CONCEPTIONS IN CIRCULAR MOTION AMONG
FORM SIX PHYSICS STUDENTS IN
KUCHING, SARAWAK

BY
MAH CHUI CHING

A Project Paper Submitted to the Faculty of Education,
University Of Malaya in Partial Fulfilment Of
the Requirements for the Degree Of
Master of Education

1999
ACKNOWLEDGEMENTS

First and foremost, I would like to thank God for His faithful love, guidance and wisdom imparted during the period I pursued my MEd study.

I would also like to convey my sincere appreciation and gratitude to the following individuals and institutions whose assistance and contributions had enabled me to complete this research study:

1. My supervisor, Mr Lew Tan Sin, for his invaluable guidance, insightful comments, critical suggestions, patience, support and constant motivation rendered throughout the course of this study. I could not have found a better supervisor who was so generous with his time and encouragement.

2. The Ministry of Education of Malaysia for awarding me the scholarship to pursue the MEd Studies.

3. The officers of the Educational Planning and Research Division of the Malaysian Education Ministry and the Sarawak Education Department for granting the permission to conduct the research in schools.

4. The principals, heads of science and mathematics departments, physics teachers and form six students of the schools involved for their kind cooperation in the collection of data for the study.

5. Mr Tang Ming Tan, Mr Tong Yoke Chai and Mr Bong Jiew Chee for their assistance in validating the UCCMT.

6. Dr Ngu Bing Hiong for her efforts and time in proofreading my final draft and the suggestions given to further improve this research paper.
7. The principal and the staff of SMB St Joseph for taking care of my professional matters so that I could focus in my study.

Last but not least, I dedicate this study to my family and my friends for their love, constant support and encouragement while I was pursuing the study and to all individuals who love this knowledge of nature that we called physics.

M.C.C.
Konsepsi Tentang Gerakan Membulat Di Kalangan Pelajar Fizik Tingkatan Enam Di Kuching, Sarawak

Abstrak

Tujuan kajian ini ialah untuk mengkaji konsepsi pelajar fizik tingkatan enam atas tentang gerakan membulat. Kajian ini juga bertujuan untuk menentukan hubungan antara kefahaman konsep dalam gerakan membulat dengan jantina dan kebolehan penaaakulan formal pelajar. Sejumlah 89 pelajar (39 lelaki and 50 perempuan) dari Kuching, Sarawak terlibat dalam kajian ini. Dua instrumen, Ujian Pemikiran Mantik (TOLT) dan Ujian Kefahaman Konsep Gerakan Membulat (UCCMT) telah digunakan untuk mengumpul data. TOLT digunakan untuk mengkategorikan kebolehan penaaakulan formal pelajar. UCCMT digunakan untuk mengkaji kefahaman pelajar tentang konsep dalam gerakan membulat and menyiasat salah konsepsi yang berulang dan yang biasa dijumpai. Keputusan kajian menunjukkan bahawa:

(1) Pelajar yang mempunyai penaaakulan formal yang tinggi mendapat pencapaian lebih baik dalam kefahaman konsep tentang gerakan membulat berbanding dengan pelajar yang mempunyai penaaakulan formal yang sederhana.

(2) Pelajar lelaki mendapat pencapaian lebih baik dalam kefahaman konsep tentang gerakan membulat berbanding dengan pelajar perempuan.

(3) Antara enam salah konsepsi yang berulang tentang gerakan membulat ialah:
   (a) Menganggap objek akan terus bergerak dalam lintasan lengkung walaupun tidak wujud daya memusat; (b) Menganggap daya memusat dan daya paduan yang bertindak pada sesuatu objek sebagai daya yang berlainan; (c)
Menganggap suatu daya motif bertindak pada jasad dalam gerakan; (d)
Menganggap suatu daya yang berhala ke luar bertindak pada jasad dalam gerakan.

(4) Sejumlah tiga belas salah konsepsi yang biasa dijumpai telah dikesan dari respons pelajar dalam UCCMT.

Implikasi daripada dapatan kajian ini dibincang dan cadangan yang spesifik bagi kajian lanjut juga disyorkan.
ABSTRACT

This study examined upper six physics students’ conceptions in circular motion. It also sought to establish the relationships between students’ understanding of concepts in circular motion and their gender and formal reasoning ability. Participants consisted of 89 students (39 males and 50 females) from two schools in Kuching, Sarawak. Two data gathering instruments, Test of Logical Thinking (TOLT) and Understanding of Concepts in Circular Motion Test (UCCMT) were used. The TOLT was used to categorize the formal reasoning ability of the students. The UCCMT was used to assess the students’ understanding of the concepts in circular motion and to probe their recurring and common misconceptions. The findings showed that:

(1) The high formal reasoning ability students performed significantly better than the medium formal reasoning ability students in their understanding of concepts in circular motion.

(2) The male students performed significantly better than the female students in their understanding the concepts of circular motion.

(3) Among the six recurring misconceptions in circular motion identified were: (a) Perceived an object would continue to travel in curvilinear path in the absence of centripetal force; (b) Regarded centripetal force and resultant force acting on an object as two different forces; (c) Perceived a motive force acting on a body in motion; (d) Perceived an outward force acting on a body in motion.
(4) A total of thirteen common misconceptions were identified from the students' responses in UCCMT.

Implications arising from the findings were discussed and specific recommendations were also suggested for future studies.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgements</td>
<td>ii</td>
</tr>
<tr>
<td>Abstrak</td>
<td>iv</td>
</tr>
<tr>
<td>Abstract</td>
<td>vi</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>viii</td>
</tr>
<tr>
<td>Appendices</td>
<td>xi</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xii</td>
</tr>
</tbody>
</table>

## CHAPTER I : STATEMENT OF THE PROBLEM

1.0 Introduction  
1.1 An Overview of Sixth Form Physics Education in Malaysian Schools  
1.2 Research Questions  
1.3 Definition of Terms  
1.4 Significance of the Study  
1.5 Limitation of the Study  

## CHAPTER II : REVIEW OF RELATED LITERATURE

2.0 Introduction  
2.1 Students’ Conceptions in Circular Motion  
2.2 Gender and Physics Achievement  
2.3 Formal Reasoning Ability and Science Achievement
CHAPTER III : RESEARCH METHODOLOGY

3.0 Introduction 32
3.1 The Subjects of the Study 32
3.2 Instrumentation 32

3.2.1 The Understanding of Concepts in Circular Motion Test (UCCMT) 33
3.2.2 Content Validation of UCCMT 36
3.2.3 Reliability of UCCMT 36
3.2.4 Test of Logical Thinking (TOLT) 37
3.2.5 Validity and Reliability of TOLT 37

3.3 Pilot Study for the Instruments 39
3.4 Data Collection 40

CHAPTER IV : RESULTS AND DISCUSSIONS

4.0 Introduction 41
4.1 Descriptive Statistics of Subjects of Study 42

4.1.1 Distribution of Gender of Students 42
4.1.2 Scoring Procedure and Categorization of Formal Reasoning Ability Groups 43
4.1.3 Distribution of Students’ Formal Reasoning Ability Groups 43

4.2 Scoring Procedure for the UCCMT 44
4.3 Formal Reasoning Ability and Students’ Understanding of Concepts in Circular Motion 46
4.4 Gender and Students’ Understanding of Concepts in Circular Motion 47
4.5 Students’ Conceptions in Circular Motion

4.5.1 Conceptions of Students in Item 1
4.5.2 Conceptions of Students in Item 2
4.5.3 Conceptions of Students in Item 3
4.5.4 Conceptions of Students in Items 4 and 5
4.5.5 Conceptions of Students in Item 6
4.5.6 Conceptions of Students in Item 7
4.5.7 Conceptions of Students in Item 8
4.5.8 Conceptions of Students in Item 9
4.5.9 Conceptions of Students in Item 10
4.5.10 Conceptions of Students in Item 11
4.5.11 Conceptions of Students in Item 12
4.5.12 Conceptions of Students in Item 13
4.5.13 Conceptions of Students in Item 14
4.5.14 Conceptions of Students in Item 15
4.5.15 Conceptions of Students in Item 16
4.5.16 Conceptions of Students in Item 17
4.5.17 Conceptions of Students in Item 18

4.6 Students’ Recurring Misconceptions in Circular Motion

4.7 Students’ Common Misconceptions in Circular Motion

CHAPTER V : SUMMARY OF THE FINDINGS, IMPLICATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

5.0 Introduction
5.1 Summary of the Findings
5.2 Implications of the Findings
5.3 Suggestions for Future Research
SELECTED BIBLIOGRAPHY

APPENDICES :

Appendix A: Understanding of Concepts in Circular Motion Test (Malay Version) 103
Appendix B: Understanding of Concepts in Circular Motion Test (English Version) 116
Appendix C: Test of Logical Thinking (Malay Version) 127
Appendix D: Sample Items from Test of Logical Thinking (English Version) 138
Appendix E: Letters of Approval to Conduct the Study 140
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Specific Aims or Objectives of Sixth Form Physics</td>
<td>5</td>
</tr>
<tr>
<td>1.2</td>
<td>Major Sections in STPM Physics Syllabus</td>
<td>6</td>
</tr>
<tr>
<td>1.3</td>
<td>Students’ Behavioral Outcomes Expected from Instruction in Circular Motion</td>
<td>7</td>
</tr>
<tr>
<td>3.1</td>
<td>Concepts Tested in UCCMT</td>
<td>34</td>
</tr>
<tr>
<td>4.1</td>
<td>Distribution of Gender of Students</td>
<td>42</td>
</tr>
<tr>
<td>4.2</td>
<td>Categorization Scheme of TOLT Score</td>
<td>43</td>
</tr>
<tr>
<td>4.3</td>
<td>Distribution of Students’ Formal Reasoning Ability</td>
<td>44</td>
</tr>
<tr>
<td>4.4</td>
<td>Item Number, Score for Each Item and Maximum Score Awarded in UCCMT</td>
<td>45</td>
</tr>
<tr>
<td>4.5</td>
<td>Comparison between Formal Reasoning Ability Groups on Their Understanding of Concepts in Circular Motion</td>
<td>46</td>
</tr>
<tr>
<td>4.6</td>
<td>Comparison between Male and Female Students on Their Understanding of Concepts in Circular Motion</td>
<td>48</td>
</tr>
<tr>
<td>4.7</td>
<td>Frequency and Percentage of Students’ Responses in Item 1</td>
<td>49</td>
</tr>
<tr>
<td>4.7a</td>
<td>Comparison between Students’ Responses in This Study and in Peters’ (1982) Study</td>
<td>51</td>
</tr>
<tr>
<td>4.8</td>
<td>Frequency and Percentage of Students’ Responses in Item 2</td>
<td>53</td>
</tr>
<tr>
<td>4.9</td>
<td>Frequency and Percentage of Students’ Responses in Item 3</td>
<td>56</td>
</tr>
<tr>
<td>4.9a</td>
<td>Comparison between Students’ Responses in This Study and McCloskey et al.’s (1980) Study</td>
<td>58</td>
</tr>
<tr>
<td>4.10</td>
<td>Frequency and Percentage of Students’ Responses in Items 4 and 5</td>
<td>59</td>
</tr>
<tr>
<td>4.11</td>
<td>Frequency and Percentage of Students’ Responses in Item 6</td>
<td>62</td>
</tr>
<tr>
<td>4.12</td>
<td>Frequency and Percentage of Students’ Responses in Item 7</td>
<td>64</td>
</tr>
</tbody>
</table>
Table 4.13  Frequency and Percentage of Students’ Responses in Item 8  67
Table 4.14  Frequency and Percentage of Students’ Responses in Item 9  68
Table 4.15  Frequency and Percentage of Students’ Responses in Item 10  70
Table 4.16  Frequency and Percentage of Students’ Responses in Item 11  72
Table 4.17  Frequency and Percentage of Students’ Responses in Item 12  74
Table 4.18  Frequency and Percentage of Students’ Responses in Item 13  76
Table 4.19  Frequency and Percentage of Students’ Responses in Item 14  78
Table 4.20  Frequency and Percentage of Students’ Responses in Item 15  79
Table 4.21  Frequency and Percentage of Students’ Responses in Item 16  80
Table 4.22  Frequency and Percentage of Students’ Responses in Item 17  81
Table 4.23  Frequency and Percentage of Students’ Responses in Item 18  82
Table 4.24  Students’ Recurring Misconceptions Identified from Their Responses in UCCMT  84
Table 4.25  Students’ Common Misconceptions Identified from Their Responses in UCCMT  87