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A Framework for Teaching Competencies in Technology and Technical Competencies: A Confirmatory Factor Analysis

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Abstract: One important role of a university is the process of transferring knowledge to the students. Despite of the massive literature behind the issue of the quality of teaching in universities, much is still argued about what contributes to quality teaching. Nevertheless, literature has shown agreement that academics or the teaching faculty members play an important role in achieving the mission of delivering quality teaching and making learning a quality process. Additionally, with the advancement of technology, teaching staff must also be equipped with knowledge in technology and technical competencies. This study is part of a larger study on teaching and learning in a technical university. The objective of this study is to develop and validate a framework of teaching and learning competencies among the teaching staff of Universiti Teknikal Malaysia Melaka (UTeM). The constructed framework for teaching and learning which is an adaptation from literature on teaching and academic competencies, consists of the following components: pedagogical content knowledge, instructional quality, classroom management, climate, mindset and values, it competencies and technical competencies. This study however, reports only two components, i.e., classroom management and climate. A confirmatory factor analysis was utilised to assess the adequacy of the two components in the proposed framework. The findings of the study shows that the items for teaching competencies from the perspectives of pedagogy content knowledge and instructional quality should be broadly defined. Additionally, the non-technical factors such as the abilities to create innovation in teaching and learning, integrate technology, identify students' ability and utilise various measurement while evaluating students' performance, are deemed necessary for lecturers of higher education. This study benefits today's university's top management particularly the academic managers in search of intervention programmes to further enhance the quality of teaching and learning of the university.

Key words: Teaching and learning, technology competency, technical competency, teaching, competence

INTRODUCTION

The current context of higher education is dynamic. Demands for change in higher education are triggered by catalysts which among others is the advent of technology (Kamarudin and Starr, 2012). In today's globalised world of higher education, academics are faced with the increasing pressure to provide quality teaching to students. Additionally, academicians are required to continuously develop themselves professionally and more specifically in relation to their teaching competencies.

The need to develop quality teaching competencies in higher education matters for student learning outcomes. However, fostering quality teaching competencies presents higher education institutions with a range of challenges. This comes at a time when the higher education sector is under pressure from many different directions to better themselves to ensure the universities survival and relevancy in the world of globalization. Higher education institutions need to ensure that education that they are offering meets the expectations of students, as well as the requirements of employers. This is easier said than done because higher education institutions are complex organisations. The presence of diverse and ambiguous objectives and semi-autonomous organizational structures in the form of faculties, departments and research centres for excellence, make aligning the vision and strategies with bottom-up

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practices and innovations in teaching and learning a challenging exercise. It is therefore important for higher institutions to develop faculty members that have effective teaching competencies with excellent pedagogical practices and instructional qualities thus, ensuring quality teaching. This is because educational institutions directly serve students. Being responsive to students' needs and demands contribute towards improving the effectiveness of student outcomes (Barnes and Lock, 2010).

Literature review: Literature has shown that there have been considerable attempts by researches to investigate what teaching competencies are required in modern, more student-centred higher education teaching contexts nowadays (Smith and Simpson, 1995; Shulman, 1986). Tigelaar *et al.* (2004) defines teaching competencies as an integrated set of personal characteristics, knowledge, skills and attitudes that are needed for effective performance in various teaching contexts. In this aspect, a framework of teaching competencies adjusted to current landscape and context of higher education is instrumental for evaluating quality teaching, as well as set professional learning goals.

In another study, Brok and Van Tartwijk highlights that the creation of positive teacher-student relations, managing and monitoring student behaviour, and teaching for student attention and engagement are among the teaching competence required nowadys. To add, teachers not only impart information and knowldge, they are also expected to be competent in managing the physical as well as the psychosocial aspects of the classrooms. This is because due the overall learning environments, atmosphere, ambience, tone and ethos influence students' satisfaction and performance. Teachers too should possess skills such as planning, management, communication, evaluation as well as interpersonal skills (Smith and Simpson, 1995). Management skills are highly important in managing the learning environment which ensures optimum learning and conducive environment for learning to take place. Desirable too is communication skill which is needed promote student engagement, enhance motivation, build confidence and collaboration among students.

According to Raob *et al.* (2012), the technology competencies is the ability to select and apply contemporary forms of technology to solve problems or compile information. Additionally, technical competencies is defined asknowledge of and skill in the exercise of, practices required for successful accomplishment of a business, job, or task (extracted from http://www.businessdictionary.com/definition/technical-competence.html). In general, this study investigates the prevalence of teaching competencies in UTeM particularly in technology and technical competencies. A framework of teaching competencies is proposed with the following components: pedagogical content knowledge, instructional quality, classroom management, climate, mindset and values, it competencies, and technical competencies. In this study, the focus is on the development and validation of this framework of technology and technical competencies among UteM academicians.

MATERIALS AND METHODS

A review of journals on teaching, as well as higher education journals shows that there is a magnitude of literature on quality educational process and outcomes. A quantitative method was employed for the collection of data. A total of 230 lecturers of UTeM participated in this study, 120 males and 110 females. The instrument used in the study was a questionnaire consisted of 109 items, 10 items were for the subjects' demography and 99 items were for the perception of lecturers on teaching competencies in UTeM. The items for the perception of lecturers on teaching competencies were using a five point Likert scale (Scale 0 denoting 'Irrelevant', scale 1 denoting 'Strongly Disagree', scale 2 denoting 'Disagree', scale 3 denoting 'Agree' and scale 4 denoting 'Strongly Agree'.

As mentioned earlier, a framework of teaching competencies is proposed with the following components: pedagogical content knowledge, instructional quality, classroom management, climate, mindset and values, it competencies and technical competencies. The components of mindset and values and technical competencies were added as new components for teaching competencies.

The items for this instrument was validated by a group of experts identified from UTeM as well as other public university. Then, we piloted the instruments to 30 samples. Subsequently, the collected data was analysed using SPSS to determine its validity. The final version of the questionnaires consist of 109 items from 154 items.

Sampling was done using stratified random sampling. A total of 480 survey was distributed to academicians but only 230 were returned. Data collected was then analysed using AMOS 21.0 to confirm the selected items for each component thus to validate the framework. This study reports the result of confirmatory factor analysis which explicitly validates the framework of technology and technical competencies as components of teaching competencies for UTeM academicians.

RESULTS AND DISCUSSION

Confirmatory factor analysis: The Confirmatory Factor Analysis (CFA) is the first step conducted prior the SEM analysis. Here, the CFA was meant to define the individual constructs and was employed for three major purposes, namely to test for model fit, convergent validity and construct reliability (Loehlin, 2013; Rencher and Christensen, 2012).

For the model fit test, two criteria were being considered; the fit indices and the individual factor loadings of each item in a construct. As shown in Table 1 is the set of criteria for fit indices and their recommended value.

According to Rencher and Christensen (2012) and Loehlin (2013), in the model fit test, the standardised factor loadings must be between 0.5 and 1.0 and should be positive. The indicators that do not meet these criteria shall be deleted. The concentration should be given more to an indicator or item that associated with high Modification Index (MI). Other considerations that need to be considered are referring to the previous literatures on the importance and significance of the items in the question naire. If the item (s) is/are to be considered as important, it should be retained in the model (Sedek *et al*., 2012)

The next test is the convergent validity test. This test is meant to identify the validity of each item that presumes to measure a construct (Kline, 2011). The convergent validity could be tested using the Average Variance Extracted (AVE). The AVE value which is = 0.5 indicates a high convergent validity.

The final test in the CFA is the Construct Reliability test (CR). The construct reliability test is a measurement of the internal consistency of the observed indicator or variables. If the construct reliability is = 0.7, the item is considered reliable.

It is worth to note that once the three tests were conducted in the CFA, the number of items for each constructs was expected to be reduced and there might be or might be not a model that will be found to be unfit. So, if there was only one model identified unfit, the construct was considered as unreliable and ought to be omitted from the model. However, if there were more than one unfit model, the models should be combined and renamed as a new construct (Sedek *et al*., 2015; Loehlin, 2013).

The Analysis of Moment Structure (AMOS) was used to validate the framework of classroom management and climate as components of teaching competencies for UTeM academicians. Table 2 reports number of items in each domain, number of items omitted and the percentage of items omitted in each component.

Table 1: Fit indices and recommended value for CFA

Fit Indices	Recommended value
CMIN/DF	≤05.0
Relative x^2	≤05.0
CFI	≥0.90
IFI	≤0.90
RMSEA	=0.80
Factor loadings	Between .5-1.0 positive

Table 2: Number of items in each domain, number of items omitted and the percentage of items omitted in each component

Component	Number of items	Number of items deleted
Technology Competency	9	4
Technical Competency	10	4

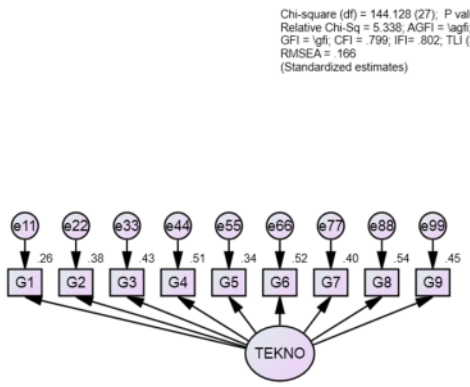

Fig.1: Technology competency before CFA

In terms for pedagogy content knowledge (PCK) factor, before CFA, there were 10 items (B1-B8) in measuring factor. The initial model indicated a poor fit (CFI = 0.914; IFI = 0.915; RMSEA = 0.116). Since, the model was considered as unfit, the process of improving the model was conducted by concentrating on the standardised factor loadings and referring to the Modification Index (MI) (Fig. 1).

After CFA, all factor loadings were observed and five items (B1, B2 and B5) were identified to be < 0.5, were deleted. This could be due to the characteristics of the items themselves. The items could be too detailed, inappropriate and redundant with other items within the same construct. Then, the test was conducted again and it showed a good fit (CFI = 1.000; IFI = 1.004; RMSEA = 0.000). As a result, the construct met the model fit. The remaining five items (B3, B4, B6, B7 and B8) were found to be the most appropriate items measuring the classroom management as one of the main components for teaching competencies (Fig. 2).

Meanwhile, in terms of instructional quality factor, there were 7 items (C1-C7) in measuring the factor. The initial model already indicated a good fit (CFI = 0.972; IFI = 0.972; RMSEA = 0.072). Since, the model was considered as fit, the process of improving the model was unneeded (Fig. 3and 4).

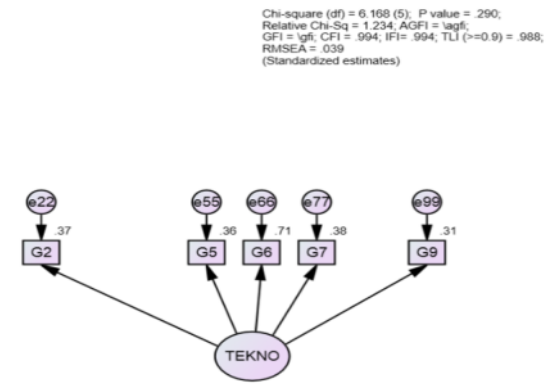

Fig. 2: Technology competency after CFA

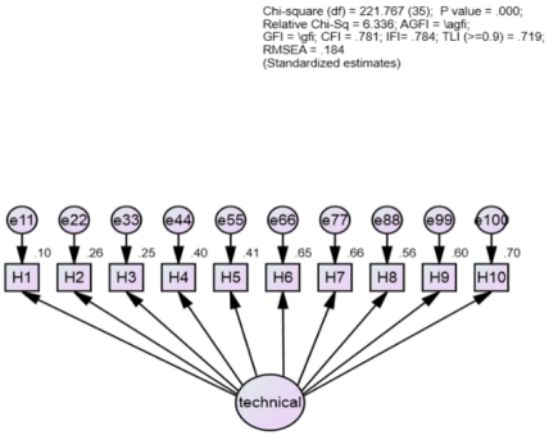

Fig. 3: Technical competency before CFA

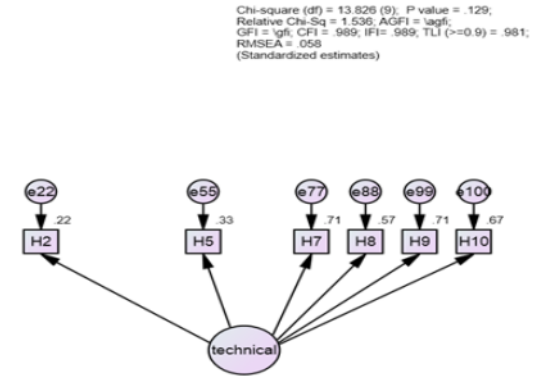

Fig. 4: Technical competency after CFA

CONCLUSION

The main objective of this study is to validate the framework of technology competency and technical competency as components of teaching competencies for UTeM academicians. The results generally indicate that the items accepted are the most fitting to measure teaching competencies in pedagogy content knowledge and instructional quality. As can be seen in Table 3, 12 items remained and 3 items were omitted. The omitted items were believed to share similar features in terms of definitions and measure up to the same criteria. The items that were omitted in classroom management are the emphasis on the lecturers' ability to develop related syllabus, conduct reflection as well as compile teaching and learning resources may be too detailed, too prescriptive and perhaps too technical. Additionally, the findings of the confirmatory factor analysis show that the items for teaching competencies from the perspectives of pedagogy content knowledge and instructional quality should be broadly defined. The non-technical factors such as identify students' ability, the abilities to create innovation in teaching and learning, integrate technology, and utilise various measurement while evaluating students' performance are deemed significant and important for lecturers of higher education.

The findings also indicate that the criteria of using a simple language utilising different type of intonation while teaching as well as optimizing students' intention by varying learning activities are found to be appropriate for instructional quality. The reason may perhaps be that inward-looking approach in teaching is less appropriate nowadays. This is in line with current teaching approaches for higher learning which give more focus on cooperative learning which promotes social inter dependence, engagement and active participation during class. Teachers must be able to create and maintain positive teacher-student and peers relationship in order to keep the students fully engaged in the classroom.

As a summary, from the perspectives of classroom management and climate, maintaining a positive classroom environment specifically to stimulate students' interest, engagement and motivation in learning, having positive rapport with students, showing high expectations of them, and fostering the value of social interdependence among the students are important factors that university teachers need to strive for, for quality education and learning to take place.

As indicated in the findings, a new framework of teaching competencies shows that lecturers should have an adequate knowledge in terms of pedagogy content knowledge and instructional quality to foster the development of effective teacher-student learning activities. Additionally, lecturers must also be creative enough to create a respectful, collaborative learning environment to enhance students' positive social behaviour and to stimulate students' proactive

participation in the classrooms. The framework proposed in this study may prove beneficial to academic and human resource development managers in universities for planning, developing and managing the appropriate intervention programmes for the academic staffs in the strive for high performing university teachers for the advancement of the universities.

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