CONCEPTUALIZING THE MEASUREMENT TOOLS FOR TEACHING 4.0 COMPETENCIES AMONG EDUCATORS IN HIGHER EDUCATION INSTITUTION

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ABSTRACT

Education 4.0 revolution has transformed the education system in the way of teaching and learning to meet the new millennials demand. This requires educators to master knowledge in line with the implementation of varieties of technology tools to provide the most effective teaching strategies. Teaching method has been given high emphasis in higher education institutions. These includes skills and competency required to apply various innovative and creative teaching methods in providing differentiated instructions to students. There are limited studies done concerning the Teaching 4.0 competencies. Due to this, there is also limited tools of measurement to measure Teaching 4.0 competencies. Thus, the aim of this study is to devise a conceptual framework as a basis for developing assessment tools of measurement for Teaching 4.0 competencies. The TPACK (technological, pedagogical, and content knowledge) model is expanded with the addition of two new variables: differentiated instructions and teaching competency. Survey items will be distributed to random samples of educators in higher education institutions. Validity tests and analysis will be run using the Rasch measurement model. Findings from the development of this instrument's model could be the solution to provide a comprehensive Teaching 4.0 competency measurement tools for educators in higher education institutions.

Keywords: Teaching 4.0, differentiated instruction, teaching competency, higher education institutions.

INTRODUCTION

The industrial revolution has had a huge impact on life systems with the implementation of various technologies. Diwan (2017) lists some technological advances that have gone through a phase of transformation such as the use of artificial intelligent (AI), robotic, internet of things (IoT), 3D printers, cloud computing and smart tools or machines. This transformational phase has also caused major changes to the education system in Malaysia, including in higher education institutions. This revamp of education system is known as Education 4.0. Fisk (2017) explained that Education 4.0 has changed the education system by providing a new shift in knowledge transferring where the teaching and learning process no longer relies on traditional methods. It is no longer concerned with the experience and knowledge of educators and goes beyond that. From these changes, various teaching strategies have been introduced in Malaysia that changed the style of teaching such as hybrid learning, long-distance learning, blended learning, and online learning. All these teaching methodologies are known as Teaching 4.0 and are in line with aspirations of the Ministry of Education Malaysia as stated in the ninth shift of Malaysian Education Development Plan 2015-2025 (Higher Education) which emphasizes online globalized learning (Ministry of Higher Education Malaysia, 2021).

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Thus, educators need to improve their skills and expertise in applying appropriate technology to produce a creative, innovative, and effective teaching method. The need for these skills is very important to educators in higher education institutions. However, the extent to which educators are skilled and competent in using technology to produce effective Teaching 4.0 is still questionable and there are limited empirical evidence concerning Teaching 4.0 competencies.

The challenge as an educator is how to convey knowledge effectively. They need to ensure that teaching objectives can be achieved and at the same time create a teaching method that is able to attract students. Teaching 4.0 is still new in the Malaysian teaching system. Although there are various programs trainings and incentives done by the Ministry of Education Malaysia, the extent to which it is really applied in every educator's teaching methodology is still questionable. Although the use of technology is common and encourages in the education system, including in Higher Education Institutions, there is still no clear measurement tools providing empirical evidence on Teaching 4.0 competency among educators in Malaysia. The problems raised in the issue of Teaching 4.0 in Malaysia are presented in Table 1 below.

Table 1: Problem of Teaching 4.0 in Malaysia

Authors	Problem
Mokhtar & Noordin (2019)	Problems of limited knowledge, ability, and exposure to Industry 4.0 in higher education institutions in Malaysia
Saud et al. (2018)	Overall, it was found that the readiness of educators to apply the IR 4.0 element is still at a moderate level.
Jafar et al. (2020)	Technical and academic institutions should create opportunities for technological adaptation, lifelong learning, and future competency sets to meet the challenges of rapidly changing professional competency requirements for TVET educators in Industry 4.0.
Kowang et al. (2020)	Environmental competence (referring to the creative skills and interdisciplinary thinking of educators by creating a R&D environment that fosters 21st century learning processes) is at a low level.

According to the problems listed above, educators need to implement technology 4.0 into their teaching methods. This has also led to a research gap for studies to be conducted on the impact of technology 4.0 use especially in higher education institutions. There is still no appropriate measurement tool built to measure the level of skills and competencies of educators in Teaching 4.0. Therefore, the objective of this research is to construct appropriate instruments to measure the competency of Teaching 4.0 among educators, especially in higher education institutions. Teaching 4.0 assessment instrument is a tool which consists of new develop items adapted from the Technological, Pedagogical and Content Knowledge (TPACK) and a new measurement tool was built with the hope of creating a valid instrument in testing more effectively the level of competence of educators.

Teaching 4.0

Teaching 4.0 is a teaching method with less dependency on talent skills or experience alone. It requires educators to be proficient in handling teaching aids and using the most efficient facilitation tools to enhance student understanding. Teaching 4.0 can help improve students' understanding in a better way because it emphasizes the atmosphere of reality and encourages self-directed and differentiated learning (Le, 2020; Yunos & Din, 2020). It is also stated that teaching should emphasize and prepare students to learn on their own (self-learning), think on their own (self-thinking) and do self-improvement (self-improvement). Teaching 4.0 is a transformation system in teaching where the educator only serves as a facilitator who helps students learn in self-learning methods (Mokhtar & Noordin, 2019). It is a transformation of existing teaching methods to new teaching strategies that encourage more exploration and the use

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of various smart technology (Mourtzis, 2018). In addition, the classroom culture in Malaysia has a very large number of students. This creates challenges for large classes but generates opportunities to use educational technologies and learning analytics to support the educator with this (Abdul Rahman, 2015). Thus, to have an interactive Teaching 4.0, educators are encouraged to adapt technology 4.0 into their teaching strategies. Technology 4.0 is one of the teaching aids that can help make the current learning process easier and knowledge can be conveyed in various ways such as analytical technologies with divers' applications to convert data into information, artificial intelligence (smart phones, smart printers, smart board) and mixed reality where it can combine a real and virtual human-machine interactions generated by computers (Horizon report, 2018). An adaptation of these various technologies will help educators to be more innovative in producing effective teaching and transferring knowledge to different levels of students.

Teaching 4.0 Differentiated Instructions

Differentiated instruction (DI) or differentiated teaching is a teaching method that considers the different needs of the students, inclinations, interests, differences between levels of understanding and the capabilities of students (Aldossari, 2018; Alsalhi et al., 2021). DI is also a teaching strategy that can meet various criteria of students individually as opposed to teaching delivered generally to a large group of students (Alsalhi et al., 2021). Educators can differentiate the learning content using a variety of tools to create instructions for what is to be taught, how the content should be taught, how learning will be evaluated while differentiating the student's level of readiness (Tomlinson, 2014).

Differentiated instruction is a teaching approach which enables educators to prepare a strategic and effective plan to meet the students' learning. It is a teaching and learning theory that employs a variety of teaching approaches on the same group of students or in the same classroom. This approach accommodates the needs, interests, aptitudes, personalities, different abilities, and experiences of a variety of students (Mulder, 2014; Onyishi & Sefotho, 2020). DI can meet personalized learning which is believed to enhance students' achievement and performance (Hamdan et al., 2015). To differentiate instructions, instructors need to make initial observations and understand each difference and level of student learning needs. Educators need to provide a variety of approaches, learning methods and how students will receive the learning information that will be presented. Adapting the implementation to fit the needs of various contexts should provide similar positive changes to the students' learning experience as suggested by Gabarre et al. (2015). Instructors need to provide differentiated instruction that includes the following 3 items, namely (1) content, (2) teaching process, and (3) assessment (Aljaser, 2019; Alsalhi et al., 2021; Onyishi & Sefotho, 2020). In the process of teaching preparation educators not only need to emphasize how differentiated instruction is used to deliver lesson content to students, but also need to adapt the learning approach used with the most appropriate pedagogy and conform to the curriculum (Onyishi & Sefotho, 2020).

Teaching Competency

Teaching competency of educator is defined as professional skills capable of realizing themselves in a particular type of job, adapting to changing needs in their teaching profession, and managing their professional mobility and self - regulation (Symanyuk & Pecherkina, 2016). Teaching competency is the skill of mastering the content of the subject taught, pedagogical knowledge, ability to choose teaching resources, ability to diversify teaching strategies, technological skills, good communication skills with students and having a positive attitude and personality such as motivation, humor and confidence (Ahmad & Jinggan, 2015). Educator competencies can be divided into several categories namely technical competence, non-technical competence, personal traits, motives and self-construction, and mental and physical fitness (Jafar et al., 2020).

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METHODOLOGY

Instruments Development Process

The instrument development process is based on Recker and Roseman's (2010) model. This model is suitable for developing valid and reliable measurement instruments for theoretical constructs. It is recommended for use by researchers who plan to develop new measurement instruments especially for conceptually defined theory constructs with existing theories. The details of the model are presented in Figure 1 below.

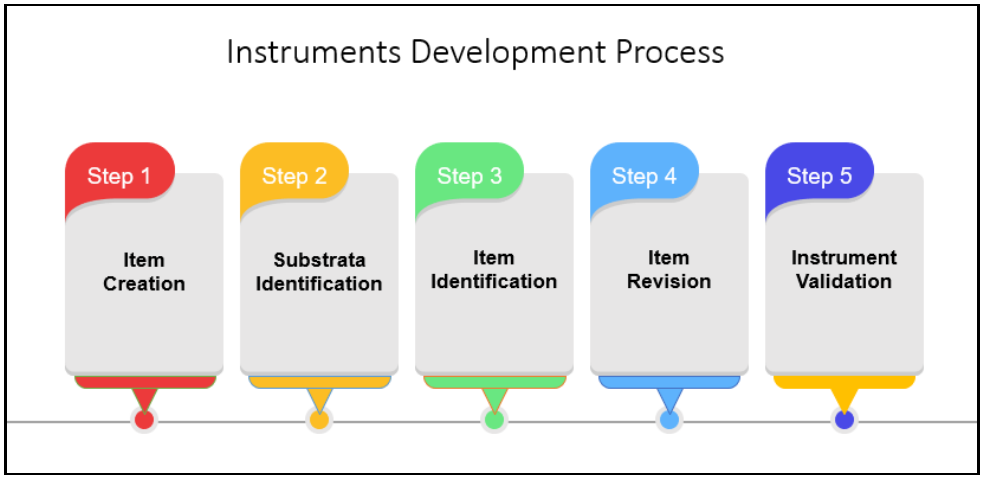

Figure 1: Instruments Development Process by Recker & Roseman (2010)

There are five steps in these processes. The first step is item creation. The purpose of this step is to ensure the validity of the content of the items measured. Items should be prepared to fit the content domains of the construct definitions to display content validity (Anastasi, 1986). The second step is substrata identification where a procedure called 'own category test' were done to display a convergent and discriminant validity (Sherif & Sherif, 1967). Categorization will be used in this process by sorting the candidate items into several constructs based on their similar and dissimilar meaning. A panel of experts will be asked to identify and categorized this process. Next, a cluster of similarity will help to reflect on the domain substrata, and this will be used to assess the coverage and the representatives of the items. The third step is the item identification stage, to establish differences in content validity between the candidate items. This step is done to drop items that show little or poor potential for high validity. The panel experts selected will use points scale as suggested by the model, then average and rank the item according to their content validity. The fourth step is item revision. This process is used to revise and reduce set of candidate items to a final set of high potential candidate items. This is done to improve the items' potential validity and reliability. The fifth step is the instrument validation adhering to a more qualitative analysis. It is not a rigorous statistical test but rather assesses and gathers experts' comment for assessment.

Instrument Validity Analysis

Instrument statistical analysis test will be conducted using the Rasch measurement model from George Rasch (1960). The main basis of the Rasch model is to separate individual abilities from instrument quality. The Rasch model is considered among the simplest response models because it has a parameter model which can measure the difficulty of the item and the ability of the person being tested (Abdul Aziz et al., 2013). There are ten analysis that will be carried out to test run the validity of the item. This is shown in Figure 2 below.

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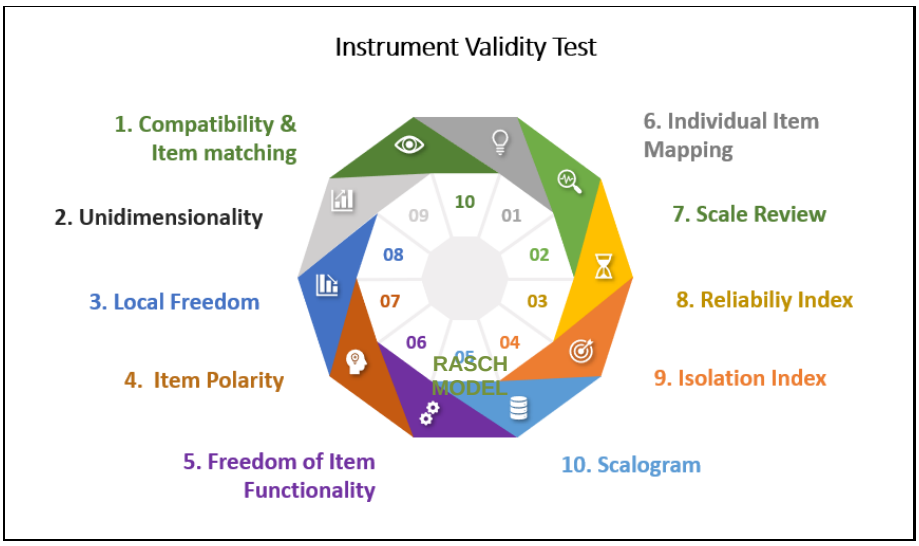

Figure 2: Instrument Validity Test using Rasch Measurement Model

To test the validity of the instrument, RASCH model will be use to run the test using the instrument construction model by Miller, Lovler and McIntire (2013). This data analysis procedure will test whether the items fit. Item compatibility statistics indicate the extent to which a piece of data is compatible with the Rasch model. Next, unidimensionality is determined. This means items in a constructed instrument measure a single capability. To check for local dependency, this test will be performed to evaluate the extent of an individual's response ability to any of the constructed items and to verify that the items are not related to other response items in the same construct.

Item polarity is used to evaluate the extent the constructed items can measure the same construct and all items are part of a single sub-construct. The fifth analysis is performed to test the item functional differences. This test will be performed to identify items that showed early signs of injustice. It can be determined by looking at the DIF value of the contrast which is between +0.5 to -0.5 logits. Individual item mapping is done to show the distribution of difficulty of instrument items that are matched with the distribution of the ability of the respondents who answered the question. Seventh, scale review will be conducted to test and evaluate the effectiveness of the scale. The researchers will make a scale review based on six appropriate criteria suggested by the model used to evaluate the effectiveness of a measurement scale. Reliability in the Rasch model indicates the reliability of an individual's abilities aimed at determining the consistency of an individual's response. Item difficulty reliability is intended to estimate how well items are coherent or related to each other. The isolation index in the Rasch model will be divided into two parts; namely the individual isolation index, and the item segregation index. The individual isolation index is used to estimate the ability of an instrument to divide individuals into several levels in the measured construct. On the other hand, the item segregation index aims to estimate individual abilities by segregating item difficulty to several levels in the measured construct. The final process, the scalogram analysis will be performed to detect misfit respondents.

EXPECTED RESULTS AND FINDINGS

The Rasch measurement model is expected to test the constructed items. It is proven that instruments developed and tested with Rasch are suitable for use as a large number of domains have been taken into account and measurements are based on selected evaluations, evaluator rigor as well as domain difficulty level. Thus, this study is expected to produce a valid assessment tool or instrument for measuring Teaching 4.0 competence accurately. The findings are expected to be a comprehensive analysis and the instruments constructed should be compatible. The instruments will validly measure the level of teaching skills of an educator. Each instrument of item used during the evaluation can be proven by testing its statistical compatibility.

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CONCLUSION

Looking Forward and Further Perspectives

A conceptual framework is constructed as a guideline (Figure 3) for this research. This conceptual framework illustrates how the teaching 4.0 competency measurement instruments will be developed. There are several variables to develop Teaching 4.0 competency instruments as shown in Figure 3. Based on the Technological, Pedagogical and Content knowledge or TPACK Model (Mishra & Koehler, 2006), three variables are used: (1) Technological Knowledge (TK), (2) Pedagogical Knowledge (PK) and (3) Content Knowledge (CK). Another two new variables will be added to this research which are (1) differentiated instruction (DI) and (2) teaching competency (TC). The selection of variables is based on the constructs identified from a selection of recent literature reviews and interviews done with experts concerning the following three keywords: (1) Education 4.0, (2) Teaching 4.0, and (3) teaching competency. Thus, all the constructs were grouped and categorized into five variables to be used in the Teaching 4.0 competency instruments.

With the development of Teaching 4.0 competency instruments, the authors aim to achieve several objectives which are: (1) to study the significant impact of the use of technology 4.0 in differentiated instructions and (2) to study the significance impact on the use of technology 4.0 in educator's teaching competency. Thus, a valid and reliable instrument is needed by running the psychometric test using RASCH model or other suitable measurement tools. A wide distribution for sampling purposes is suggested to educators at all levels in higher education institutions. Given that the importance of the higher education system is extremely high, an important emphasis on educator teaching methods is essential. There is a potential to further the investigation to different levels of teaching such as primary and secondary schools for future studies.

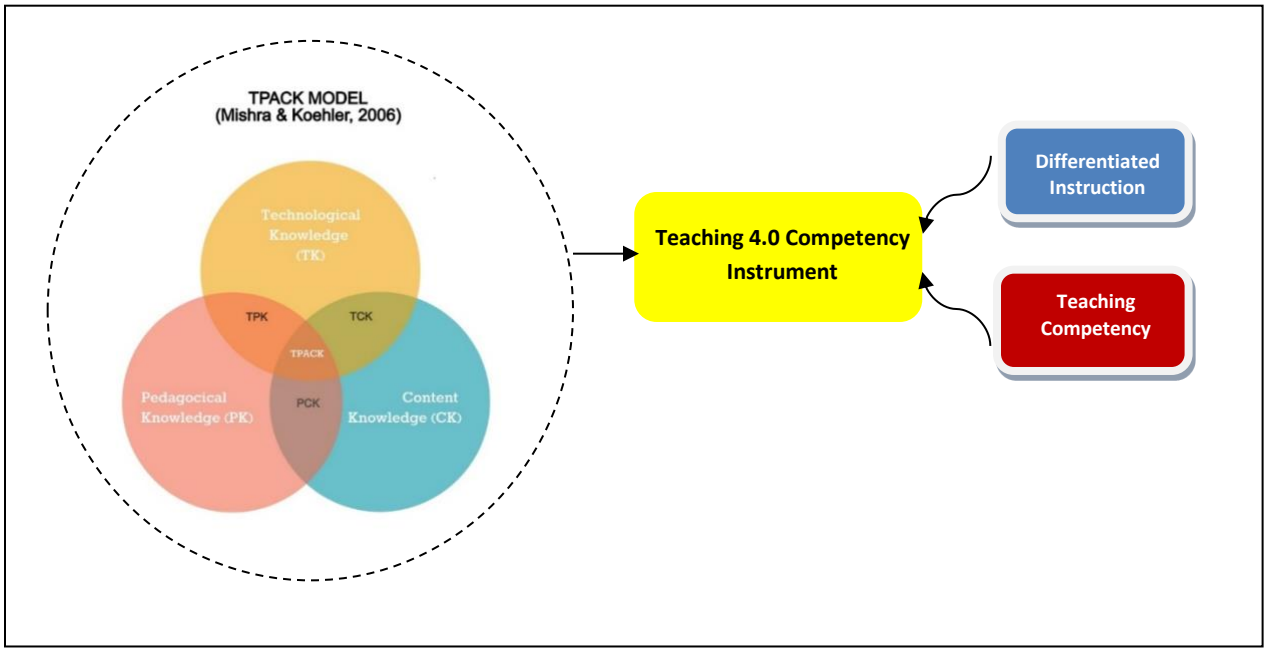

Figure 3: Conceptual framework of Teaching 4.0 Competency Instrument Development

As a conclusion, new instruments to measure Teaching 4.0 competency will be developed based on the TPACK model with two additional variables which are differentiated instruction and teaching competency. These will be tested using the Rasch measurement model. The scope of this study supports the importance of building measurement instruments to test and evaluate the skill level of educators especially in terms of teaching using technology 4.0. Therefore, a valid construction of instruments will facilitate the measurement process and should help provide empirical evidence to be used as a reference for higher education institutions and for future studies.

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