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Development and Assessment of Digital Pedagogy Competency Instrument for Teaching and Learning: A Needs Analysis

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Abstract

This study aims to identify the difference between digital technology competence using a self-assessment approach compared to a task-based approach among teachers of a secondary school in the Federal Territory of Kuala Lumpur. An interview protocol that was developed and used in this study, consists of six parts where the digital competence of the respondents will be assessed in parts IV and V. In part IV, self-evaluation is done by the respondents using a five-point Likert scale from less proficient to very proficient for Microsoft Word, Microsoft Excel, and Microsoft PowerPoint. In part V, tasks related to Microsoft Word, Microsoft Excel, and Microsoft PowerPoint are given to the same respondent. The data obtained in the form of interviews were transcribed and a comparison between the data of part IV and part V was made. The results found that there is a difference in competency between self-assessment compared to task-based assessment.

Keywords: Digital Pedagogy Competence, Self-Assessment, Task-Based.

Introduction

The use of digital technology in teaching and learning aims to produce a new generation that is competent in the digital field and capable of using digital technology in an integrated, creative, innovative, responsible, and ethical manner. A successful implementation that encompasses knowledge, skills, and values in education will boost the economy of a country (Falck et al., 2020). Therefore, teachers, who are the drivers of teaching and learning, need to have good digital skills to facilitate the integration of technology in the classroom (Aslan & Zhu, 2016). Teachers will be more confident in using digital technology for teaching if they can master it (Sani, 2018). The success and effectiveness of digital technology use in the classroom by digitally competent teachers encourage students to emulate these teachers in integrating technology both inside and outside the classroom (Szymkowiak et al., 2021). This simultaneously increases students' awareness of using technology in learning while enhancing their performance (Comi et al., 2017).

A study conducted by (Sipilä, 2014) in Finland states that teachers with high digital competency will frequently use these skills in teaching and learning. According to (Puteh et al., 2017), teachers need to prepare themselves physically, spiritually, emotionally, and intellectually to resolve any issues that arise during the integration of technology in 21st-century teaching. Therefore, the role of teachers as effective facilitators for students is very important to realize the nation's aspiration towards becoming a developed country.

Digital Technology in Classroom Teaching and Learning

Digital technology in education, or digital education, involves the integrated, creative, and innovative use of digital technology in teaching and learning to produce digitally fluent students (Educational Resources and Technology Division, 2016). In the early stages of digital technology adoption in classrooms, the use of technology often involved multimedia presentations and visual displays (Gray et al., 2010). However, the application of technology in the classroom should not be limited to simple multimedia materials but should encompass a variety of digital resources that constantly evolve to meet the demands of a more challenging future environment (Falloon, 2020). This requires unwavering commitment from teachers (Irina Engeness, 2021). Clear examples of digital technology use today include social media, online games, multimedia, and mobile phones (Murcia et al., 2018).

The Malaysian government has long recognized the potential of integrating digital technology into the national education system. This is evident through policies on digital or ICT, highlighted by the Smart School action plan since the 1990s, aimed at improving the quality of education in the country. The latest initiative is the Digital Education Policy, which aims to drive changes in the digital education landscape to produce digitally fluent and competitive students. This is to be achieved through the enhancement of knowledge, skills, and values of students, educators, and educational leaders; the provision of quality infrastructure, infostructure, and content; and the active participation of strategic partners in an integrated and comprehensive manner from preschool to post-secondary levels (Ministry of Education Malaysia, 2023).

The rapid development of digital technology has provided clear implications and valuable opportunities for diversifying pedagogical approaches in teaching and learning. However, it still cannot replace the role of teachers as facilitators or leaders in designing their teaching approaches (Educational Resources and Technology Division, 2016). Here, teachers are not only users of technology in teaching and learning but also involved in designing technology-based environments that need to be adapted to students' needs (Casillas Martín et al., 2019; Irina Engeness, 2021). Thus, the role of teachers in the classroom has been redefined in line with technological advancements in teaching and learning (Cheng et al., 2016), where teachers are a crucial factor in fostering innovative thinking among students (Ely, 1995) and achieving international standards (Chieng & Tan, 2019).

The Covid-19 pandemic, which began affecting the world at the end of 2019, posed a significant challenge to the education sector. It led to the closure of schools in 192 countries, impacting 1.6 billion students who could no longer engage in face-to-face learning (Mahaye, 2020). Malaysia was no exception, adopting similar measures to curb the spread of Covid-19. However, according to Kekic & Miladinovic (2013), prolonged school closures due to any epidemic can cause temporary or long-term damage. Consequently, in this unforeseen

situation, teachers and administrators had to quickly devise ways to meet students' learning needs (Daniel, 2020; Ramli & Rahman, 2021). This concern arose from the fear that students would fall behind and face long-term disadvantages due to a lack of access to learning.

Simultaneously, teachers faced numerous challenges and issues in identifying the best mechanisms to ensure the continuity of teaching and learning (Ramli & Rahman, 2021). However, viewed positively, this situation led to the emergence of a new era in the use of digital technology in education. Many countries introduced technology-based pedagogy to ensure students could access learning even while at home (Mahaye, 2020). Consequently, the use of digital tools in teaching and learning saw a significant surge (Shankar, 2020). The presence of these technologies, some of which existed before the pandemic, became crucial in realizing home-based teaching and learning, necessitating teachers to quickly adapt and find suitable technologies for their content (Shankar, 2020).

It is believed that the dramatic shift in teaching methods during the Covid-19 pandemic will leave a lasting impact on teaching techniques. This shift will promote the adoption of innovative teaching methods compared to traditional classroom instruction (Dhawan, 2020). This transition will benefit both teachers and students by diversifying their digital teaching and learning techniques post-pandemic, aligning with 21st-century teaching and learning goals.

Teacher's Digital Competency in Teaching and Learning

The use of digital technology in teaching and learning requires a high level of digital competency (McGarr & McDonagh, 2019). Educators who are knowledgeable, skilled, and innovative in digital technology can add value by supporting an effective teaching and learning process, especially in 21st-century education. Recognizing this importance, efforts must be made to enhance teachers' digital competency, whether through blended training or self-directed learning, so that educators can integrate digital technology into the education ecosystem (Ministry of Education Malaysia, 2023, Mohamed et al., 2021). This is crucial because efforts to provide quality education to students will be hindered by teachers' weaknesses in digital competency.

Krumsvik (2014), argues that the digital competencies required by teachers are more complex compared to other professions because they involve two main components essential to teaching. Firstly, it concerns their ability to proficiently use technology to encourage students to mimic such usage in their lives. Secondly, it involves the use of digital technology in pedagogy while simultaneously considering how digital technology can help develop student learning in the subjects being taught (Krumsvik, 2008). Similarly, Lund & Eriksen (2016) assert that teachers need to have multifaceted competencies compared to engineers, lawyers, nurses, or other professions because they not only need to be skilled in the use of digital technology but also face the primary challenge of fostering digital technology use among students.

In the 21st century, there has been a significant increase in literature addressing teachers' competencies in using digital technology during teaching and learning processes. This trend parallels the rapid advancements in computing technology. Studies such as those by Rais et al (2015), and Tasir et al (2012), highlight that teachers' competencies and skills in

digital technology have a significant impact on their application in teaching and learning. These findings support Holden & Rada (2011), and Ismail et al (2012), which suggest that the extent to which a teacher can effectively use technology can be determined by their attitudes toward it. Teachers who fully integrate technology into teaching and learning tend to have positive attitudes and perceptions (Holden & Rada, 2011; Tasir et al., 2012).

Additionally, research by Syahid et al (2019), on primary school teachers indicates that teachers with strong digital competencies can apply them in various forms of classroom management and learning. This underscores that a teacher's ability to implement teaching and learning using digital technology greatly depends on their knowledge and skills (Mahmud et al., 2011). Moreover, teachers with strong digital competencies not only continually develop their digital skills but also integrate them into their pedagogy to enhance their students' digital competencies (McGarr & McDonagh, 2019, Omar et al., 2023).

In 2021, during the ongoing COVID-19 pandemic, a large-scale study on the level of digital competency among teachers was conducted in Malaysia. This survey involved 297,018 teachers, revealing that 57.9% of them were classified at a basic level, 39.9% at an intermediate level, and only 2.2% at an advanced level of digital competence (Ministry of Education Malaysia, 2023). Additionally, the study found that in key STEM subjects such as Mathematics and Science, 90% of Mathematics teachers and 82% of Science teachers either never or rarely used computers in their teaching and learning practices (Ministry of Education Malaysia, 2023).

These findings align with research by (Tondeur et al., 2017), indicating that many teachers, especially those early in their careers, may be less prepared to effectively integrate technology in their classrooms. This is due to a gap between their technological knowledge and pedagogical understanding (Gudmundsdottir & Hatlevik, 2018; Røkenes & Krumsvik, 2014). Therefore, it is crucial to ensure that teachers are equipped with adequate digital skills to ensure effective teaching and learning, ultimately fostering a generation that creatively and innovatively embraces technology.

The main framework that forms the basis of this study is the European Framework for the Digital Competence of Educators (DigCompEdu). DigCompEdu was published in 2017 to identify the pedagogical and professional focus areas for integrating technology into teaching and professional practice (Redecker, 2017). It was developed through extensive expert consultations to structure existing views and evidence into a comprehensive model that can be applied in all educational contexts (Ghomi & Redecker, 2019). According to Redecker (2017), this framework details 22 specific digital competencies for educators, grouped into 6 areas: i) professional engagement, ii) digital resources, iii) teaching and learning, iv) assessment, v) empowering students, and vi) fostering students' digital competence.

The United Nations Industrial Development Organization (UNIDO) (2002) outlines that competencies consist of a combination of knowledge (cognitive), skills (psychomotor), and attitudes (affective) that are applied to build and improve oneself. These competencies exist due to life values, attitudes, and motivation within an individual to successfully complete tasks (Khamis, 2014; Salleh et al., 2015). The presence of competencies in workers is expected by employers not only to possess specific skills for performing tasks with high job performance

(Spencer & Spencer, 1993)but also to solve them critically (Olofsson et al., 2020). Additionally, the presence of competencies in workers helps employers assess the suitability and expertise of workers in completing assigned tasks (Salleh et al., 2015).

> *"The Digital Education Policy (DEP) aims to create a digitally fluent generation that is competitive by enhancing the knowledge, skills and values of students, educators and educational leaders, providing quality infrastructure, infostructure and content as well as actively involving strategic partners in an integrated and comprehensive manner"*
> (Ministry of Education Malaysia, 2023)

The launch of the Digital Education Policy on November 28, 2023, outlines six core pillars of digital education, one of which emphasizes "educators capable of effectively implementing PdP (Teaching and Learning Activities) through integrated, creative, and innovative use of digital technology". To achieve this objective, the first strategy implemented by the Ministry of Education Malaysia is to assess the digital skills level of educators (Ministry of Education Malaysia, 2023).

Currently, research direction on technology use in classrooms has shifted from merely studying technology use to assessing teachers' ability to integrate technology to support teaching and learning activities (McDonagh et al., 2021). This shift underscores the importance of having sufficient digital capabilities to effectively integrate technology into their teaching practices (Kaarakainen et al., 2018).

Several research methods have been identified for assessing the digital competencies of teachers, including self-assessment, open-ended surveys, performance or task measurements, interviews, and observations (Koehler et al., 2011). However, most assessments of digital technology competencies today rely on self-assessment (Alarcón et al., 2020; Caluza et al., 2017; Cantabrana et al., 2019; Ghomi & Redecker, 2019; Sani, 2018; Tondeur et al., 2017). This method is considered more efficient in terms of time and cost (Schmid et al., 2020). Despite being foundational in competency assessment according to Stan & Manea (2015), self-assessment is criticized for its lack of accuracy (Merritt et al., 2005).

Therefore, this study aims to identify the differences between digital technology competencies based on self-assessment and task-based assessment among secondary school teachers. Also, this paper seeks to observe the need for developing digital technology competence instruments among secondary school teachers.

Methodology

The sampling process of the study was conducted at a secondary school in the Federal Territory of Kuala Lumpur. Researchers chose to employ both qualitative and quantitative approaches in conducting this foundational study to address the research questions stated. An interview protocol was developed to obtain information related to the research questions and the need for developing digital technology competence instruments for secondary school teachers. There are six sections in the conducted interview protocol:

- Section I: Introduction to the study. In this section, the study's introduction is provided, and respondent consent is obtained.
- Section II: Respondent demographics. This section collects background information from respondents to ensure that the study includes a diverse range of teaching fields.
- Section III: Use of digital technology in teaching and learning. This section employs an open-response approach to explore teachers' experiences in using digital technology in teaching and learning.
- Section IV: Teacher digital competencies. In this section, teachers conduct self-assessments to evaluate their digital technology competencies using a five-point Likert scale from less skilled to highly skilled for software such as Microsoft Word, Microsoft Excel, and Microsoft PowerPoint.
- Section V: Teacher digital competencies. This section involves providing simple tasks related to the use of digital technology to teachers, representing two tasks for each software: Microsoft Word, Microsoft Excel, and Microsoft PowerPoint.
- Section VI: Need for developing new instruments to assess actual teacher digital competencies. In this section, an open-response approach is used to obtain teachers' opinions and suggestions regarding the need to develop performance-based competency assessment instruments.

Using this interview protocol, a total of five teachers were selected from a secondary school in Kuala Lumpur. The selected teachers cover various fields and teaching experiences. The respondents are directly involved in the use of digital technology in teaching and learning at the school. Table 1 below presents the demographic profile of the study respondents:

Table 1
Study Respondent Demographics

Respondent	**Gender**	**Main subjects taught**	**Teaching experience (years)**
A	Female	Geography	21
B	Female	Malay Language	3
C	Male	Mathematics	12
D	Female	Design and Technology	30
E	Female	Invention	12

Findings and Discussion

Digital Technology Competencies Based on Self-Assessment and Task-Based Assessment among Secondary School Teachers

To support the objectives of this study, the findings include responses given by respondents and observations from how respondents explain or complete given tasks. Interviews were transcribed verbatim, capturing respondents' words, and how tasks were carried out by the respondents was recorded. A summary of parts IV and V can be summarized in Table 2 below.

Table 2
Summary of findings for Part IV and Part V

Respondent	Section	Microsoft Word		Microsoft Excel		Microsoft PowerPoint		Mean of Part IV and the number of solved tasks of Part V	The new standing of Part IV after the tasks of Part V are given
		Task 1	Task 2	Task 1	Task 2	Task 1	Task 2		
A	IV	5		3		3		3.7	Reduce
	V	/	X	X	X	X	X	1/5	
B	IV	4		3		4		3.7	Same
	V	X	X	/	X	/	X	2/5	
C	IV	5		4		3		4.0	Reduce
	V	/	X	/	X	/	X	3/5	
D	IV	5		5		4		4.7	Reduce
	V	X	X	/	X	X	X	1/5	
E	IV	5		4		4		4.3	Reduce
	V	X	X	/	X	/	X	2/5	
Min	IV	4.8		3.8		3.6		/ Successfully solved by the respondent X Not successfully solved by the respondent	
Number	V	2/5	0/5	4/5	0/5	3/5	0/5		

Based on Table 2, four out of five respondents rated themselves with a score of five when asked about their skills in handling Microsoft Word. This yields a high average (minimum 4.8) for self-assessment in Microsoft Word. However, only two respondents managed to complete Task 1 given, while none of them were successful in completing Task 2. This indicates that although the majority of respondents felt very confident in stating they were highly skilled in Microsoft Word, in reality, some key components of Microsoft Word still elude them.

For Microsoft Excel assessment, four out of five respondents were able to complete or knew how to complete one out of the two tasks given. However, when compared with self-assessment scores, there were discrepancies among them. For instance, Respondents A and B both gave a score of three on the Likert scale, but their actual skills differed based on the tasks given. Respondent B completed one out of two tasks, while Respondent A did not complete either task.

Regarding the Microsoft PowerPoint assessment, respondents gave the lowest average score of 3.6. This indicates that among these three software applications, Microsoft PowerPoint is considered the most challenging. However, task completion success rates were still low, with only three respondents managing to complete Task 1, while none of the respondents were successful in completing Task 2.

As a result, when asked about their opinions on the confidence level regarding their previously assessed digital competencies using the Likert scale, four out of five respondents suggested that the scores they gave in the previous self-assessment should be reduced.

Teacher A: I shouldn't give five.. Give four, those five are too good..
Teacher C: It's like I have to reduce it..like that Ms word, maybe reduce to four..Ms excel maybe three..I have to study some more..
Teacher D: I have to reduce.. maybe there is a new function, maybe I was stressed.. I used it once in a while.. then I don't remember much.. this teacher is an old school..
Teacher E: Haa... I have to reduce..hahaha (lauhing). If Ms word, it's four to three. I don't know a lot about this.. ha.. I know just basic things..

This indicates that while respondents have high confidence in using the software they typically use; the reality is that they may not be aware of their actual proficiency levels if relying solely on self-assessment. This discrepancy between self-assessed competencies and task-based assessments supports findings from studies such as Merritt et al. (2005), which suggest a low correlation between self-assessed competencies and actual capabilities due to respondents' tendency to over report or underreport their competencies (Kaarakainen et al., 2018). This is one of the reasons why teachers still struggle to integrate technology effectively in teaching and learning (Cuhadar, 2018; Instefjord & Munthe, 2015).

Need for the development of digital technology competency instruments among secondary school teachers

The research findings for this objective show the need to develop an instrument that can measure the digital competence of a teacher more accurately. This is because the respondents who were asked, are confident to give five points especially for MS Word software because they believe that it is often used in their daily life and also in their teaching. Respondent A stated "Five, I know how to used it for a long time". Likewise with the other three respondents who gave a point of five except for one who gave a point of 4. The answers from these respondents show that they are confident and think that the skills they have are enough to describe that they are proficient in using certain software, but in reality, not that good. This opinion supports the statement that individuals with high digital skills are more likely to over-report their own skills (Aesaert et al., 2017; Palczyńska & Rynko, 2020).

Result of the tasks solve cause respondents' uncertainty about their actual competence, therefore suggest and also agreed with the researcher that the development of an instrument that can measure their actual level of digital competence is necessary. Respondent C said "it seems necessary.. because we think we can.. actually a lot of people don't know". Likewise with the other four respondents, for example respondent B who said "it's good, no problem.. because the new instrument indirectly can increase our competence in the use of ICT" and respondent A "It's good.. it means we can see how good our skills are".

Continuing from the question about the need to have an instrument that can measure competence, the respondents were asked about the appropriate course that can be carried out after knowing the competence that a teacher has. The majority of respondents who were asked had a positive view of the question. Among them are "yes..yes.. that's what we'll do

later, but it's rare to get it".. "it's okay..it's okay, no problem".. "haah..it's necessary..in a hands-on way".. "yeah, that's right, right, I agree". This shows that respondents have the desire to improve their respective digital competence. However, the wish will only be achieved if the course given refers to the benchmark which is the value of the actual competence that the person has (Fong et al., 2013). This statement is supported by Ali et al. (2009) said the training and courses that have been conducted by the ministry have not been successful in providing a positive impact on the digital competence of teachers because they are not guided by the available competence standards (Fong et al., 2013). Therefore, the application of digital technology in teaching and learning will remain a long-term problem if the basic issue, which is the true competence of the teacher, cannot be identified.

Conclusion

This study is a needs analysis focusing on conducting further research related to the problem statement outlined above. The findings obtained will provide input into the issues faced by educational institutions today and are believed to drive toward sought-after solutions.

Based on the interviews conducted, it was found that the competency skills of teachers assessed differ when using two different assessment approaches: self-assessment and task-based assessment. This difference indicates discrepancies in teachers' digital competencies as self-assessed compared to their actual abilities in digital usage. The significance of this study lies in understanding the true digital competence of individual teachers, as it will assist stakeholders in designing more precise and effective interventions to ensure optimal implementation of digital tools in teaching and learning processes.

Implication and Recommendation

The findings in this study show that there is a difference between self-assessment and task-based assessment to assess teachers' digital competence. This shows the need to develop more accurate instruments to assess digital competence other than instruments that are already available. With more accurate data and results it is believed that it will facilitate the preparation of an approach that is more appropriate to issues related to digital technology that are to be overcome.

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