, such as organizing professional development workshops, implementing mentoring programs, and providing ongoing feedback and

Universiti Malaya

support from school leaders, to empower teachers with the necessary skills and knowledge to effectively engage students and cultivate their interest in science.

In addition, private schools in Klang Valley may explore the possibility of integrating mechanisms to evaluate and monitor teachers' proficiency in clarity and rapport as part of their performance assessment procedures. Acknowledging and acknowledging educators who exhibit exemplary levels of clarity and rapport in their teaching can serve as an incentive for other teachers to prioritize these crucial aspects of instructional practices. By incorporating measures to recognize and reward teachers who excel in these areas, schools can encourage a culture of prioritizing clarity and rapport, thereby promoting students' interest in science and enhancing overall instructional quality.

In summary, the findings of this study highlight the crucial role of teachers' clarity and rapport in shaping students' interest in science, which is vital for the success of DLP in private schools. To ensure effective promotion of students' interest in science, private schools in Klang Valley can prioritize the enhancement of teachers' clarity and rapport skills through professional development programs and performance evaluation measures. By providing clear instruction and fostering positive relationships with students, teachers can create a supportive and motivational learning environment that promotes students' interest in science. These efforts can contribute to the overall improvement of science education in DLP classrooms and sustain the success of DLP in private schools.

Universiti Malaya

5.3.9 Influence of Teachers' Transformational Leadership Practices on Teachers' Teaching Behaviour in Private Schools, Klang Valley, Malaysia

- *Research Question 9*

The analysis using the Pearson product-moment correlation coefficient revealed a statistically significant positive correlation between all four dimensions of teachers' transformational leadership practices and their teaching behaviour.

The results of the stepwise multiple regression analysis are noteworthy as they provide insights into the impact of teachers' transformational leadership practices on their teaching behaviour in private schools located in the Klang Valley. The analysis reveals that three out of the four dimensions of teachers' transformational leadership practices, namely individualized consideration, inspirational motivation, and intellectual stimulation, have a significant positive influence on teachers' teaching behaviour. These three predictors collectively explain a substantial 64.5% of the variance in teachers' teaching behaviour, indicating the importance of transformational leadership in shaping teachers' instructional practices.

The findings of this study reveal that individualized consideration, which involves recognizing and addressing the personal and psychological needs of students, has the most significant impact on teachers' teaching behaviour. This result is in line with previous research that suggests leaders who show concern and care towards their followers can influence their behaviour, as demonstrated by Beauchamp et al. (2010). These findings are also consistent with prior studies that highlight the positive impact of transformational leadership practices on work outcomes of employees, with individualized consideration being a crucial aspect of transformational leadership (Bass & Riggio, 2006; Beauchamp et al., 2010). The results provide further support to the idea that when teachers exhibit

Universiti Malaya

leadership practices that prioritize care, concern, and support, they are more likely to be motivated to engage in instructional practices that enhance student learning.

Furthermore, the results of this study indicate that the dimensions of inspirational motivation and intellectual stimulation have a moderate effect on teachers' teaching behaviour. This implies that when leaders are able to inspire and energize their followers, motivating them to achieve their goals, and encouraging them to challenge existing assumptions, it has a positive impact on their teaching behaviour. These findings align with previous research that suggests transformational leaders who possess the ability to inspire and stimulate their followers can enhance their job performance, as supported by Beauchamp et al. (2010).

The results of this study underscore the crucial role played by teachers' transformational leadership practices in shaping their teaching behaviour within the context of DLP in private schools in Malaysia, specifically in the urban Klang Valley region. One of the key implications of these findings is the urgent demand for highly qualified and proficient science teachers who are capable of delivering lessons in English in private schools that offer DLP in Malaysia. DLP requires teachers to effectively deliver lessons in both English and the local language, and those who possess strong transformational leadership practices, particularly in the dimensions of individualized consideration, inspirational motivation, and intellectual stimulation, are more likely to successfully implement DLP in their classrooms.

Additionally, private schools that offer DLP in Malaysia, specifically in the urban Klang Valley region, can capitalize on the distinctive nature of their DLP offering as a significant competitive advantage in attracting more parents to enrol their children in

Universiti Malaya

private schools. DLP is a relatively rare and valuable educational program in Malaysia (SchoolAdvisor.my., 2021), and parents who prioritize English language proficiency and bilingual education may view private schools offering DLP as an appealing option for their children's education. Therefore, it is imperative for private schools to ensure that they have a pool of well-qualified and competent science teachers who possess robust transformational leadership practices to effectively implement DLP and meet the expectations of parents who choose to enrol their children in DLP classrooms.

Furthermore, the findings of this study carry significant implications for educational leaders and policymakers in private schools situated in the Klang Valley region. Educational leaders need to acknowledge the crucial role of transformational leadership practices in improving teachers' teaching behaviour and ultimately impacting student outcomes. It is imperative to provide teachers with adequate training to cultivate and implement transformational leadership practices that prioritize individualized consideration, inspirational motivation, and intellectual stimulation. This training should be seamlessly integrated into leadership development programs for leaders in private schools, emphasizing the importance of equipping educators with the necessary skills and knowledge to effectively implement transformational leadership practices in their schools.

In general, the results of this study underscore the significance of teachers' adoption of transformational leadership practices in shaping their teaching behaviour. Teachers who demonstrate individualized consideration, inspirational motivation, and intellectual stimulation are more likely to exhibit positive teaching behaviour and excel in their job performance. These findings can serve as valuable input for the design and implementation of leadership training programs that prioritize the cultivation of

Universiti Malaya

transformational leadership practices to enhance teachers' teaching behaviour, with the ultimate goal of improving the quality of teaching and learning in schools and enhancing student outcomes. It is crucial for private schools offering DLP in Malaysia to prioritize the development of highly qualified and competent science teachers who possess strong transformational leadership practices to ensure the sustainability and success of the DLP.

5.3.10 Role of Teachers' Teaching Behaviour as a Mediator on the Relationship Between Teachers' Transformational Leadership Practices and Students' Interest in Science in Private Schools, Klang Valley, Malaysia

- *Research Question 10*

The literature widely acknowledges the crucial role of teachers in cultivating students' interest in science. In this study, it was observed that there were significant correlations between teachers' transformational leadership practices, teachers' teaching behaviour, and students' interest in science, meeting the prerequisites for conducting a mediation analysis. To further explore the potential mediating effect of teachers' teaching behaviour on the relationship between their transformational leadership practices and students' interest in science, a mediation analysis was performed using the PROCESS Macro for SPSS. The results revealed that teachers' transformational leadership practices were significant predictors of both students' interest in science and teachers' teaching behaviour. However, the presence of a mediating variable resulted in a reduction of the direct effect, indicating partial mediation. The mediation analysis demonstrated that teachers' teaching behaviour partially mediated the relationship between their transformational leadership practices and students' interest in science, with a moderate effect size of .1539. This suggests that teachers' transformational leadership practices enhance students' interest in science in private schools in Klang Valley through the mediating role of teachers' teaching behaviour.

Universiti Malaya

Transformational leadership is characterized by leaders who possess the remarkable ability to inspire and motivate their followers towards a shared vision, while also challenging them to think critically and providing intellectual stimulation. The findings of this study underscore the pivotal role of teachers' transformational leadership practices in influencing the level of students' interest in science. These results corroborate earlier research that has shown the positive impact of transformational leadership on students' interest in science, as well as their overall learning and motivation (Elliott & Asghar, 2014; Noland & Richards, 2014; Kim et al., 2017). Notably, teachers' transformational leadership practices are instrumental in shaping students' attitudes towards science, fostering curiosity, and motivating them to learn. The significance of teachers' transformational leadership practices in influencing students' interest in science is unmistakable. Effective transformational leaders understand the importance of recognizing and addressing the unique needs, strengths, and interests of individual students. They also set clear goals and expectations, and consistently challenge students to think critically and creatively. By creating a positive and engaging learning environment through their transformational leadership practices, teachers can cultivate students' interest in science. The results of the present study further reinforce this notion, demonstrating that practicing transformational leadership in private schools in Klang Valley enhances students' interest in science. Such enhanced interest in science can ultimately lead to improved student outcomes.

Research has revealed that teachers' teaching behaviour plays a crucial role in predicting students' interest in science. Specifically, teachers who exhibit enthusiasm, engagement, and utilize hands-on activities in their teaching methods have been identified as effective in fostering students' interest in science (Teppo et al., 2021).

Universiti Malaya

The findings of the current study indicate that teachers' transformational leadership practices have a significant impact on both students' interest in science and their teaching behaviour. Furthermore, this study highlights the crucial role of teachers' teaching behaviour as a mediator between their transformational leadership practices and students' interest in science. Teachers' teaching behaviour encompasses various classroom practices, such as utilizing interactive teaching methods, providing feedback, and encouraging student participation (Hadie et al., 2019). The results suggest that teachers who demonstrate transformational leadership practices are more likely to adopt effective teaching behaviours, which in turn positively influence students' interest in science. These findings align with previous research that has shown a positive association between effective teaching behaviours and students' interest in learning (Ukobizaba et al., 2020), as well as academic engagement (Inda-Caro et al., 2019). Additionally, the results of the present study reveal that teachers' teaching behaviour plays a crucial role in mediating the relationship between their transformational leadership practices and students' interest in science. This implies that teachers' transformational leadership practices have a direct influence on students' interest in science, and their teaching behaviour serves as a facilitator of this relationship. Therefore, it is imperative for teachers in private schools in Klang Valley to prioritize and maintain effective teaching behaviours in order to enhance students' interest in science based on the findings of this study.

The findings of this study have important implications for addressing the urgent need for highly qualified and competent science teachers who are capable of conducting lessons in English within private schools in Malaysia, in order to ensure the sustainability of the DLP. Teachers who exhibit strong transformational leadership practices are more likely to demonstrate effective teaching behaviours that can positively impact students' interest in science. Given that private schools in the Klang Valley area are striving to attract more parents to enrol their children in the DLP, having qualified and competent science teachers who possess strong transformational leadership practices can offer a significant advantage. These teachers have the ability to create a positive and engaging learning environment, inspire and motivate students, and effectively implement the DLP, resulting in enhanced student interest in science and overall program sustainability.

The findings of the current study hold significant implications for educational leaders and policymakers alike. The results suggest that placing emphasis on incorporating transformational leadership practices in the training and professional development of teachers would be beneficial. Additionally, the study underscores the importance of teachers' teaching behaviour in positively influencing students' interest in science. As a result, it is recommended that teachers receive training in adopting engaging and stimulating teaching methods aimed at enhancing students' interest in science. By doing so, teachers can create a dynamic and stimulating learning environment that fosters students' curiosity and motivation towards science.

In summary, this study provides compelling evidence that both teachers' transformational leadership practices and teaching behaviour are critical factors in fostering students' interest in science. The results underscore the importance of nurturing transformational leadership practices among teachers and promoting effective teaching techniques that can boost students' motivation and engagement in science. This highlights the need for qualified and competent science teachers who can deliver lessons in English in private schools in Malaysia, particularly in the urban Klang Valley area where private schools offering DLP can gain a competitive edge in attracting parents' enrolment. Therefore, it is imperative for private schools to prioritize the development and support of teachers'

Universiti Malaya

transformational leadership practices and effective teaching behaviours as crucial elements in enhancing students' interest in science and overall program success. The findings of this study carry significant implications for teacher training and professional development programs aimed at improving science education in private schools in the Klang Valley region of Malaysia.

5.3.11 The Fitness of the Model Linking with Teachers' Transformational Leadership Practices, Students' Interest in Science, and Teachers' Teaching Behaviour Applicable to the Private Schools

- *Research Question 11*

In the proposed conceptual model of the present study, teachers' transformational leadership practices are the exogenous variable, students' interest in science is the endogenous variable, while the teachers' teaching behaviour is the mediating variable. Structural equation modelling (SEM) analysis was employed to assess the acceptability of the overall model. Following the recommendations of researchers Hair et al. (2010), one fit index from each of the three categories was utilised to evaluate the proposed model. Specifically, the Goodness of Fit Index (GFI) was selected from the absolute fit index category, the Comparative Fit Index (CFI) from the incremental fit category, and the Chi-Square/Degrees of Freedom ratio from the parsimonious fit category. Additionally, for this particular study, the researcher included the Root Mean Square Error of Approximation (RMSEA) as an extra fit index.

Initially, the measurement model did not exhibit satisfactory fit indices. Consequently, the Modification Indexes (MI) were consulted. According to Byrne (2010), the re-specification process is necessary to achieve a model that is both statistically strong and substantively meaningful. As advised by Zainuddin (2014), the correlated measurement

Universiti Malaya

errors of redundant items were "set as a free parameter" (p. 68). The model was then re-tested to determine if it met the threshold levels. Based on the MI table, correlations were established between five measurement errors of redundant items, which significantly improved the fit indices. All decisions regarding model modification were grounded in research literature. The final model achieved the following threshold values: CFI = .961, GFI = .907, Chi-Square/Degrees of Freedom ratio = 3.019, and RMSEA = 0.090.

Although the RMSEA value exceeds the ideal value suggested by Zainuddin (2014), it is important to note that researchers Browne and Cudeck (1993) and Byrne (1998) categorised RMSEA values into four distinct categories: RMSEA values $\leq .05$ are considered a good fit; values between .05 and .08 are regarded as an adequate fit; values between .08 and .10 are classified as a mediocre fit; and values $\geq .10$ are deemed unacceptable. Thus, in the context of this study, the RMSEA value falls into the mediocre fit category. Therefore, the re-specified structural model aligns well with the data collected from private schools in the Klang Valley, Malaysia.

The re-specification of the model by correlating the measurement errors of redundant items is a methodological approach often employed to improve model fit and clarify the relationships between latent constructs. The correlations chosen in this study—usefulness of science and lack of anxiety (e6-e7), enjoyment of science and ability to make choices (e8-e12), motivation for science and self-concept of ability (e9-e10), motivation for science and career interest (e9-e11), and motivation for science and ability to make choices (e9-e12)—are rooted in the interconnected nature of these constructs as supported by the literature.

Universiti Malaya

The correlation between the usefulness of science and lack of anxiety suggests that students who perceive science as useful are likely to experience less anxiety about the subject. This relationship is supported by research indicating that the perceived relevance and applicability of science can reduce anxiety by fostering a sense of purpose and competence in students (Mensah et al., 2023; Mónica, 2023). Therefore, addressing both the perceived usefulness and anxiety in science education can contribute to better student outcomes.

Enjoyment of science and the ability to make choices are closely related, as autonomy in learning is known to enhance intrinsic motivation and enjoyment (Beymer et al., 2020). When students have the opportunity to make choices in their learning processes, such as selecting topics or methods of inquiry, their engagement and enjoyment increase (Han, 2021). This correlation captures the essence of student-centred learning approaches that prioritize student agency and engagement.

The correlation between motivation for science and self-concept of ability highlights the role of self-efficacy in motivating students to pursue science. Bandura's (1997) theory of self-efficacy posits that individuals' beliefs in their abilities influence their motivation and performance. Students who believe in their scientific abilities are more likely to be motivated to engage in and excel at science-related activities. This relationship underscores the importance of fostering a positive self-concept in science education to boost motivation (Jayanti & Wulandari, 2024).

The link between motivation for science and career interest is well-documented, with studies showing that students motivated by science are more likely to pursue careers in scientific fields (Kizilay & Yamak, 2023; Razali et al., 2020). This correlation reflects

Universiti Malaya

the alignment of students' academic interests with their future career aspirations, emphasizing the need for educational practices that connect science learning with real-world career opportunities to sustain long-term motivation.

Lastly, the correlation between motivation for science and the ability to make choices reiterates the role of autonomy in fostering motivation. When students have control over their learning experiences, their intrinsic motivation to engage with science increases (Maximo & Gallardo, 2024). This relationship reinforces the importance of providing students with opportunities for choice and self-directed learning to maintain and enhance their motivation for science.

The re-specification of the model by correlating the measurement errors of these redundant items provides a clearer and more accurate representation of the interrelated constructs within science education. By addressing the interconnected nature of usefulness of science, lack of anxiety, enjoyment of science, ability to make choices, motivation for science, self-concept of ability, and career interest, the model better captures the complexities of student experiences and outcomes in science education. This approach is supported by extensive literature, emphasizing the need for comprehensive strategies that address multiple facets of student engagement and motivation in science.

Consequently, the data gathered for the current study aligns well with the proposed model. However, it is important to note that this alignment was only accomplished after correlating the measurement errors of several variables within the model. Despite this adjustment, the proposed model remains strong and demonstrates its potential in enhancing the teaching behaviours of teachers in private schools located in the Klang Valley, Malaysia.

Universiti Malaya

5.4 Implication of the Study

5.4.1 Implication to the Body of Knowledge

This study makes significant contributions to the existing literature by exploring the relationship between transformational leadership, teachers' teaching behaviour, and students' interest in science. The findings underscore the positive impact of transformational leadership on students' interest in science, confirming earlier research by Elliott & Asghar (2014) and Noland & Richards (2014), who found similar positive correlations in different educational contexts. Furthermore, the study adds to the body of knowledge by highlighting the mediating role of teachers' teaching behaviour in this relationship. Previous studies, such as those by Logan & Skamp (2013) and Frommelt et al. (2021), have also shown that effective teaching behaviours significantly influence students' interest in science. This study reinforces these findings, providing additional evidence of the critical role of teachers' teaching behaviour in fostering student engagement and motivation in science education.

5.4.2 Implication to the Theory

The theoretical framework of this study is grounded in the constructivist learning theory, which posits that learning is an active process shaped by prior experiences. The findings support this theory, demonstrating that transformational leadership and effective teaching behaviours create a conducive learning environment that encourages active student participation and engagement. By confirming the applicability of constructivist principles in promoting students' interest in science, this study contributes to the theoretical understanding of how leadership and teaching practices can be aligned with constructivist principles to enhance educational outcomes.

Universiti Malaya

5.4.3 Implication to Practice

5.4.3.1 Implication for Private School Management

For private schools, particularly in Malaysia, the findings emphasize the importance of prioritizing the recruitment and development of highly qualified science teachers who exhibit strong transformational leadership practices. Schools should invest in training programs that focus on developing the dimensions of transformational leadership, such as idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. These programs can equip teachers with the skills necessary to inspire and motivate students, create a positive learning environment, and challenge students' thinking. Additionally, policies should support the ongoing professional development of teachers to enhance their teaching behaviours, ensuring that they can effectively engage students and foster a strong interest in science.

5.4.3.2 Implication for Science Teachers

Science teachers should embrace transformational leadership practices to create a positive learning environment that fosters students' interest in science. By adopting strategies that inspire and empower students, provide intellectual stimulation, and show individualized consideration, teachers can significantly impact students' motivation and engagement in science education. Effective teaching behaviours, such as clarity in instruction, responsiveness to student inquiries, and the use of diverse teaching strategies, are essential in promoting students' interest and active participation in science. Teachers should be proactive in seeking professional development opportunities that enhance these skills, thereby contributing to improved student outcomes.

Universiti Malaya

5.4.3.3 Implication for School Counsellors

School counsellors play a crucial role in supporting teachers and students in the educational process. The findings of this study suggest that counsellors should work closely with teachers to foster a positive school culture that promotes transformational leadership and effective teaching behaviours. Counsellors can provide support by facilitating professional development workshops, offering individual coaching sessions for teachers, and promoting collaborative practices that enhance the overall learning environment. By supporting teachers in their professional growth, counsellors can help create a school atmosphere that nurtures students' interest in science and promotes academic success.

5.4.4 Policy Implications

The findings of this study have significant implications for policy development in private schools, particularly in the context of the Dual Language Program (DLP) in Malaysia. Policies should prioritize the recruitment and retention of highly qualified science teachers with strong transformational leadership practices. This can be achieved through incentives such as higher salaries, professional growth opportunities, and career advancement prospects. Additionally, funding for professional development programs focusing on transformational leadership and effective teaching behaviours should be prioritized. These programs can provide workshops, mentoring, and coaching opportunities to help teachers cultivate essential skills that promote a positive learning environment and enhance students' interest in science.

Universiti Malaya

5.5 Recommendations from the Study

Based on the findings, several recommendations can be made for various stakeholders in the education sector:

1. For Teachers:

- Embrace transformational leadership practices to create a positive and engaging learning environment.
- Prioritize effective teaching behaviours, such as providing clear explanations, being responsive to student inquiries, and using diverse instructional strategies.
- Actively participate in professional development programs to enhance leadership and teaching skills.

2. For Private School Management:

- Recruit and develop highly qualified science teachers with strong transformational leadership practices.
- Invest in training programs focusing on transformational leadership and effective teaching behaviours.
- Implement policies that support ongoing professional development for teachers.

3. For School Counsellors:

- Provide support and resources for teachers to develop transformational leadership skills and effective teaching behaviours.
- Facilitate professional development workshops and individual coaching sessions for teachers.
- Promote collaborative practices that enhance the overall learning environment.

Universiti Malaya

4. For Policy Makers:

- Develop policies that prioritize the recruitment and retention of highly qualified science teachers.
- Provide funding for professional development programs focusing on transformational leadership and effective teaching behaviours.
- Implement support mechanisms and incentives for teachers to develop essential skills that promote students' interest in science.

By addressing these recommendations, private schools can enhance their science education programs, foster students' interest in science, and ensure the long-term sustainability of initiatives like the DLP. These steps will position private schools as institutions that offer high-quality science education, attracting more parents and contributing to the overall development of students.

5.6 Recommendations for Future Research

The present study has conducted a comprehensive analysis to examine the association between transformational leadership practices of teachers, their teaching behaviour, and students' interest in science. The results demonstrate that the relationship between teachers' transformational leadership practices and students' interest in science is mediated by their teaching behaviour in private schools located in the Klang Valley area. While this study has generated valuable data and contributed to the existing knowledge base, the researcher acknowledges that there are several areas that warrant further investigation. Therefore, the following recommendations are proposed for future research:

1. In future research, it is recommended to broaden the geographical scope by including a larger sample size and analysing schools beyond the 25 private schools in the

Universiti Malaya

Klang Valley. Additionally, comparative studies across different types of schools could also be undertaken to gain a more comprehensive understanding.

2. To better understand potential differences in perceptions among respondents, future studies could explore demographic characteristics such as gender, age, grade level, previous science exam grades, and participation in science competitions or workshops within the last 12 months. It is also important to investigate whether teachers' demographic profile influences their transformational leadership practices, teaching behaviour, and students' interest in science.

3. In addition to using Google Form questionnaires, future studies could consider incorporating mixed-method approaches that include interviews, site visits, and observations to gain a more in-depth understanding of respondents' perceptions.

4. Furthermore, future research should investigate the impact of teachers' transformational leadership on other outcomes, such as student performance and achievements.

5. Another potential area of research could explore the impact of gender on students' interest in science. Previous studies have shown that gender can influence attitudes and interest in science, with females being underrepresented in science-related fields. For instance, research by Desy et al. (2011) found that middle school female students displayed less interest and more anxiety towards science compared to male students, which was attributed to a lack of female role models in science-related fields (Breda et al., 2020).

6. Finally, future studies could investigate the role of technology in promoting students' interest in science. Technology, such as augmented reality (AR), has become an integral tool in education, and studies have shown that its use can have a significant positive impact on academic success, motivation, and interest in science education (Sivri & Eroglu, 2022). For example, a study by Kul and Berber (2022) revealed that AR

Universiti Malaya

positively influenced academic performance and motivation towards science learning in seventh-grade students. Similarly, Şahin & Yilmaz (2020) and Demircioğlu et al. (2022) found that students who used AR technology had higher levels of achievement and more positive attitudes towards science education compared to a control group.

5.7 Conclusion

In summary, this research adds to the existing literature on the impact of teachers' transformational leadership practices and teaching behaviour on students' interest in science, contributing to the growing body of knowledge in this area. The findings emphasize the crucial role of teachers' transformational leadership practices in private schools located in the Klang Valley, Malaysia, and their positive influence on students' interest in science. Additionally, the results highlight the significance of teachers' teaching behaviour as a mediator in the relationship between their transformational leadership practices and students' interest in science. This study aimed to address ten research questions in total.

The findings of this study underscore the significance of teachers' transformational leadership practices and teaching behaviour in shaping students' perceptions of their teachers in private schools located in Klang Valley. These results are consistent with previous research that has shown the positive impact of teachers' transformational leadership practices on students' interest in science (Elliott & Asghar, 2014). Notably, students in private schools in Klang Valley generally reported a moderate level of interest in science, with high levels of enjoyment and perceived usefulness of science, moderate levels of self-concept of ability, ability to make choices, motivation for science and career interest, but low levels of anxiety. These findings suggest that there is room for further improvement in enhancing students' interest in science, particularly through the

Universiti Malaya

implementation of effective transformational leadership practices and teaching behaviour by teachers.

The findings of the study reveal that transformational leadership is evident among teachers in private schools located in Klang Valley and is highly perceived by students. The results align with the established definition of transformational leadership, which encompasses inspiring and motivating followers, setting high expectations, and serving as role models (Beauchamp et al., 2010). Teachers in private schools in Klang Valley were perceived to hold high expectations for their own teaching abilities and the academic success of their students. They were seen as role models by the students, exemplifying excellence and success. These findings emphasize the crucial role of teachers' leadership practices in creating a positive learning environment and influencing students' perceptions and interest in science. When teachers exhibit transformational leadership practices, they can inspire and motivate students, foster their interest in science, and shape their beliefs and attitudes towards the subject. Thus, the role of teachers as leaders in private schools in Klang Valley is vital in shaping students' interest in science and promoting their academic achievements.

The impact of teachers' teaching behaviour on students' perceptions and attitudes towards science cannot be understated. The study highlights that students' high perception of their teachers' teaching behaviour signifies the significant influence it has on them. When students perceive their teachers' teaching behaviour positively, it can greatly impact their learning experience and outcomes. This study underscores the importance of effective teaching behaviour among science teachers in private schools located in Klang Valley. The findings reveal that science teachers in these schools exhibit effective teaching behaviours, including the use of diverse instructional strategies, demonstration of knowledge, passion, and enthusiasm, and the establishment of positive interpersonal relationships with students. Such effective teaching behaviour can be a valuable asset for schools, as it creates a positive learning environment and promotes students' interest, engagement, and academic achievements in science.

The findings of this study provide conclusive evidence that teachers' transformational leadership practices have a significant and positive impact on students' interest in science and teachers' teaching behaviour in private schools located in Klang Valley. These results are consistent with previous research that has highlighted the significance of transformational leadership in educational contexts (Beauchamp et al., 2010; Leithwood & Sun, 2012). The positive and significant relationships identified between teachers' transformational leadership practices and students' interest in science underscore the importance of inspirational and motivational leadership styles in fostering students' engagement and interest in the subject. Teachers who embrace transformational leadership practices, such as setting high expectations, providing intellectual stimulation, and demonstrating individualized consideration towards students, have the ability to inspire and motivate them to develop a positive attitude towards science (Elliott & Asghar, 2014). These findings are in line with the results of this study, which suggest that transformational leadership practices have a positive influence on students' interest in science.

Moreover, the notable and meaningful associations observed between teachers' transformational leadership practices and their teaching behaviour underscore the impact of leadership practices on instructional practices. Teachers who embody transformational leadership practices are more inclined to adopt effective teaching behaviours, such as employing diverse instructional strategies, possessing in-depth knowledge, displaying

Universiti Malaya

enthusiasm, and providing support in their teaching (Bass & Riggio, 2006; Beauchamp et al., 2010). These findings align with the results of this study, which demonstrate that teachers' transformational leadership practices have a positive influence on their teaching behaviour.

Furthermore, the results of this study corroborate the importance of implementing transformational leadership practices in private schools located in the Klang Valley. These findings highlight the pivotal role of teachers as motivators, inspirers, and role models for their students. By embracing transformational leadership, teachers can effectively foster their students' positive interest in science and exhibit effective teaching behaviours, ultimately resulting in enhanced learning outcomes and academic achievements.

However, the results of multiple regression analysis indicated that among the various dimensions of teachers' transformational leadership, the intellectual stimulation dimension emerged as the sole predictor of students' interest in science in private schools located in the Klang Valley. This underscores the specific significance of this dimension in promoting students' interest in the subject. Furthermore, the study revealed that students' perception of their teachers' teaching behaviour plays a pivotal role in shaping their interest in science, with the dimensions of clarity and rapport being significant predictors. While the clarity dimension had a moderate effect on students' interest in science, the rapport dimension had a larger impact. Additionally, the dimensions of individualized consideration, inspirational motivation, and intellectual stimulation were found to be significant predictors of teachers' teaching behaviour. While both the inspirational motivation and intellectual stimulation dimensions exhibited a moderate

Universiti Malaya

effect, the individualized consideration dimension had a more pronounced impact on teachers' teaching behaviours.

Moreover, the findings of this study shed light on the role of teachers' teaching behaviour as a partial mediator in the relationship between teachers' transformational leadership practices and students' interest in science in private schools located in the Klang Valley. This is evident from the observed reduction in the coefficient representing the direct effect of teachers' transformational leadership practices on students' interest in science when the mediator is introduced, indicating partial mediation. This underscores the crucial role of teachers' teaching behaviour in enhancing students' interest in science and highlights the importance of teachers exhibiting effective teaching behaviours in the classroom.

In conclusion, this study offers valuable insights into the critical roles of teachers' transformational leadership practices and teaching behaviour in fostering students' interest in science within private schools in Klang Valley, Malaysia. The findings emphasize the significance of both transformational leadership practices and teaching behaviour in shaping students' interest in science, underscoring the need for teachers to exhibit effective leadership practices and teaching behaviours to promote student engagement in the subject. Furthermore, the study highlights the mediating role of teachers' teaching behaviour in the relationship between their transformational leadership practices and students' interest in science in private schools in Klang Valley, albeit with partial mediation. Nevertheless, this underscores the importance of teachers' teaching behaviour in enhancing students' interest in science.

This study also addresses a significant research gap in the literature. Prior studies have examined the individual effects of teachers' transformational leadership practices and

Universiti Malaya

teaching behaviour on students' interest in science. However, this study uniquely explores the mediating role of teachers' teaching behaviour in the relationship between their transformational leadership practices and students' interest in science. By investigating this mediating mechanism, the study contributes to a more comprehensive understanding of how these factors interact and influence students' interest in science within private schools in Klang Valley, Malaysia. Furthermore, the study's focus on private schools in the Klang Valley region of Malaysia fills a specific research gap in the literature. Previous research on the relationship between teachers' transformational leadership practices, teaching behaviour, and students' interest in science has primarily focused on general educational settings or specific geographical contexts. This study narrows the gap by specifically examining the private school context in Klang Valley, providing insights that are relevant and applicable to this specific setting.

These findings have implications for educational policymakers, school administrators, and teachers, providing guidance for promoting students' interest in science education in private schools in Klang Valley, Malaysia, and beyond. They emphasize the significance of incorporating both transformational leadership practices and teaching behaviour in educational practices. By adopting effective leadership practices and teaching behaviours, educators can create a positive learning environment that fosters students' interest in science and promotes their academic achievement. Teachers can focus on enhancing their transformational leadership practices, particularly by providing intellectual stimulation to students, while also paying attention to their teaching behaviour, including clarity and rapport.

School administrators can play a role by providing professional development opportunities for teachers to improve their leadership and teaching skills. Policymakers

Universiti Malaya

can also consider incorporating training on transformational leadership practices and effective teaching behaviour in teacher preparation programs and professional development initiatives. Additionally, further research can explore other potential mediators and moderators in the relationship between teachers' leadership practices, teaching behaviour, and students' interest in science, to gain a more comprehensive understanding of this complex relationship.

5.8 Summary of Chapter

In this section, the key findings of the study are provided in a concise manner, covering the areas of teachers' transformational leadership practices, teachers' teaching behaviour, and students' interest in science. The subsequent discussion delves into the specific findings related to the eleven research questions that were explored in the study. The implications of these findings are then discussed, including recommendations for future research. Lastly, a conclusion is drawn based on the results and discussions presented in this chapter.

Universiti Malaya

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