Chapter III

Methodology

Introduction

The primary aim of this study was to investigate the factors that influence the implementation of Competency Assessment and Modular Certification (CAMC) of vocational subjects in secondary schools. This chapter introduces and justifies the research approach used in this study. It first explains the research design utilized in this study. This then followed by an explanation of the research procedures, which includes sampling, the development of the instrument, data collection techniques and the data analysis used in this study

Research Design

The research design followed the conventional approach to structural equation modeling as shown in Figure 3.1. First, a theory is presented, next a sample is selected and measures obtained on the sample. At this stage, the measurement model can be estimated at once. This is followed by an assessment of the 'goodness-of-fit' of the model**,** followed by modification if necessary. Typically, this stage is cyclical with the model continually being modified and evaluated in terms of 'goodness of fit' until the decision is made that the model met a pre-defined standard of adequate fit (Kaplan, 2000).

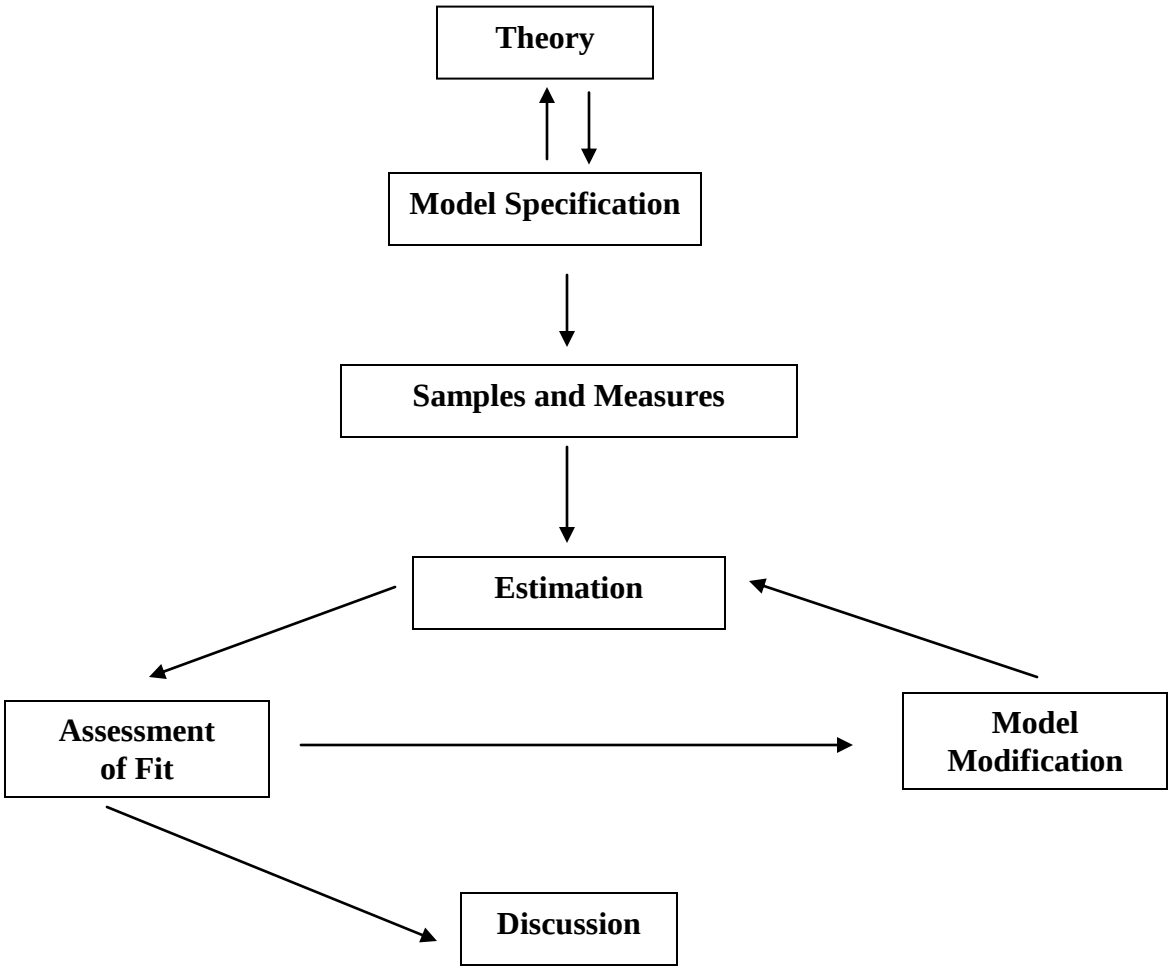

Figure 3.1. The conventional approach to structural equation modeling.

Source: From *Structural equation modeling: Foundations and Extensions* (p.8), by David Kaplan, 2000, Advanced Quantitative Techniques in the Social Sciences Series. Thousand Oaks: Sage.

A survey approach was selected as a tool for collecting observable measures on constructs involved in the structural research design. In this study, the use of a survey, as recommended by Borg and Gall (1989) and De Vaus (1991), allowed the researcher to describe the characteristics of groups (sets of data), relationships between groups, and to identify possible causes for a phenomenon by comparing cases within the data. This

approach has many virtues and one of it was its ability to provide accurate information on explanation and exploration. It was best adapted to obtaining demographic data, beliefs, attitudes, opinions, motivations and behaviors (Kumar,1996). Surveys helped identify beliefs and attitudes of individuals (Creswell, 2005). There were certain standards of quality**,** especially in relation to sampling**,** that had to be met. According to Creswell (2005) there were eight steps to conducting survey research. The first step was to decide whether surveys were the best design to use in the study ; then the research questions or hypotheses is identified; followed by the identification of the population, sampling frame and the sample; the survey design and data collection procedures are then determined; an instrument is developed or located; administered; the data is analyzed to address the research questions or hypotheses**,** and finally, the report is written. He also mentioned that surveys helped describe trends in a population**,** relationship among variables or comparisons between groups. Surveys were most suitable to assess trends or characteristics of a population; learn about individual attitudes, opinions, beliefs and practices; evaluate the success or effectiveness of a program; or identify the needs of a community.

In exploring the possibility of using a survey questionnaire in this study, the researcher considered a number of factors. The survey or questionnaire was the most commonly-used descriptive method in educational research. Typically, according to Cohen, Manion and Morrison (2000), they gathered data at a particular point in time to identify standards**,** with which existing conditions could be compared. This data collection technique was used to measure variables in quantitative research. Used as a distinctive technique, it was a process of asking many people the same questions and

examining the range of their answers. The survey was considered by many authors (Babbie, 1995; Berdie & Anderson, 1974; Borg & Gall, 1989; Hyman & Singer, 1991) to be the most appropriate data collection strategy to use when a large amount of information was needed from a larger group of respondents than was possible when using other designs. According to them, the survey was also an excellent means of generalizing findings obtained from a small sample to a larger population**.** However, they do rely on self-reports of knowledge, attitudes and behaviors.

Various support and criticisms for the use of a survey were also considered prior to its use in this study**,** and this included the four advantages associated with the use of surveys as highlighted by Babbie (1995). They are: i) the use of a carefully selected survey combined with a standardized questionnaire provided the possibility of making refined descriptive assertions; ii) very large samples were feasible; iii) the opportunity to ask many questions on a given topic provided the researcher with considerable flexibility in his or her analysis; and iv) as the same questions were asked of all subjects, the results had a weightage with regard to measurement.

In response to criticisms that surveys were limited to description only, Borg and Gall's (1989) claimed that survey research actually used a variety of instruments and methods to study relationships, effects of treatment, longitudinal changes and comparisons between groups. Four disadvantages, as mentioned by Babbie (1995), regarding the use of survey research were also considered. They are: i) the need to standardize the survey items often seemed to result in fitting 'square pegs into round holes', as some or many of the questions could be minimally relevant or inappropriate to the individual subject's experiences or circumstances; ii) survey research could seldom

develop the ‘feel’ for the total life context of the subjects; iii) surveys typically required the initial design to remain unchanged whereas field researchers could often become aware of new variables and adapted their study design to accommodate these new variables; and iv) some surveys were subject to a degree of artificiality which could affect its’ validity.

The most popular form of survey design used in education was the cross-sectional survey design, which is the design adopted in this study. In cross-sectional survey design, the researcher collects data at one point in time. This design has the advantage of measuring current attitudes or practices, specifically of the vocational teachers in implementing CAMC. The data was collected using a set of developed instruments. In this study, the research questions were formulated in order to test the proposed *a priori* implementation model of Competency Assessment and Modular Certification (CAMC) in secondary schools.

The design of the study was based on a descriptive approach to research. According to Ary, Jacobs and Razaveih (1990) descriptive studies provided a detailed account of a population, situation or event and was useful in examining relationships between phenomena. The aim was to describe “what existed” with respect to variables or conditions in a given situation**,** based on well-formulated research questions. A defined study population and a clear measurement of the phenomena of interest was thus required. Descriptive research attempts to systematically describe a situation, problem, phenomenon, service or program, or provide information or describes attitudes towards an issue (Kumar, 1996).

Sampling

The process of survey research began with identifying the population. The sample obtained has to be the representative of the population. In this study**,** the sample selected was the whole population of teachers teaching vocational subjects and assessing via the school-based assessment of CAMC in the selected secondary schools, from 2002 to 2007. Table 3.1 shows the population of these academic schools. It also shows the distribution of the schools in each state. There are a total of 656 schools offering one to three vocational subjects nationwide (list of schools obtained from MES as at January 2006). This number was found to be too small for sampling. So, purposive sampling was adopted by choosing instead, vocational teachers teaching vocational subjects in forms 4 and 5 in these schools. There are a total 860 teachers teaching these subjects (list of teachers obtained from MES as at January 2006) but 220 teachers involved in the pilot studies were excluded as a result there are 640 teachers chosen as samples in this study.

This study employed structural equation modeling (SEM), as the major statistical analysis tool, using large-sample technique. As a rule of thumb, Tabachnick and Fidell (2000) recommended that at least 300 cases be obtained for a comfortable analysis. Basically, in any kind of statistical method, results derived within large samples had less sampling errors than from within smaller samples. Kline (2005) proferred some guidelines on absolute sample size in estimation methods, which considered the model complexity. That is, the more complex models with more parameters, required larger samples. Kline suggested that a sample size of 200 or larger could be necessary for a very complicated model. He further noted that although there were no absolute standards in literature about the relation between sample size and path model complexity, he

recommended that a desirable goal would be to have a ratio 20:1, as the number of cases to the number of free parameters , though a 10:1 ratio, could be a more realistic target. Thus, a path model with 20 parameters should have a minimum sample size of 200 cases. Kline further observed that if the cases to parameter ratio was less than 5:1, the statistical precision of the results could be doubtful.

Table 3.1

The Population of Academic Schools Selected to Offer Vocational Subjects Since 2002 to 2007

List of State	No. of schools offering vocational subjects
Perlis	15
Kedah	43
Pulau Pinang	55
Perak	60
Selangor	64
Kelantan	50
Terengganu	44
Pahang	54
Wilayah Persekutuan Kuala Lumpur	41
Wilayah Persekutuan Labuan	5
Negeri Sembilan	41
Melaka	36
Johor	69
Sabah	41
Sarawak	38
Total	656

Instrument

The development of the survey questionnaire is discussed in this section. A comprehensive review of the literature revealed that there were no existing instruments which were satisfactory to address the research questions. Most existing instruments covered only a small part of the research questions and were not comprehensive enough to be useful for this study. Acknowledging that to a large extent**,** the success of a study depended on the quality of the chosen data collection methods (Beanland, Schneider, LoBionda-Wood, & Haber, 1999), the researcher therefore designed and developed a self-administered and context-specific questionnaire of 95 items, guided by the findings of the preliminary study and literature review. The researcher followed the recommendations by Lydeard (1991), who listed a number of steps necessary for developing a questionnaire to be used as a research tool. They are: 1) define the area of investigation; 2) formulate the questions; 3) choose the sample and maximize the response rate; 4) pilot and test for validity and reliability; and 5) recognize sources of error. The area of investigation was defined by reviewing the relevant literature. The questions were formulated from a number of sources, including the literature review and data obtained from the preliminary study. The instrument was reviewed by two senior personnel from the MES – the Deputy Director (Production) and the Head of the Vocational Unit. These two personnel were selected based on their vast experience in the development and implementation of CAMC, and so could thus vet the instrument, to ensure the content and construct validity of the questionnaire.

The questionnaire comprised the following items: 1) cover letter; 2) instructions to respondents; 3) the demographic items requiring response to collect information about

teachers' demographic background and the training they had received with regards to CAMC implementation; and 4) closed and open-ended questions to collect information and suggestions about the implementation of CAMC.

Each of these elements is discussed. The result of the pilot test undertaken to establish questionnaire validity and reliability is also described. (Refer to copy of the instrument in Appendix B). The survey questionnaire was divided into seven sections. These sections are discussed in turn.

Section A – The Cover Letter

A cover letter accompanied the questionnaire outlining the purpose and significance of the study, the confidentiality of information and instructions on how and when to return the questionnaire. In writing the cover letter, the researcher took into account the importance of ensuring that respondents understood the purpose of the study and believed the study to be relevant to themselves as teachers assessing using the school-based assessment of CAMC. These strategies were employed to minimize respondents' negative states including fatigue, boredom and discouragement (Kervin, 1992).

Section B – Demographic Data

The first section of the questionnaire elicited respondents' demographic background. The respondents were asked to supply demographic information. The data was collected to describe the study sample and to examine relationships between the subjects' characteristics. The demographic items were name of school, vocational subject

taught, number of vocational subjects offered in their school, teachers' gender, their professional and academic qualifications, their subject major, their years of teaching and whether the respondents had been trained by MES in CAMC.

Section C – Teachers' Conceptions of school-based assessment of CAMC

The purpose of this section was to examine the respondents' conceptions of school-based assessment of CAMC. This section consisted of eleven statements that required the respondents to indicate their beliefs and conceptions of the school-based assessment of CAMC. For a response category, five categories (Strongly Disagree, Disagree, Not Sure, Agree and Strongly Agree) were considered the most appropriate response scale because the researcher wished to obtain the opinion of the respondents.

Section D – Teachers' Receptivity to CAMC

This section of the questionnaire examined respondents' perceptions about the current assessment system, that is, the school-based assessment of CAMC. The respondents were asked to choose one of the following five response categories: 'Strongly Disagree, Disagree, Not Sure, Agree and Strongly Agree' for 37 written statements. They were to choose which response best represented their own perception and/or opinion related to the implementation of the school-based assessment of CAMC. These statements were categorized using six headings. These included 'perceived cost benefit of CAMC', 'practicality in the classroom', 'alleviation of fears and concerns', 'participation of decision making at school', 'perceived improvement of CAMC compared to the previous system', and 'perceived support of senior teachers and

principal'. The statements were developed based on the literature review and the Waugh and Godfrey (1995) study which suggested the six variables to measure teachers' receptivity to system-wide change. Their six variables were used as the six headings in this section.

Section E – The Degree of Implementation of CAMC

The goal of this section of the questionnaire was to examine the degree of implementation of school-based assessment of CAMC. The respondents were asked to choose one of the following five responses categories: 'Strongly Disagree, Disagree, Not Sure, Agree and Strongly Agree' for 36 written statements. They were to choose which response best represented their own perception and/or opinion related to the degree of implementation of the school-based assessment of CAMC. These statements were categorized using five headings. These included 'logistics arrangement', 'use of assessment activities', 'quality relationship of assessment, teaching and learning', 'knowledge of the characteristics of the assessment scheme of CAMC' and 'attitude towards school-based assessment'. The statements were developed based on the literature review and the five dimensions, as proposed by Cheung et al. (1996) to measure the degree of implementation. These five dimensions were used as the five headings in this section.

Section F – The Quality Assurance of CAMC

The purpose of this section was to address issues related to the quality assurance strategies of the assessment process used in implementing school-based assessment of CAMC. The respondents were asked to choose one of the following five response categories: 'Not at all, Only once, 2 years once, once a year and twice a year' to the statements given**,** on monitoring and moderation. They were to choose which response best represented the frequency of the quality assurance strategies used in relation to the implementation of the school-based assessment of CAMC. These statements were categorized using two headings. These were 'monitoring' and 'moderation' of the assessment process'.

Section G - Issues and Challenges in implementing the school-based assessment of CAMC

This section contained two open-ended questions. Each open-ended question had a response set of eight blank lines. Open-ended questions provided greater depth than closed-ended ones, by eliciting extensive responses from the respondents. The responses could provide rich context for the research description and support**,** and expand on summary findings (Shi, 1997). The researcher was also aware that open-ended questions could cause low response and completion rates because they required greater effort and time on the part of the respondent, thus the number of open-ended questions was kept to a minimum of two.

Research Procedures

This section discusses the research procedures carried out by the researcher. A preliminary study was conducted before the development of measuring tools and a pilot study was conducted to test the reliability and validity of the instrument. The instrument was then administered to the respondents of this study.

Preliminary study

As mentioned earlier**,** the questionnaire was developed based on the findings from the preliminary study conducted by the researcher**,** to identify issues and barriers related to the implementation of the school-based assessment of CAMC. This pilot effort selected three teachers who taught and assessed students using the school-based assessment of CAMC. The researcher conducted an informal interview and discussion with the teachers individually. The findings from this study were used to identify the variables and develop the instrument for this study.

Pilot study

The questionnaire was designed specifically for the purpose of this study and it was imperative to conduct a trial to test it for clarity of questions and statements, choice of words, missing items, effectiveness of instructions, completeness of response sets, and to gauge the amount of time it would take to complete. The pilot analysis was to test the data collection instrument for face validity and in particular, to check that the questions drew forth appropriate responses (Beanland et al., 1999).

Two pilot studies were conducted. The first was conducted using a purposive sample of ten teachers from schools offering vocational subjects in Kuala Lumpur. This was carried out during the questionnaire design stage and was checked by the researcher's supervisor and reviewed by two MES personnel, to reveal any early problems. The researcher approached the respondents individually and obtained verbal consent for their participation in the pilot study. Respondents were asked to note how long it took them to complete the questionnaire, if they felt uncomfortable answering any questions**,** or if there were any ambiguous or difficult questions. They were also given an opportunity comments on the content of the questionnaire. A discussion session was organized after they completed the questionnaire in which their feedback was discussed. The outcome of the first pilot and the feedback from the discussion indicated the need for some changes. The three main concerns were: 1) failure to understand some statements; 2) failure to understand some of the given instructions; and 3) inappropriate choice of words. Minor alterations to the wording were made to increase the clarity of several questions.

The second pilot study with the questionnaire was conducted using a purposive sample of 210 schools from the state of Selangor, Negeri Sembilan, Melaka, Kuala Lumpur and Perak. A cover letter by Malaysia Examination Syndicate (MES) was sent out, outlining the importance of the pilot questionnaire and this study. The respondents in the pilot study were chosen because they had similar backgrounds and knowledge and were from the same target population involved in the issues being investigated. The second pilot study was conducted to determine the reliability of the instrument. A response rate of 97.6% yielded 205 responses from the questionnaire distribution.

The Reliability of the Instrument

The reliability of the instrument reported here was based on the data collected from the second pilot study. In this aspect**,** the researcher made use of the 'estimates of internal consistency (Cronbach's alpha)' and the 'confirmatory factor analysis (CFA)'. Cronbach's alpha is a commonly-used measure used to test the extent to which multiple indicators for a latent variable**,** belong together. A general rule was that indicators should have a Cronbach's alpha of 0.7 or more. Table 3.2 shows the internal consistency of the instrument of this study (Cronbach's alpha).

Table 3.2

Internal Consistency of The Instrument (Cronbach's Alpha)

Instrument	Cronbach's alpha value
Teachers' Conceptions of CAMC	.857
Teachers' Receptivity to CAMC	.889
Quality Assurance of CAMC	.884
Degree of Implementation of CAMC (DOI)	.890

Data Collection Procedure

Measures identified by Shi (1997), were employed to improve response rate in the data collection process. They included a cover letter with the questionnaire and the method of questionnaire return. Several strategies were employed in this study to reduce measurement error and non-response. First, the questionnaire was divided into seven

logical subsections with each section clearly labeled. Second, the questionnaire was developed in Bahasa Malaysia**,** because based on the preliminary study**,** respondents felt that they were more comfortable answering the items in Bahasa Malaysia. Third, repetitious questions were avoided and respondents were provided with instructions on how to respond to the statements. At the beginning of each section, specific instructions were given for a number of questions**,** for example, for the questions which required respondents to circle a response indicating their level of agreement to the given statements and questions where there was more than one possible response. The instructions were carefully tested by the pilot subjects. During the pilot study, the questions and statements were also examined and tested for appropriateness, content, wording and order. Lastly, adequate space was provided for answers and comments for the open-ended questions (see Appendix B).

The instruments, together with stamped**,** self-addressed return envelopes were posted to all the selected schools. The envelopes were coded so that the researcher could easily identify the schools which had not returned the questionnaires. The teachers were given 14 days to return the instruments. Reminders were sent to schools which did not return the questionnaires. A total of 548 vocational subjects' teachers responded to the questionnaire.

The process of getting access to the vocational teachers in the academics schools began by requesting permission formally, in writing, through the official channels. The first step the researcher took regarding this matter was to write and explain in detail the purpose of the study and the data collection method to the Director of the Educational Planning, Research and Development, Ministry of Education, Malaysia to get permission

to conduct the research. A letter of approval to conduct the research is provided in Appendix C. The researcher informed the State Education Department by attaching the approval letter. Letter of approval from the State Education Departments are also provided in Appendix C.

Statistical Data Analysis Techniques

Multiple statistical techniques were used in this study. The Statistical Package for the Social Sciences (SPSS) for Windows and Structural Equation Modeling (SEM) using Analysis of Moment Structures (AMOS) statistical program were utilized for data analysis. Descriptive statistics was used to report the socio-demographic data. Exploratory factor analysis (EFA) was used as a technical preliminary step within the framework of confirmatory factor analysis (CFA). Results of the exploratory factor analysis (EFA) were used to provide information of which items are appropriate to serve as reference indicators in the CFA model. Confirmatory factor analysis (CFA) was used for measurement models, also known as the confirmatory factor models. The measurement models are concerned with relationship between unobserved measures and their latent constructs. A final set of measures determined with structural equation modeling (SEM) were used to assess and test the proposed measurement model and structural model of this study**,** and the multiple group comparison method was used to test whether the proposed model fit the data according to teachers' gender, experience, training and their field of specialization. The open-ended items were categorized and the frequency for each category was computed. The following sections provide further details about the overall procedures for the assessment of the measurement model**,** using

exploratory factor analysis (EFA)**,** confirmatory factor analysis (CFA) and structural equation modeling (SEM) that were used in this study.

Assessment of the Measurement Model

Assessment of the measurement model involved exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) (Hoyle, 1995). Factor analysis using SPSS version 16 was employed to EFA and analysis of Moment Structures (AMOS) version 16 was employed for CFA**,** that assessed the reliability and validity of the individual items and the overall measurement model.

Exploratory factor analysis (EFA)

Exploratory factor analysis (EFA), is a useful technique for identifying items that belong to a factor in a multi-factor structure. First, all of the items for measuring the research construct were entered into the statistical program, SPSS for analysis. The program extracted the number of factors and their associated items, and reported the factor loading of each item *on* the respective factors. The resulting factor structure was examined in order to determine the conformity of the structure to an *a priori* theoretical structure. The measurement model was then specified by relating each observed variable to its corresponding latent variable using confirmatory factor analysis (CFA).

Confirmatory factor analysis (CFA)

Confirmatory factor analysis (CFA) was used to confirm that the indicators were sorted into factors corresponding to the manner the researcher had linked the indicators to

the latent variables. CFA plays an important role in structural equation modeling. CFA models in SEM are used to assess the role of the measurement error in the model, to validate a multi-factorial model and to determine group effects on the factors. In this study**,** the researcher adopted the two-step modeling suggested by Kline (2005). He urged SEM researchers to always first test the pure measurement model underlying a full structural equation model**,** and only if the fit of the measurement model was found acceptable, to proceed to the second step of testing the structural model which compared the fit to that of different structural models.

The specified measurement model was estimated using the AMOS 16 statistical program. The validity of an item of a latent variable was determined by the magnitude of the standardized regression estimates (λ) value**,** for the path from an indicator variable to the latent variable in the measurement model. The reliability of all the items used in measuring the latent variable was also indicated by the magnitude of the squared multiple correlations (R^2). Items of the questionnaire that showed reliability and validity below recommended threshold values were removed and the subsequent structural model was assessed using the items that survived the assessments.

Further confirmation of the measurement model using CFA was obtained from evaluating the overall fit indices. A chi-square statistics is commonly used to evaluate model fit, but this statistic is known to be too sensitive to sample size (Kline, 1998). According to Hoyle (1995), there was a general agreement in choosing 'goodness-of-fit' indices. They are the Tucker-Lewis Index (TLI), and Adjusted Goodness-of-fit Index (AGFI), of greater than .90 and the absolute fit of the model, Root Mean Square Error of Approximation (RMSEA) of below .08.

Thus, in this study, a number of fit indices were considered in evaluating structural equation models. Fit indices included the chi-square statistic adjusted by the degrees of freedom (χ^2/df), the Tucker-Lewis Index (TLI), the Comparative Fit Index (CFI) and the absolute fit of the model, Root Mean Square Error of Approximation (RMSEA). The chi-square statistic adjusted by the degrees of freedom (χ^2/df) less than 3 was considered a good fit. For Tucker-Lewis Index (TLI) and the Comparative Fit Index (CFI), values over 0.9 were generally considered an acceptable model fit. A value of less than 0.05 for Root Mean Square Error of Approximation (RMSEA) indicated a good fit (Kline 1998). If the initial measurement model indicated an inadequate 'goodness-of-fit', the model needed to be re-specified, based both on theories and residual matrixes.

If the overall fit of the CFA model was acceptable, the second stage of the two - step modeling was to test a structural model. This test included testing the structural paths between the latent variables**,** as well as the overall fit of the hypothesized model. If the initial model indicated an inadequate overall fit, the model needed to be modified, based both on theories and residual matrixes. After modification, differences in χ^2 statistics were obtained to ensure significant improvement of the modified models.

Assessment of the Structural Model

Assessment of the structural model followed the confirmatory of the measurement part of the model. Using the AMOS statistical program, the full structural model was specified and estimated (Arbuckle, 1999). The criteria for the structural model assessment included the criteria employed for the measurement model assessment**,** as discussed in the confirmatory factor analysis (CFA).

The path significance indicated by the standardized regression estimate assessed the effect of one variable on another variable. The significance level was set at .05. AMOS 16 is capable of assessing direct, indirect and total effects of variables in hierarchical**,** causal relationships among variables in the research model. Standardized regression estimates were also measures of the validity of indicator variables**,** of each construct. The final assessment of the proposed research model was made by examining all the criteria of fit**,** and the model was re-specified until a good fit was obtained.

Steps for Structural Equation Model Assessment

In order to assess this proposed *a priori* research model using the SEM statistical procedure, a preliminary analysis of the measurement model which specified the relationships between the latent variables and their corresponding observed variables, was conducted. Separate testing of the measurement models was required to verify the reliability and validity of the observed variables that were used as measures of the respective latent variables. This preliminary procedure was necessary to ensure that the measurement model fit the sample data**,** in order to proceed with the full model testing (Hoyle, 1995).

In the case of this study, the composite reliability (CR) and variance extracted (VE) were computed separately for each multiple indicator construct in the model. The composite reliability (CR) is a measure of the internal consistency of the construct indicators. More reliable measures provided the researcher with greater confidence that the individual indicators were all consistent in their measurements. The commonly-used threshold value for acceptable reliability was .70 (Hair et al., 1998). Another measure of

reliability was the variance extracted (VE) measure. This measure reflected the overall amount of variance in the indicators accounted for by the latent construct. Higher variance extracted values occurred when the indicators were truly representative of the latent construct. Guidelines suggested that the variance extracted value should exceed .50 for a construct (Hair et al., 1998).

The variance extracted measure is a complementary measure to the composite reliability value. Once the composite reliability and the variance extracted of the measurement model were confirmed, the evaluation of the structural model that showed causal relationship among the latent variables was conducted. This two-stage model assessment was useful in avoiding conflicting interpretation due to interactions between measurement and structural models (Hoyle, 1995). Items with low level of reliability could lead to misinterpretation of model misfit**,** as the source of misfit could originate from within-construct (measurement model) or between construct (structural model) estimation. Thus, the performance of the items in the measurement model was first established so that the results of the subsequent structural modeling could be interpreted confidently.

Structural Equation Modeling

The structural equation modeling (SEM) is based on linear statistical models. It is a major statistical technique that was used in this study. Hoyle (1995) proposed that SEM had at least two advantages over the linear statistical models. First, unlike ANOVA and multiple regression analyses, SEM offered no default model specification requiring instead that the researcher specify the relations in the model. This characteristic was

believed to be an advantage because it required the researcher to think carefully about their data venturing hypotheses about each variable. Second, Hoyle (1995) proposed that the most compelling advantage of SEM was its characteristic of estimating and testing relationships between latent variables. These SEM characteristics met the need of the present research to address empirical questions about the nature of the relationship of variables and factors that best described the implementation of school-based assessment of CAMC among teachers. Another reason for using SEM methodology was to examine the direct and indirect effects of the variables and factors on the degree of implementation.

The structural equation modeling (SEM) confirmatory factor analysis technique was used to determine the nature of the structure of teachers' receptivity to CAMC, teachers' conceptions of CAMC, quality assurance of CAMC and the degree of implementation of CAMC. SEM allowed for tighter specification of multiple hierarchies or paths between factors**,** by utilizing the factor patterns, correlation patterns, covariance patterns and residual values within a data matrix (Hoyle, 1995). Specification of a model included identifying observed variables that loaded onto latent first-order factor, and the relationship of the first-order factors to the second or higher-order latent factors. It was critical to remember that the development of an SEM model was dependent on theory. In other words**,** SEM was a sophisticated correlation technique that ought to be used only in the context of a meaningful set of proposed relationships (Hoyle, 1995). Structural equation modeling generates two types of model, 'measurement' and 'structural'. The measurement models explain the relationships among structures while the structural models predict relationship between factors (Hoyle, 1995).

The measurement model was made up of observed variables (or indicator variables) linked to latent variables via a confirmatory factor model. The measurement model was also known as a confirmatory factor analytical model. The structural model was made up of latent variables linked to each other via systems of simultaneous equations, with arrows specifying the direction of hypothesized causal paths. As such, a structural model is analogous to a path diagram, and structural modeling is likened to path analysis.

The measurement modeling process determined how well one or more**,** of the observed variables (i.e. measurement items) measures each of the theoretical latent variables (i.e. the unobserved theoretical constructs) through confirmatory factor analysis. For instance, in this study, the measurement model showed links between moderation in school-based assessment of CAMC (a theoretical latent variable)**,** and five measurement items that indicated how well those specific observable variables measured the unobservable variable. The structural modeling process determined the strength of the causal structure among the latent variables in the research model. For instance, in this study the structural model showed a path from quality assurance of CAMC (a latent variable) to the degree of implementation (DOI) of CAMC (another latent variable)**,** to indicate that DOI was predicted by quality assurance of CAMC. The previously assessed items in the measurement model were used to assess the structural model.

SEM was chosen as the statistical technique for model testing in the present study as it offered several unique advantages compared to other classical statistical techniques, such as multiple regressions. First, in contrast to other multivariate analyses that assumed no measurement errors in estimating independent variables, SEM took into account errors

in observed variables. This meant that a more precise estimation of observed theoretical constructs could be obtained using the observed variables that were measured through the actual specific items of the questionnaire ; and since the theoretical model underpinning this study was composed of latent variables measured by multiple observed variables, SEM was considered a suitable statistical procedure.

Second, unlike other multivariate analyses that tested only a single step in a hierarchical model**,** or did not incorporate measurement data in the testing of a model, SEM has an advantage in that it was able to test a series of interrelated causal relationships simultaneously**,** as well as incorporate measurement data. Consequently, SEM was able to estimate the size of the total effect of each independent, on dependent variables in the multi-stage path model**,** by providing both direct and indirect effect.

The direct effect registered the strength of the direct path from a predictor variable to a particular dependent variable**,** as indicated by the path coefficient. The indirect effect registered the strength of indirect paths from a predictor variable to a dependent variable through mediator variable(s) in the structural model. This determined the total effect of both direct and indirect variables on the dependent variables in the structural model. The use of SEM in this study provided a complete perspective of the manner in which each of the independent variables affected the dependent variables, either directly or indirectly.

The multiple group analysis was used to test the moderating effects of the demographic variables selected for this study. The demographic variables are gender, training, experience and field of specialization. The tested structural model was used with

all the groups and was modified to obtain the parsimonious model that better predicted the influences of the selected factors on the degree of implementation of CAMC.

Summary

This chapter detailed the rationale for using quantitative methodology. It also discussed the process of instrument development and the structural equation modeling approach used in this study. The first part of this chapter explained the research design that was utilized in this study, followed by a detailed description of the research procedures, and how the samples were selected for this study. The data collection method and the development of the instrument was also been outlined. Finally, the data analysis using structural equation modeling approach used in this study, was discussed. The next chapter displays results and findings gathered by this study.