

# Measuring Teacher Competency for the Era of Education 4.0 in Malaysian Secondary Schools

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**Abstract:** The main purpose of the study was to measure the level of teacher competency for the era of Education 4.0 (TCEdu4.0) in Malaysian secondary schools. The study employed a quantitative approach with a total of 1,078 teachers completing the survey. Descriptive statistics were applied for data analysis. The results revealed that, i) teachers achieved *Quite Good* level in the practice of TCEdu4.0 and its six dimensions; ii) among the six competencies of TCEdu4.0, teachers achieved the highest mean score in *Pedagogical Psychology and Assessment* but obtained the lowest mean score in *Functional and Research Competency*; and iii) teachers achieved at the upper level of *Quite Good* in *Pedagogical Psychology and Assessment, Self-Management and Interactive Competency, and Problem Solving* but at a lower level of *Quite Good* in *Technological and Digital Competency, Leading Learning and Mentoring and Functional and Research Competency*. The study summarised that only professional development programmes that are teacher-driven can empower teachers to take ownership of their learning experiences as they recognise teachers as professionals with valuable insights for teachers' continual growth. The study offers one small step in the direction of continuous teacher development and growth in the face of the FIR both locally and internationally.

**Keywords:** Education 4.0, Fourth Industrial Revolution, Teacher competency, Teacher education, Teacher professional development

## 1. Introduction

The Fourth Industrial Revolution (FIR) has gained tremendous attention and has become one most frequently discussed topic in recent years. In line with the current and anticipated requirements of the industry, Education 4.0 was developed to respond to the demands of the FIR; the education arena can stay vibrant in a rapidly changing environment (Tai & Omar, 2021). One major characteristic of Education 4.0 is to transform the education system from one that is procedures and facts oriented, to one that constructs and applies knowledge actively to deal with complex problem solving collaboratively in the real world (Tai,

Omar, Khalip & Arsalan, 2022). It is widely recognized that Education 4.0 can empower students towards innovation, accelerate student achievements and enhance student learning outcomes; it will help to produce well trained and qualified young generations who possess advanced technical skills, social skills, and interdisciplinary thinking to thrive in a highly automated, networked, virtualised and technologically-driven world (Brown-Martin, 2018).

Substantial literature has revealed that teacher quality is a critical predictor of student learning and hold considerable promise for effective student outcomes (Harris, Jones & Huffman, 2018). As the role of the teachers is changing along with the challenges of Education 4.0, it is essential for teachers to equip themselves with sufficient competencies to cope with the changes effectively. In Malaysia, research has found that 50% of lessons in the secondary schools are being conducted in an ineffective manner (Ministry of Education [MOE], 2013); almost 80% of the teachers in Malaysia spent less than an hour a week applying ICT in the classroom (MOE, 2013); the level of teachers integrating ICT into teaching was low (Umar & Abu Hassan, 2015); teachers are slow to change and using outmoded “traditional” methods of teaching and learning (Pauline, Canrinus & Wong, 2020); and in terms of international assessments such as TIMSS and PISA, Malaysian students had poorer performance than their international counterparts over the last ten years (Joseph, 2017).

This depressing trend has prompted an investigation into the competencies of schoolteachers as their competence correlates closely with student learning and achievements (Harris, Jones & Huffman, 2018). Indeed, the objective of the 4th shift of the 11 major shifts delineated in the Malaysia Education Blueprint 2013-2025, “Transform Teaching into the Profession of Choice” is to enhance and raise the quality of the teaching profession (MOE, 2013). One of the important steps in making teaching a preferred professional choice is to implement competency and a performance-based career progression as effective teaching and learning have a crucial relationship with teacher professional competencies (Muijs et al., 2014). Given this backdrop, it seems functionally apt and timely at this juncture to examine if Malaysian secondary school teachers were competent to teach in the era of Education 4.0. The findings would provide valuable information on whether school teachers are equipped with relevant competencies to prepare students efficiently to meet the demands and challenges of Education 4.0.

## **2. Literature Review**

### **2.1 Teacher Professional Development in Malaysia**

Teacher professional development (TPD) is widely conceptualised as activities that develop teachers’ knowledge, skills, expertise, and attitudes; pre-service training provides teachers with a solid foundation towards improving teacher practice from day one, whereas in-service training allows teachers to develop and grow to stay up to date with the most recent developments in pedagogy (McChesney & Aldridge, 2019). Teacher education and in-service training are two pathways of TPD to improve teacher learning to reframe teaching and learning practices that are contingent to students’ needs (Harris, Jones & Huffman, 2018). In Malaysia, teacher education is under the purview of the Teacher Education Division, MOE. Initially, the primary school teacher training was under the jurisdiction of the Institute of Teacher Education (ITE) and secondary school teacher training under government-funded universities (MOE, 2013). Presently, both ITE and universities may now train teachers for secondary and primary schools (Mahmud, Mohamad Nasri, Samsudin & Halim, 2018).

There are 27 ITEs in Malaysia which offer students fresh out of secondary school or those with an undergraduate degree to be teacher trainees; a three-year diploma programme and a post-graduate certificate programme are offered for the trainees (Jamil, Razak, Raju & Mohamed, 2007). Since 2009, these ITEs have been upgraded into degree-conferring organisations, providing prospective teachers the Bachelor of Education (Primary) (Adams & Muthiah 2020). On the other hand, faculties of education in public universities confer the Bachelor of Education as a four-year programme. Besides, they also provide the Postgraduate Diploma in Education for those who are interested in pursuing a teaching career after acquiring a non-educational first degree (Jamil et al., 2007). Both ITEs and public universities adhere to a

standard curriculum developed by the Malaysian Qualifications Agency although the universities are granted autonomy to develop their own curriculum (Adams & Muthiah, 2020).

Besides, in exploring ways to capture youngsters from a wider range of backgrounds and inspire them into a teaching career, Teach for Malaysia (TFM) was established in late 2010; this programme was a springboard from the success of Teach for All programmes such as Teach for America in the USA. It is an innovative effort between the MOE and the private sector in Malaysian teacher education (MOE 2013). With support from various corporate sponsors, this two-year programme targets students who have a strong academic track record, and leadership and management skills. While pursuing a professional qualification in teaching, the TFM fellows are placed in high-need schools as a full-time salaried teacher (MOE, 2013). Coaching is provided during their placements; a coach is assigned to help the fellows on their journey of personal growth and to develop a solid foundation towards making effective contributions in their profession. Besides gaining first-hand experience in teaching and problem solving, TFM also offers a fully sponsored qualification that allows the fellows to continue teaching in the public school system (MOE, 2013).

After having embarked on their professional teaching careers, the in-service training programme is important as a mechanism to re-skill and up-skill teachers with relevant competencies (Jamil et al., 2007). The cascade model is widely used for this type of TPD interventions; the master trainers will train those chosen teachers, and these trained teachers will go on to conduct training at the state or district levels or for those teachers in their own schools (Adams & Muthiah 2020). Furthermore, short term in-service training and development programmes are also organised by the MOE from time to time, specifically for teachers who are teaching STEM subjects (MOE, 2014). Additionally, schools are urged to carry out in-house training programmes that cover areas of students' needs to improve teacher practices. Overall, it is compulsory for teachers to meet the seven days per year fundamental requirement of TPD (MOE, 2014).

Apart from the above, under the School Improvement Specialist Coach Plus Programme (SISC+), coaches from ITEs are responsible to provide a series of in-service training and coaching for teachers (Davrajoo & Letchumanan 2019). It was introduced in Malaysia in 2013 and implemented across the country in 2014 (MOE, 2013). Those coaches from ITEs have a minimum of five years' teaching experience and are in full-time positions so that they can engage frequently with more teachers providing individualised, adaptive, and situation-specific professional learning focused on the three interlinked dimensions of curriculum, assessment, and pedagogy (Davrajoo & Letchumanan 2019). To be effective in sustaining the quality of teaching, these specialists play an important role in identifying relevant interventions, observing, and analysing together data in the classroom and engaging in professional dialogue about learning and assessment (MOE, 2013).

On top of these and in line with the growing recognition that the professional learning community (PLC) acts as a platform that supports a school-wide capacity that promotes teacher learning (Qiao, Yu & Zhang, 2018), the MOE started to promote a professional peer-led culture by implementing PLCs in 1,548 schools in 2011 (MOE, 2016). This is a powerful strategy that empowers teachers to improve the overall teacher professionalism and to realise the goals of "Transform Teaching into the Profession of Choice" in the Blueprint as mentioned earlier. By encouraging teachers to involve collaboratively in professional learning, sharing best practices and taking efforts proactively to construct knowledge collectively, PLC is a good platform for teacher continuous development that enables schools to develop as learning organisations which can make positive changes in teacher learning school-wide (MOE, 2016).

### **3. The Theoretical and Conceptual Framework of the Study**

O' Flaherty and Beal (2018) defined competency as clusters of skills, knowledge, abilities, behaviours, and attitudes that display outstanding and excellent performance. According to Gokee (2015), teacher competency refers to teachers' capability to perform teaching practices excellently and effectively. The study would be guided based on the competency theory advocated by Markus, Cooper-Thomas and Allpress (2005), that by acquiring new and better knowledge, skills and attitudes, individuals can perform their roles and tasks competently.

To measure whether teachers in Malaysian secondary schools are competent to teach in the era of Education 4.0, the Teacher Competency Model for Education 4.0 (TCMEdu4.0) developed by Tai, Omar, Khalip, and Arsalan (2022) was applied to guide the study. It is an empirical model derived within the Malaysian cultural and educational setting. The selection of the model is appropriate and relevant because, to a large extent, education is embedded within a culture and teaching is contextually situated (Krull, 2001). As delineated in Figure 1, the TCMEdu4.0 encompasses six major dimensions i.e., *Self-Management and Interactive Competency*, *Functional and Research Competency*, *Pedagogical Psychology and Assessment*, *Leading Learning and Mentoring*, *Technological and Digital Competency* and *Problem Solving*. By equipping themselves with the above six major competencies, schoolteachers are better able to lead change in teaching and learning competently in the era of Education 4.0.



**Fig. 1** The conceptual framework of the study

*Self-management and Interactive Competency* refer to the awareness of teachers about the ways of guiding their actions towards positive outcomes through effective communication, collaboration, utilisation of emotion and stress management (Tai, Omar, Khalip & Arsalan, 2022). Communicating effectively with colleagues and stakeholders by word, deed and direction will help teachers in the process of realising change goals in schools (Smith & Riley, 2012). Equally important, as teachers often work in teams, they need to perform their tasks interdependently where members are held mutually accountable (Zhang & Pang, 2016). It is also essential for teachers to harness their emotions as emotions facilitate cognitive activities (Nusrah & Chan, 2020). that predicts effective judgement and problem solving (Naicker, Madondo & Mlangeni, 2017). Besides, as the teacher's role is changing along with the shifting demands of Education 4.0, intense job stress is always the consequence. Thus, it is particularly important for teachers to deal with stress and to hold up under pressure, to meet any challenges in realizing common school goals.

*Pedagogical Psychology and Assessment* is the basic competency for teachers as these directly impact the teaching-learning process. For effective teaching and learning, teachers are required to equip themselves with good knowledge and skills on how to apply psychological knowledge in education, understanding the psychology and the psychological phenomena of learners, as well as practising this knowledge creatively and innovatively (Mohamed, Valcke & De Wever, 2017). Assessment skills, both formative and summative, will help teachers gather more information about effective student learning. These initiatives enable teachers to provide meaningful and relevant feedback to students and helping teachers to enhance student-learning effectiveness through a variety of designed remediation and enrichment activities (Tai, Omar, Khalip & Arsalan, 2022).

*Functional and Research Competency* consists of analytical skill, critical thinking, research skill and technique (Tai, Omar, Khalip & Arsalan, 2022). Analytical skill is the competence of teachers in collecting, organising, assimilating, and analysing information effectively (Ahonen & Kinnunen, 2015). Critical thinking is the capability to analyse, synthesise and evaluate using different kinds of reasoning as relevant to the circumstances (Joe, 2011). Research skills include teachers' competence in designing research as well as in gathering, analysing, and interpreting the collected data of the study that may bring solution to a problem (Creswell & Creswell, 2018) in teaching and learning. Through a variety of research-verified approaches and obtained data, teachers may gather better information on how to improve teaching and learning strategies that may enhance student-learning effectiveness (Miles, Lemon, Mitchell & Reid, 2016).

*Leading Learning and Mentoring* is defined as how teachers can serve as leaders and mentors among their peers to influence instructional practices, improve student learning and shape learning culture in schools (Tai, Omar, Khalip & Arsalan, 2022). Teachers are front liners of school change; teachers' critical role in the pursuit of learning and teaching excellence is that of a learner and using what they have learnt to maximise students' learning impact. Specifically, instead of "knowledge feeding", it is crucial for teachers to be competent in articulating thoughts and ideas to influence other teachers to facilitate their role in constructing knowledge on teaching and learning (Pauline & Blake, 2015). To lead this pathway towards excellence, teacher leaders can serve as mentors for novice or less competent teachers by providing guidance in subject curriculum, classroom instruction, procedures, and best practices to help teachers develop and reach their personal best (Tai, Omar, Khalip & Arsalan, 2022).

*Technological and Digital Competency* is the ability of teachers in information literacy, data management and integrating ICT into teaching and learning (Tai, Omar, Khalip & Arsalan, 2022). Education 4.0 basically embraces technology; ICT is critical in enhancing the development of students' inquiry skills, critical thinking, analysis and is particularly relevant for conveying many spatial concepts (Petko, Prasse & Cantieni, 2018). To deal with large unstructured data sets, it is essential for teachers to know how to handle data, organise and maintain data processes that meet on-going information lifecycle needs (Tai, Omar, Khalip & Arsalan, 2022). Besides, high information literacy will help teachers integrate ICT into their teaching and learning effectively. Additionally, blended learning that adopts virtual or on-line classrooms is gaining momentum due to the Covid-19 pandemic and this has undoubtedly sparked a sense of urgency for the teachers to learn how to conduct virtual or on-line classes effectively.

*Problem Solving* is viewed as the ability to make choices among alternatives and develop new ideas and solutions as well as turning problems into opportunities; it enables teachers to analyse facts, make sense of a situation, think strategically, make wise choice, and come up with a solution effectively in the process of teaching and learning (Tai, Omar, Khalip & Arsalan, 2022). *Problem Solving* is a key competence in determining teacher effectiveness as it empowers and enables teachers to conduct their assigned duties effectively. As learning in schools becomes more complex due to the increasing demands of different stakeholders as well as the advancement of technology, effective problem solving in connection with student learning is seen as a major responsibility of teachers as teachers are widely recognized as professionals that take charge of student learning (Zhang & Pang, 2016).

## **4. Methodology**

### **4.1 Sample**

The purpose of the study was to examine if Malaysian secondary school teachers were capable or competent to teach in the era of Education 4.0. Malaysia consists of 16 states/federal territories with different sizes and different numbers of secondary schools. To enhance the likelihood of representation and to ensure schools in every state/federal territory have an equal chance to be engaged in the study, four secondary schools were chosen randomly from each state/federal territory, giving a total of 64 schools engaged in the study. For each school, 20 teachers were selected at random or a total of 1,280 were involved in the survey.

The sample size of the final survey was adequate for the concerned descriptive statistics analysis (Awang, 2012).

#### 4.2 Survey Instrument

To measure teacher competency for Education 4.0 (TCedu4.0), the model of TCMEdu4.0 developed by Tai, Omar, Khalip and Arsalan (2022) had been employed. As mentioned earlier, this model consists of eight dimensions and each dimension consists of five items respectively. With normed  $\chi^2=4.125$ , TLI=.948, CFI=.953 and RMSEA=.056, TCMEdu4.0 possessed convergent validity because the squared multiple correlations were well above the 0.5 threshold (Hair, Black, Babin & Anderson, 2010), the average extracted value met the cut off value of 50% (Hair et al., 2010), and the composite reliability index achieved the requirement level of 0.60 (Awang, 2012). Besides, the discriminant validity of TCMEdu4.0 is encouraging as all the average extracted values were above 0.50 (Hair et al., 2010). This instrument employed a Likert point of six with responses from “strongly disagree” to “strongly agree”. Two indicators were applied to interpret the data i.e., the performance frequency and performance rating as delineated in Table 1.

**Table 1.** The interpretation of TCedu4.0 in terms of level and indicator

Raw Scores	Level of TCedu4.0	Indicators	
		Performance Frequency	Performance Rating
5.51 - 6.00	Very good	Almost all the time	Very satisfactory
5.01 – 5.50	Good	Often	Satisfactory
4.01 - 5.00	Quite good	Quite Often	Quite satisfactory
3.01 - 4.00	Fair	Sometimes	Average
2.01 - 3.00	Quite poor	Quite Rarely	Quite Dissatisfactory
1.51 – 2.00	Poor	Rarely	Dissatisfactory
1.00 – 1.50	Very poor	Almost Never	Very Dissatisfactory

#### 4.3 Data Analysis

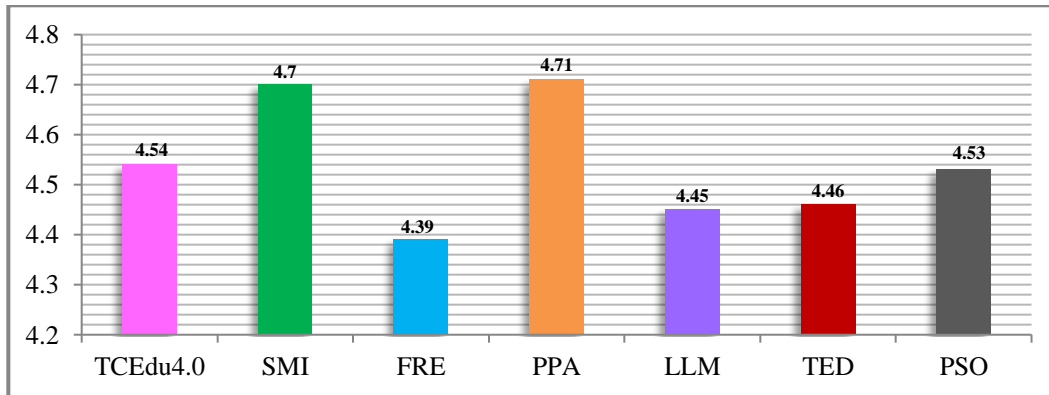
The data collection adheres to all ethical considerations and was successfully conducted within two months. Of 1,280 questionnaires distributed by post, 1,100 questionnaires were returned. However, 22 questionnaires were discarded without further analysis due to invalid responses or incompleteness, leaving a total of 1,078 questionnaires or 85.94% of the total number of posted questionnaires for the final stage analysis. Descriptive statistics was adopted to obtain scores, means and standard deviation in the analysis.

### 5. Demographic Characteristics

Of 1,078 questionnaires with usable data, 31.91% (N=344) were males and 68.09% (N=667) were females. The age group 31 to 40 years was the largest group among the respondents (46.20%; N=498), followed by the age group 41 to 50 years (29.03%; N=313), 51 to 60 years (12.43%; N=134) and 21 to 30 years (12.34%; N=133). For academic qualifications, 83.95% (N=905) obtained a bachelor’s degree, 13.45% (N=145) had a master’s degree and 2.60% (N=28) had a diploma certificate. Besides, 27.83% (N=300) of the respondents had worked between 16 and 20 years, 20.69% (N=223) more than 20 years, 19.57% (N=211) between one to five years, 18.74% (N=202) six to 10 years and 13.17% (N=142) had worked 11 to 15 years. In terms of school location, 65.77% (N=709) were from urban and 34.23% (N=369) from rural areas.

## 6. Findings

In measuring the level of TCEdu4.0, descriptive statistics was employed to obtain means and standard deviation in the analysis. Based on the interpretation displayed in Table 1, teachers at the secondary school obtained a mean score of 4.54 (SD=.53) and therefore were rated as *Quite Good* of the level of TCEdu4.0 as it fell within 4.01 to 5.00. Likewise, in measuring the six dimensions of TCEdu4.0, as shown in Figure 2, with the mean scores between 4.39 and 4.71, teachers at the secondary school achieved the *Quite Good* level in practising TCEdu4.0 in all the dimensions.



Note. TCEdu4.0=Teacher Competency for Education 4.0; SMI= Self-Management and Interactive Competency; FRE= Functional and Research Competency; PPA= Pedagogical Psychology and Assessment; LLM = Leading Learning and Mentoring; TED = Technological and Digital Competency; PSO= Problem Solving

**Fig. 2** Mean scores of TCEdu4.0 and its components

Further, a close investigation among all the six was conducted. The results demonstrated that *Pedagogical Psychology and Assessment* obtained the highest mean score (M=4.71; SD=.52). This was followed by *Self-Management and Interactive Competency* (M=4.70; SD=.59), *Problem Solving* (M=4.53; SD=.64), *Technological and Digital Competency* (M=4.46; SD=.66), and *Leading Learning and Mentoring* (M=4.45; SD=.66). Among the six competencies, *Functional and Research Competency* achieved the lowest mean score (M=4.39; SD=.67).

Another interesting observation was obtained by looking closer at these six competencies based on the mid-point of the level of *Quite Good* (between 4.01 and 5.0), i.e., 4.50. It was found that *Pedagogical Psychology and Assessment*, *Self-Management and Interactive Competency* and *Problem Solving* achieved an upper level of *Quite Good* of TCEdu4.0. However, *Technological and Digital Competency*, *Leading Learning and Mentoring* and *Functional and Research Competency* achieved a lower level of *Quite Good* in the practice of TCEdu4.0 at the secondary schools. Simply put, teachers at the secondary schools were comparatively more competent in the former than the latter three competencies.

## 7. Discussion

There were few important findings observed in the study. Firstly, the secondary school teachers achieved *Quite Good* level in the practice of TCEdu4.0 as well as in all its six dimensions. This observation implied that school teachers had only demonstrated TCEdu4.0 or its six competencies ‘quite often’ with ‘quite satisfactory’ performance. The finding is not encouraging as in meeting the new demands of Education 4.0, teachers, to a large extent, are expected to practise TCEdu4.0 or its six competencies ‘often’

with 'satisfactory' performance, i.e., at the level of 'good'. As extensive time and resources have been invested in TPD (Adams & Muthiah, 2020), it is essential to identify the factors that have caused these results.

Practically, it may link significantly to the effectiveness of the implementation of TPD. Malaysia is practising a centralised school system whereby centralised planning and decision-making for TPD by the MOE or school top management are common practices (Adams & Muthiah, 2020). Oftentimes, teachers are sent for cascade fashion training courses offered by the MOE, State Education Department or District Education Department (MOE, 2013). This top-down planning approach may lead to the mismatch between the content of TPD and the actual needs of the teachers (Wendy & Murray, 2021). Moreover, as teachers have less opportunities to make choices or decisions upon their preferences, in comparison with voluntary participation, the non-voluntary participation may be unable to ensure more successful learning outcomes (Ufnar & Shepherd, 2019). Studies conducted by local researchers such as Ali (2002), Kabilan (2004) and Kabilan, Vethamani and Chee (2008) reported that TPD programmes that are cascade-oriented may neglect teachers' interests and needs and thus are relatively irrelevant, impractical, and less effective.

In terms of training mode, the one-size-fits-all approach such as workshops, courses and conferences have become predominant forms of TPD available in Malaysia (Senom, Zakaria & Ahmad Shah, 2013). It is favoured by programme providers, school leaders and the MOE as it is relatively easy to handle, is focused, self-contained and most importantly, more economical compared to those developed based on individual needs and growth (Wendy & Murray, 2021). Nevertheless, there is a growing consensus that TPD is less effective if the programme is not built on the specific needs of the teachers and their developmental stage as they cannot make sense of the current knowledge they possess (Palmer & Noltemeyer, 2019). Wendy and Murray (2021) also argue that TPD programmes that are one-size-fits-all-oriented has an abysmal track record for unsuccessful transmission of knowledge or skills as it does not put the professional needs of the teachers at the centre of the activities.

Apart from these, existing literature reveals that TPD programmes that incorporate active learning and connect theory and practice appear to have compounding impacts on instruction (Palmer & Noltemeyer, 2019). For instance, lesson study groups, reviewing examples of student work, practicing newly acquired skills, obtaining feedback, cooperative development or job-embedded coaching are some examples of TPD practices that emphasise active learning. Unfortunately, TPD programmes that do not incorporate active learning in the training process are quite prevalent in Malaysia (Senom, Zakaria & Ahmad Shah, 2013). These kinds of unincorporated active learning programmes do not encourage participants to engage in in-depth and reflective examinations of their teaching practices and thus providing teachers less opportunities to construct new knowledge, resulting in a lesser impact on teachers' learning (Gulamhussein, 2013).

Another possible reason why the secondary school teachers only achieved *Quite Good* level of TC Edu4.0 might be the limited time allocation for TPD due to teachers' heavy workload. Researchers, practitioners, and teachers have consistently claimed that lack of time is one of the barriers in implementing effective TPD (Gulamhussein, 2013; Mitgang, 2012). Mitgang (2012) highlights that the probability of participants being exposed to TPD programmes account for a significant amount of the variation in the competence of participants. Gulamhussein (2013) claims that TPD programmes with longer durations provide trainers with sufficient time to clarify and reinforce the presented content and enable them to be more accommodating to teachers' needs, thus maximising learning impact. However, Joseph (2017) points out that the teachers in Malaysia are burdened with reports or administrative work that may impede their engagement in TPD. Local researchers such as Ali (2002) and Senom, Zakaria and Ahmad Shah (2013) highlight that in-house training was not implemented effectively in schools due to time factor and workload constraints. Hence, if the MOE is unable to free teachers from their heavy workload, teachers would probably not be able to engage effectively in TPD programmes.

The second interesting observation of the study was that among the six competencies of TC Edu4.0, teachers at the secondary schools achieved the highest mean score in *Pedagogical Psychology and Assessment* but obtained the lowest mean score in *Functional and Research Competency*. Teachers at the secondary schools achieved the highest mean score in *Pedagogical Psychology and Assessment* implied that schoolteachers were equipped with better knowledge and skills on how to apply psychological



knowledge in teaching and learning as well as competent enough in both formative and summative assessment in comparison with other competencies. As mentioned earlier, *Pedagogical Psychology and Assessment* is the basic competency for teachers in the effective teaching-learning process. It is the focus of all teacher training programmes no matter in the East or West. By understanding the psychology and the psychological phenomena of students, this enables teachers to enhance student-learning effectiveness. On the other hand, with better assessment skills, teachers can provide relevant feedback to students contingent to their mastery level and needs via designed remediation and enrichment activities and thus maximising learning impact (Tai, Omar, Khalip & Arsalan, 2022). As *Pedagogical Psychology and Assessment* is the basic and core of all teacher training programmes, it should come as no surprise that teachers rated it with the highest mean score.

However, among the six competencies, teachers at secondary schools were least competent in *Functional and Research Competency*. In other words, they were weak in analytical skill, critical thinking, research skill and technique (Tai, Omar, Khalip & Arsalan, 2022) in comparison with other competencies. To meet the challenges of the 21<sup>st</sup> century, Higher Order Thinking Skills (HOTS) that include analytical and critical thinking skills had been incorporated in both school-based assessments as well as national examinations in 2011 by the MOE (Abu Hassan, Aqilah Mohamad, Mohd Rosli, Ajmain & Yusof Azuddin, 2020). Additionally, research-based project work was first introduced in the Secondary School Integrated Curriculum since 1992 (Mohd Meerah & Mohamad Arsalan 2010) and today the school-based project work is an important integral component of the Secondary School Standards-based Curriculum launched in 2017 (Ilhavenil, Pillay, Kim & Sudiman, 2020). Undeniably, teachers are unable to help students to learn the above competencies at higher levels until teachers themselves begin performing at higher levels in this area (Wilson & Narasuman, 2020). With the competence of *Functional and Research Competency*, teachers are expected to conduct lessons and assessment about HOTS and project work effectively. Importantly, this competence directly relates to teachers' capability to gain helpful insights and inspires action that hones teachers' thinking and problem-solving skills that improves student learning effectiveness in the era of Education 4.0 (Tai, Omar, Khalip & Arsalan, 2022). Hence, there is a pressing need for teachers to enhance this competence so that our students are trained to be critical thinkers and problem solvers in the FIR.

The third interesting observation of the study was that the secondary school teachers achieved at an upper level of *Quite Good* in *Pedagogical Psychology and Assessment*, *Self-Management and Interactive Competency*, and *Problem Solving* but at a lower level of *Quite Good* in *Technological and Digital Competency*, *Leading Learning and Mentoring* and *Functional and Research Competency*. Simply put, teachers were comparatively less competent in the latter than the former three competencies. Undoubtedly, to meet the new demands of Education 4.0, there is room for improvement for teachers at secondary schools on the above six competencies. However, comparatively, more efforts are needed to improve the latter three competencies. Notably, out of the latter three competencies, the following discussion will be focused on *Technological and Digital Competency* and *Leading Learning and Mentoring* as *Functional and Research Competency* has been discussed in the previous section.

As mentioned earlier, Education 4.0 is a purposeful approach to learning that aligns with the FIR; the biggest change of Education 4.0 is a deeper integration of technology into the teaching process. Instead of traditional teaching aids, technological-based resources and tools are being employed to drive education in non-traditional ways. This technological shift enables schools to up-skill students to accelerate flexible learning and empower students towards innovations, resulting in greater learning outcomes (Pauline & Blake, 2021; Petko, Prasse & Cantieni, 2018). Therefore, teachers need to equip themselves with *Technological and Digital Competency* to make drastic changes to their instruction and assessments. Unfortunately, teachers in the secondary schools were rated at a lower level of *Quite Good* in *Technological and Digital Competency*. To re-shape teaching and learning in the classroom that parallels the accelerating global revolution in technology is a *sine quo non* to improve the quality of classroom instruction. This is especially true as we see the distinctive rise of digital education during the outbreak of the Covid-19 pandemic (Chandra, 2021; Pauline & Blake, 2021). There is mounting evidence that digital education will consequently become an integral component of school education (Chandra, 2021). Like it or not, to be effective, Malaysian teachers in the era of Education 4.0 must move along with the growth of digital

education and be equipped with *Technological and Digital Competency* as technology becomes crucial in effective classroom teaching and learning.

*Leading Learning and Mentoring* was another competency that teachers in the secondary schools achieved at a lower level of *Quite Good* of TCEdu4.0. This implied that most probably teachers did not have good competence to serve the role as leaders and mentors among their peers to influence instructional practices, improve student learning and shape learning culture in schools (Tai, Omar, Khalip & Arsalan, 2022). Without good competence in *Leading Learning and Mentoring*, most likely teachers are unable to perform well and lead effectively in collaborative learning, resulting in the failure of helping teachers step out of the traditional individual-oriented learning culture, and being unable to articulate thoughts and ideas to influence other colleagues in constructing knowledge on teaching and learning. Therefore, there is a high likelihood that teachers are less competent to enact their professional agency, which is the capacity of teachers to act productively to direct their professional growth and the growth of others (Andrews, Hayes, Kilgore, MacDonald & Gabbard, 2020) that is so central to the era of Education 4.0.

The above issue does not stand in isolation. Although teacher leadership is at the forefront of practising the competence of *Leading Learning and Mentoring*, local researchers such as Hamidah, Vyapuri, Abdul Jalil, Mahaliza and Mohd Asri (2017), Misdi, Sumintono and Abdullah (2019), Pauzi and Mohamad (2019) found that teacher leadership were practised only at a moderate level in schools. These implied that opportunities for teachers to involve in shared decision making, taking ownership, enacting leadership and exerting influence that are crucial in developing the competence of *Leading Learning and Mentoring* were relatively not robustly practised in schools. Besides, Chong, Muhammad Faizal and Zuraidah (2018), Ismail, Loh and Abdullah (2017), Omar, Tai, Khalip and Arsalan (2019), Tai and Omar (2021) found that the professional learning community that serves as the platform for teachers to exercise the competence of *Leading Learning and Mentoring* in schools was implemented only at a moderate or less satisfactory level. Abdullah, Manaf, Ail and Ramzv (2016) even point out that the lack of understanding the concept of a professional learning community was common among teachers. To a large extent, all these constraints did not encourage the practice of *Leading Learning and Mentoring* in schools. Not surprisingly, the secondary school teachers were rated at a lower level of *Quite Good* in *Leading Learning and Mentoring*.

## 8. Implications

Basically, it is essential for the MOE to investigate the predicament and identify the root causes of why teachers in the secondary schools were rated as *Quite Good* in TCEdu4.0. The findings bring to light the need for the MOE to enhance the level of TCEdu4.0 of schoolteachers to meet the challenges of Education 4.0. The success of this initiative will determine not only the students' future but also the power of the nation in competing with other countries in this highly competitive world. Firstly, the MOE probably needs to proactively review the development of teacher education as well as the TPD programmes periodically. It is to ensure its effectiveness by making policy decisions that are based on sound pedagogical reasons instead of just expediency whereby the teachers' developmental stage, professional needs, and readiness are taken into consideration in the planning of any intervention programmes. Otherwise, all efforts and resources spent would not be able to meet the return on investment (ROI) as suggested by the MOE (MOE, 2016).

Secondly, it is time for the MOE to design and create a paradigm shift in TPD. This shift requires that, i) in the conceptualising of TPD, teachers are regarded as decision makers, experts and active professionals in charge of their own professional development and growth (Lopes & D' Ambrosio, 2016); ii) TPD should not be viewed as isolated learning sessions or even seven-day training programmes but engaging teachers in real-life or authentic learning situations arising in their daily life in schools (Morris & Hiebert, 2011); and iii) TPD is a valuable experience that affects the way teachers think and act toward more authentic professional learning goals which bring internal teacher growth and facilitate educational change (Insulander, Brehmer & Ryve, 2019). It is only with this awareness and the above desired outcomes,

TPD programmes enable teachers to be equipped with sufficient competence and help them prepare students to thrive in the competitive world of FIR.

Thirdly, although teacher leadership roles have been defined before and are being practised as prescribed, it is essential for the MOE to reframe and realign teacher leadership roles both in formal and informal settings in response to the dynamic challenges of Education 4.0. The embrace of a redefined conceptualization of teacher leadership roles would create more opportunities for teachers to initiate and proactively engage in teacher learning and establish their professional agency that would ultimately guide personal teacher professional growth and the growth of others. Besides, the implementation of a professional learning community would initiate the momentum for teacher professional growth and development; close monitoring of this community would ensure that this professional learning culture in schools is sustained for teachers' continual growth in the long haul.

Fourthly, as school leaders are pivotal in securing the success of school instruction, concerted efforts need to be taken to enhance the effectiveness of the school based TPD programmes and the relevancy of the programmes provided for school teachers; this might be the focus of the efforts besides considering the unique needs of each school respectively. In fact, if little is invested in communicating teachers' involvement in TPD programmes especially in the decision-making process, it would not be able to encourage teachers to proactively engage in teacher learning and maximise teachers' professional agency that would guide teacher professional growth effectively and continuously. Apart from this, to ensure that teachers have enough time to learn effectively, it is essential for school leaders to identify and create ways to relieve teachers' heavy administrative workload. This would help free up time for teachers to engage effectively in TPD programmes that might allow teachers to learn and acquire new knowledge and skills to make changes in their instruction.

## **9. Limitations of the Study and Future Directions**

The study was subject to several limitations that would be of relevance to future studies. Firstly, as the cross-sectional nature of the study limits our understanding about TCEdu4.0 at a single point in time, instead of just a survey, future studies could perhaps adopt a mixed method design that combines surveys, classroom observations, or interviews that examines TCEdu4.0 over a period. Secondly, as our data only drew upon teachers' self-reports, there is possible data inaccuracy; hence it would be meaningful to incorporate data from both school principals and senior assistants to measure TCEdu4.0 triangularly in future research. Thirdly, it is essential to further investigate TCEdu4.0 across more diverse national settings that include the religious and residential secondary schools in Malaysia to capture a comprehensive picture of the level of TCEdu4.0 nation-wide to guide practices, research, and policy. Finally, the assumption made about the potential reasons why the secondary school teachers were only rated as *Quite Good* in TCEdu4.0 have yet to be examined further; any endeavours to explore these issues in depth would make a significant contribution to this area.

## **10. Conclusion**

The ultimate goal of any TPD programme should be to improve teacher quality that would lift student learning and achievement. Therefore, the real issue is not about providing TPD programmes, but about providing effective ones. Only TPD programmes that are teacher-driven can empower teachers to take ownership of their learning experiences as they recognise teachers as professionals with valuable insights for teachers' continual growth. To a large extent, the success of school improvement agendas in the era of Education 4.0 hinges on such pervasive awareness and deliberate practices that may create possibilities for sustained meaningful teacher learning and development that breeds excellence. The study is timely and a constructive initiative as it provides useful information about teacher competence in preparing students to meet the challenges of Education 4.0. It also offers one small step in the direction of continuous teacher development and growth in the face of the FIR both locally and internationally, that can inform and guide practices in school improvement and effectiveness.

## 11. Co-author contribution

The first co-author was responsible for the theoretical and the conceptual framework of the study and revising the intellectual content critically whereas the second co-author provided substantial contribution for the data collection and analysis.

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