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# INVESTIGATING THE INFLUENCE OF PEDAGOGICAL CONTENT KNOWLEDGE ON FORMATIVE ASSESSMENT PRACTICES IN ISLAMIC RELIGIOUS EDUCATION OF MALAYSIAN SECONDARY SCHOOLS

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## ABSTRACT

*This study examines the influence of pedagogical content knowledge (PCK) on formative assessment practices among Islamic religious education (IRE) teachers in Malaysian secondary schools, mixed methods design. The research integrates quantitative and qualitative approaches to comprehensively analyse the relationship between content knowledge, pedagogical knowledge, and PCK in shaping formative assessment practices. Quantitative data were collected from 249 IRE teachers via an online survey and analysed using partial least squares structural equation modelling (PLS-SEM), revealing that pedagogical knowledge and PCK significantly influence formative assessment practices, with pedagogical knowledge emerging as the strongest predictor. Content knowledge, however, did not demonstrate a significant impact. Three IRE teachers were randomly selected for semi-structured interviews to complement these findings, providing qualitative insights into their formative assessment strategies. The qualitative findings underscored the role of PCK in designing assessments that integrate Islamic teachings with real-life applications, promoting both intellectual engagement and moral development. Teachers employed varied strategies, including reflective essays, oral recitations, and real-world scenarios, to foster a deeper understanding of Islamic principles such as Tawheed and Fiqh. The interviews also highlighted the importance of addressing misconceptions and implementing differentiated instruction to cater to diverse learning needs. This study demonstrates the critical role of PCK in shaping effective formative assessments thus emphasising its potential to enhance students' academic achievements and their spiritual and ethical growth. The findings contribute valuable insights into the intersection of pedagogy and assessment within the context of Islamic education, offering implications for future research and educational practices.*

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**Keywords:** Formative assessment, Islamic religious education, Islamic education teacher, pedagogical content knowledge, Malaysian secondary schools

## INTRODUCTION

The Malaysian education system has undergone significant reforms to improve student outcomes, with increasing emphasis on formative assessment. This approach, defined as an ongoing process of tracking progress and providing consistent feedback, is essential for identifying student strengths and weaknesses and offering targeted support (Mohd Arif et al. 2019; Sidhu et al. 2018; Kaya-Capocci et al. 2022). The Ministry of Education has issued guidelines emphasising a variety of assessment techniques as observation, questioning, and self-assessment, to obtain a comprehensive picture of student learning.

A key area influenced by these reforms is Islamic religious education (IRE), a compulsory subject in Malaysian secondary schools. Taught in Malay, the IRE curriculum covers Islamic law, history, and civilisation, aiming to provide students with a deep understanding of Islamic beliefs and practices. Instructional methods include lectures, group work, discussions, and independent study, supplemented by extracurricular activities like Quran recitation and volunteerism (Ministry of Education Malaysia 2013). Formative assessment plays a vital role in monitoring students' grasp of Islamic values and adjusting instruction to meet diverse learning needs (Tambak et al. 2022; Mohamad Marzaini et al. 2024).

Students undergo a national IRE examination at the end of secondary education, assessing both content knowledge and the effectiveness of instruction (Tuna 2022). While the subject supports Islamic values, its objective is to foster a comprehensive, inclusive understanding of Islam, encouraging critical thinking and personal growth (Douglass and Shaikh 2004; Habibi et al. 2021). Given IRE's dual focus on academic achievement and moral development, effective formative assessment and pedagogical content knowledge (PCK) are essential.

PCK, as defined by Shulman (1986), merges content knowledge with pedagogical strategies, enabling teachers to deliver subject matter effectively. In IRE, this includes understanding religious content, appropriate teaching methods, and how to assess learning meaningfully (Tanjung et al. 2020). Teachers' past educational experiences and training shape their instructional styles, influencing how well they implement formative assessment.

However, challenges persist. Studies reveal issues like teacher bias in evaluations (Dalail et al. 2016), gaps between expected and actual use of technology (Mahat et al. 2021), and confusion between formative and summative assessments (Hasim et al. 2018). Excessive workloads and lack of training further hinder effective implementation (Dalail et al. 2018). Nonetheless, early professional development has been shown to foster positive attitudes toward formative assessment (Smith and Ahmadun, 2017).

Although some studies highlight the importance of PCK in IRE (Hashim et al. 2015; Ucan and Wright 2019; Gray-Hildenbrand and King 2019), there is limited research specifically examining how Malaysian IRE teachers integrate PCK with formative assessment. Addressing this gap, the current study explores the relationship between PCK and formative assessment practices among IRE teachers in Selangor, Malaysia. Hence, this study aims to answer the following research questions:

1. How does teachers' PCK influence the formative assessment practices of Islamic religious education teachers in Malaysian secondary schools?
2. In what ways do Islamic religious education teachers integrate PCK to design formative assessments that promote intellectual engagement and moral development among students?

## THE PCK MODEL

In 1986, Lee Shulman introduced PCK, highlighting the importance of effective teaching that goes beyond just subject matter knowledge. It refers to the unique understanding that teachers possess of how to teach their subject matter effectively. This concept is crucial for educators to ensure that their students achieve deep learning and understanding of the subject matter (Hume et al., 2019). Shulman (1986) identified three components of PCK development, namely, content knowledge, pedagogical knowledge, and PCK. Content knowledge is fundamental to the subject matter and includes an understanding of concepts, principles, and theories, along with the ability to apply them to problem-solving and connecting various areas of the subject.

Pedagogical knowledge encompasses the teacher's understanding of the teaching and learning process. It includes knowledge of effective teaching strategies, assessment techniques, and classroom management techniques for their subject matter (Jacob et al. 2020; Mesci et al. 2020). It is necessary for teachers to continuously update their pedagogical knowledge to design effective teaching strategies tailored to their student's learning needs. The PCK integrates content knowledge and pedagogical knowledge to develop effective teaching strategies. It includes the ability to communicate complex ideas in ways accessible to students and to design activities and assessments that help students develop a deep understanding of the subject matter (Rapanta et al. 2020).

Besides, Shulman (1986) emphasised the importance of ongoing reflection and self-evaluation in developing PCK. Teachers must evaluate their teaching practices constantly and seek opportunities for professional development to enhance their PCK continually. They must also strive to bridge the gap between theoretical knowledge and practical implementation to achieve a balance in their teaching practices. Therefore, PCK is a critical concept that teachers need to understand to be effective in their teaching practices. It requires a continuous effort to develop and refine one's teaching strategies and reflect on their implementation to enhance student learning.

Figure 1 illustrates the foundational model of PCK proposed by Shulman (1986), which underpins the conceptual framework of this study. In the context of IRE, the development of an IRE PCK model is critical for improving the quality of IRE teaching and learning (Ucan and Wright 2019). Therefore, generating a PCK model for IRE should entail identifying the knowledge and skills that IRE teachers require to teach Islamic concepts and practices effectively. This model should also take into account the unique context and characteristics of IRE, such as the students' religious and cultural backgrounds, as well as the Islamic values and principles that underpin the subject matter (Ucan and Wright 2019; Habibi et al. 2021). The IRE PCK model can be used to teach any Islamic subject, including Quranic studies, Islamic law, Islamic history, and Islamic ethics (Amzat 2022). Teachers can make sure that they are developing instruction and assessments that are relevant to the subject matter and the learners using the PCK model. Hence, IRE teachers can also use the model to assess and improve their teaching practices on a continuous basis, ensuring that they are meeting the needs of their students.

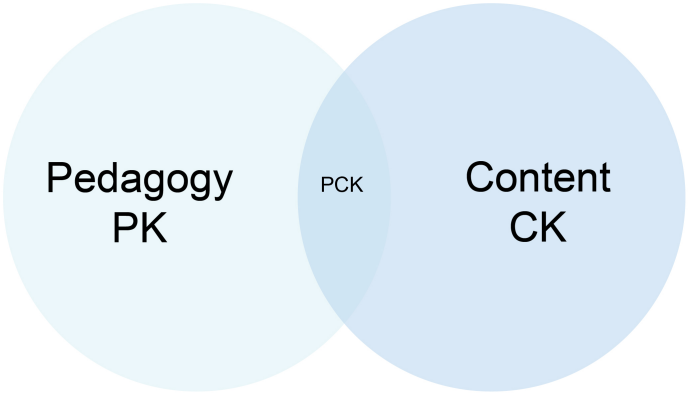


Figure 1: Pedagogical content knowledge (PCK).
*Source:* Shulman (1986)

## THE RELATIONSHIP BETWEEN TEACHERS' PCK AND FORMATIVE ASSESSMENT PRACTICES

Teachers possess specialised knowledge that guides their instructional decisions. In formative assessment, this knowledge shapes how they design lessons and make real-time judgments in the classroom (Mesci et al. 2020; Mohamad Marzaini et al. 2023). PCK a synthesis of content and pedagogical knowledge, is widely considered the most relevant knowledge base for effective teaching, learning, and assessment (Tanjung et al. 2020). PCK influences how teachers structure and present subject matter to accommodate diverse student needs and abilities, ultimately shaping their classroom assessment strategies. This form of knowledge is referred to as knowledge-in-action that guides decision-making during instruction (Mohd Arif et al. 2019). However, effective teaching also requires knowledge-in-action, a dynamic, responsive form of knowledge used for in-the-moment judgments.

According to Mohamad Marzaini and Mat Yusoff (2022), reflection-in-action during teaching fosters the growth of knowledge-in-action. This highlights a non-linear, reciprocal relationship between the development and implementation of PCK, where experience gained through classroom practice and peer interaction continually shapes a teacher's assessment approach. Developing PCK requires continuous reflection, self-evaluation, professional development, and hands-on teaching experience. As Carlson et al. (2019) emphasise, the application of PCK in assessment significantly impacts educational quality and student outcomes. Ongoing enhancement of teachers' PCK is therefore essential to improving teaching effectiveness and learning results.

### Content Knowledge and Formative Assessment Practices

The effectiveness of teachers in developing and conducting formative assessments is greatly influenced by their subject-matter competence. The teacher's knowledge of the subject matter, teaching style, and assessment techniques significantly impact the assessment process (Retnawati et al. 2018). The research suggests that teachers' subject-matter expertise affects the accuracy and precision of student assessments and feedback, and assessments that do not

accurately reflect student learning or feedback that does not align with learning objectives can be attributed to teachers' lack of subject-matter competence (Mellati and Khademi 2018; Mat Yusoff et al. 2022). Insufficient subject-matter expertise in formative assessment development and implementation can negatively affect student learning and progress by leading to incorrect interpretations of their abilities and growth. These challenges may be compounded by various factors, such as changing curriculum standards, resource constraints, and time limitations that may limit teachers' subject-matter expertise and ability to conduct effective assessments (Russo and Hopkins 2019). To ensure the validity and reliability of classroom assessments, teachers must continuously engage in professional development to enhance their content knowledge.

The research suggests that teachers' subject-matter expertise affects the accuracy and precision of student assessments and feedback, and assessments that do not accurately reflect student learning or feedback that does not align with learning objectives can be attributed to teachers' lack of subject-matter competence (Mellati and Khademi 2018; Mat Yusoff et al. 2022). Insufficient subject-matter expertise in formative assessment development and implementation can negatively affect student learning and progress by leading to incorrect interpretations of their abilities and growth. These challenges may be compounded by various factors, such as changing curriculum standards, resource constraints, and time limitations that may limit teachers' subject-matter expertise and ability to conduct effective assessments (Russo and Hopkins 2019). To ensure the validity and reliability of classroom assessments, teachers must continuously engage in professional development to enhance their content knowledge.

It is critical to understand that the subject-matter competence of teachers significantly affects the development and implementation of formative assessments, which can directly impact student learning outcomes. The accuracy and precision of student assessments and feedback depend on the teacher's subject-matter expertise, which affects the validity and reliability of assessments (Panadero et al. 2020; Mat Yusoff et al. 2022). Teachers must understand the importance of ongoing professional development to enhance their content knowledge and ensure the validity and reliability of formative assessments. To mitigate the negative impact of changing curriculum standards, resource constraints, and time limitations, it is essential for teachers to continuously enhance their subject-matter competence to develop and implement effective assessments that align with student learning objectives. Hence, teachers' subject-matter competence is an integral part of effective formative assessment development and implementation, and it is necessary to support and promote continuous professional development to ensure the quality of assessments and student learning outcomes. Based on this understanding, the following hypothesis is proposed to examine the relationship between content knowledge and formative assessment practices.

H1: There is a positive association between content knowledge and formative assessment practices.

## Pedagogical Knowledge and Formative Assessment Practices

Teachers' pedagogical knowledge is crucial in developing and implementing classroom-based assessments. This knowledge encompasses a deep understanding of teaching methods, assessment techniques, and using assessments to guide instruction. Using their pedagogical knowledge, teachers can create assessments aligned with the curriculum and learning objectives and accurately measure student progress and understanding (Hume et al. 2019; Adom et al. 2020). This allows teachers to make informed instructional decisions, provide targeted feedback, and monitor student growth over time.

However, changes in curriculum standards, resource limitations, and time constraints can have negative effects on teachers' pedagogical knowledge and their ability to design and execute effective classroom assessments (Shepard et al. 2018). Therefore, teachers need to engage in ongoing professional development opportunities to enhance their pedagogical knowledge and skills in assessment design and implementation. Mohamad Marzaini and Mat Yusoff (2022) added that effective classroom assessments are essential in enabling teachers to understand students' knowledge and skills, identify areas of improvement, and modify instruction to meet the diverse needs of all students. This leads to increased academic success and better preparation for future learning experiences and opportunities. Building on the significance of pedagogical expertise in shaping effective classroom assessment, the following hypothesis is proposed to explore its influence on formative assessment practices.

H2: There is a positive association between pedagogical knowledge and formative assessment practices.

## PCK and Formative Assessment Practices

In the realm of formative assessment, teachers' PCK is of utmost importance. The PCK refers to the combination of knowledge in content and knowledge in pedagogy, allowing teachers to develop assessments that are tailored to the curriculum and teaching strategies, which effectively measure student progress and comprehension (Grieser and Hendricks 2018; Jacob et al. 2020). This highlights the significance of PCK in the development of assessments that are both pedagogically sound and specific to content. Therefore, teachers must possess a strong understanding of PCK to create assessments that accurately measure student growth and achievement.

With a strong PCK, teachers have an understanding of the interplay between content and teaching methods, allowing them to design assessments that accurately gauge students' comprehension and progress (Novianti and Febrialismanto 2020). Moreover, Lee et al. (2018) posited that teachers who comprehend the relationship between subject matter and instructional strategies are better equipped to create assessments that reflect this understanding. This ensures the validity of the assessments in reflecting students' abilities and progress, as well as providing valuable information to inform instruction and guide future learning. Therefore, PCK plays a critical role in developing valid and reliable assessments, which can help teachers make informed instructional decisions and adjust their teaching strategies accordingly. In addition to creating valid assessments, teachers possessing robust PCK can provide students with constructive and targeted feedback, enhancing student motivation, engagement, and overall learning experience (Auerbach et al. 2018). As teachers understand both content and pedagogy, they can provide feedback that is specific to both the student's understanding of the content and the teaching strategies used. This targeted feedback can assist students in identifying areas of strength and weakness, which helps to foster growth and promote student achievement. Thus, PCK allows teachers to develop assessments that not only measure student achievement but also help students learn and progress.

Furthermore, PCK empowers teachers to use assessments effectively to inform their instruction, furnish targeted feedback, and make necessary adjustments to their teaching strategies (Mesci et al. 2020). Teachers who possess a strong understanding of PCK can use assessment results to identify areas of student misunderstanding and adjust their teaching strategies to help students achieve success. By doing so, teachers can help ensure that students receive instruction that is tailored to their individual needs, promoting equitable outcomes for all students. Thus, PCK is critical for developing assessments that can help guide future learning and promote student success. In light of the pivotal role that PCK plays in integrating subject matter with instructional strategies, the following hypothesis is proposed to examine its impact on formative assessment practices.

H3: There is a positive association between PCK and formative assessment practices

# METHODOLOGY

## Research Design

This study aims to quantify and evaluate teachers' PCK and formative assessment practices using a mixed-method research design. The researchers have chosen a mixed method approach to obtain a deeper understanding of the social world, specifically in education, and to meet the research objectives as survey research popularly studies human perceptions, beliefs, and behaviour. As stated by Creswell (2011), it is commonly used in social science research and is most suitable for this particular study. Not only that, using a mixed-method research design enables the collection of diverse data by integrating qualitative and quantitative approaches. The data obtained from the survey can be easily analysed using statistical techniques, which provides reliable and accurate results. However, one of the limitations of using a survey is that it relies heavily on self-reporting, which can lead to biased responses. Thus, adding semi-structured interviews to complement the survey will give deeper insight and complement the survey findings (Leech et al. 2010).

In this study, a survey was employed to gather information concerning the impact of PCK on formative assessment practices. The survey derived from the studies of Schmidt et al. (2009), Koh et al. (2010), Goggin (2018), and Luik et al. (2018), was crafted based on the principles outlined in the book by Chappuis et al. (2012). Meanwhile, the semi-structured interview was employed to understand further the teachers' PCK reflected in the formative assessment practices. The interview protocols were derived from the study of Sothayapetch et al. (2013) on PCK and assessment practices. To ensure its validity, the survey and interview protocols underwent a process of face validation involving consultation with four secondary school religious education teachers and one teacher educator. Furthermore, the content validity of the survey was established by distributing it to 20 experts in the field through various communication channels such as email, ResearchGate, WhatsApp, Telegram, and Facebook Messenger. Out of the 20 experts contacted, 10 agreed to participate, two declined, citing time constraints, and the remaining experts did not respond. These experts were selected based on their research experience, educational background, and relevant research activities and achievements, aligning with the recommendations of Lynn (1986) and Hong et al. (2019). These experts evaluated the survey's relevance, clarity, and simplicity through a questionnaire provided by the researchers. Table 1 presents the instrument employed in this study.

Table 1: The instrument used in the study.

| No. | Construct | Indicator | No. of items |
|---|---|---|---|
| 1 | CK | CK1, CK2, CK3 | 3 |
| 2 | PK | PK1, PK2, PK3, PK4, PK5, PK6, PK7 | 7 |
| 3 | PCK | PCK1, PCK2, PCK3 | 3 |
| 4 | FA | FA1, FA2, FA3, FA4, FA5, FA6, FA7, FA8, FA9, FA10, FA11, FA12, FA13, FA13 | 14 |

*Notes:* CK = content knowledge; PK = pedagogical knowledge; PCK = pedagogical content knowledge; FA = formative assessment.

## Data Collection, Sampling, and Preparation

Data for this study were collected from January 2022 to March 2023 by distributing an instrument to participants from 30 secondary schools in Selangor, Malaysia. Ethical approval was obtained

from the Educational Policy Planning and Research Division of the Ministry of Education Malaysia, and informed consent was secured from all participants prior to their involvement in the questionnaire and interviews. Data collection was conducted online to ensure convenience and facilitate efficient data management. Responses were processed using Microsoft Excel and the Statistical Package for the Social Sciences (SPSS), developed by IBM Corp., Armonk, NY, USA. Online questionnaires have become increasingly popular due to their ease of distribution and streamlined analysis.

The study employed a convenience sampling method to recruit 260 IRE teachers, chosen based on the researchers' access to specific schools. This method provided the flexibility needed when exact population parameters were difficult to determine (Chua 2012). After a thorough screening process, 249 usable responses were retained for analysis (as shown in Table 2). Additionally, three teachers were randomly selected from this group for follow-up interviews. Although the sample size was relatively modest, it was deemed sufficient for statistical analysis (Sekaran and Bougie, 2016). The rigorous screening enhanced data quality, thus strengthening the study's reliability and validity.

Table 2: Demographic information of the participants

| Gender | Frequency |
|---|---|
| Male | 64 |
| Female | 185 |
| Total | 249 |
| Years of teaching | Frequency |
| 1 year to 5 years | 149 |
| 6 years to 10 years | 22 |
| 11 years to 15 years | 24 |
| 16 years to 20 years | 9 |
| More than 20 years | 45 |
| Total | 249 |
| Academic qualifications | Frequency |
| Diploma | 8 |
| Bachelor's degree | 239 |
| Master's degree | 2 |
| Total | 249 |

## Data Analysis

Prior to conducting the measurement model, a comprehensive data preparation process was undertaken to ensure completeness and accuracy. This included identifying and addressing anomalies, missing values, non-normal distributions, and input errors (Hair et al. 2010). Techniques such as skewness, kurtosis, Q-Q plots, and histograms were used to assess normality, confirming the data were suitable for analysis. Ensuring data normality was essential for maintaining the validity and reliability of the measurement model.

To evaluate the reliability and validity of the construct, the study employed reflective measurement models with four indicators. Techniques included assessing reflective indicator loadings, internal consistency reliability, convergent validity, and discriminant validity. Partial least squares structural equation modelling (PLS-SEM) was used to assess the measurement model. Internal consistency was measured using Cronbach's alpha and composite reliability (CR). Discriminant validity was verified using the Fornell-Larcker criterion, loading and cross-loading, and heterotrait-monotrait (HTMT) ratios. These techniques strengthened the credibility and generalisability of the findings.

The structural model's predictive power was evaluated using procedures recommended by Hair et al. (2019), including collinearity assessment, path coefficients (β), coefficient of determination ($R^2$), effect size ($f^2$), and $Q^2$ with its effect size. The PLS-SEM approach was selected for its suitability in exploratory research and its ability to handle complex models involving multiple constructs (Hair et al. 2021; Sarstedt et al. 2022).

For qualitative data analysis, Atlas.ti 23 software (ATLAS.ti Scientific Software Development GmbH, Berlin, Germany) was used to organise and manage data efficiently (Creswell 2012). This tool facilitated code assignment and keyword searches but did not perform analysis itself (Bryman 2008). Each participant's file included data from interviews, classroom observations, and curriculum excerpts. The first phase involved a detailed examination of each dataset, beginning with IRE teachers, to ensure systematic understanding (Creswell 2012).

To minimise data omission, a structured classification system was used. Through iterative coding and sub-coding, emergent themes were identified to address the research questions. Findings were presented narratively for in-depth interpretation and contextualised within relevant literature. To enhance reliability, an intercoder reliability (ICR) assessment was conducted using Cohen's kappa, as shown in Table 3, ensuring consistency in the coding process and reinforcing the credibility of the results.

Table 3: Cohen's kappa threshold of agreement

| Value | Indication of agreement |
|---|---|
| ≤ 0 | No agreement |
| 0.01–0.20 | Slight agreement |
| 0.21–0.40 | Fair agreement |
| 0.41–0.60 | Moderate agreement |
| 0.61–0.80 | Substantial agreement |
| 0.81–1.00 | Perfect agreement |

## The Trustworthiness of the Study

To ensure the validity and reliability of the study's findings, an ICR assessment was conducted on the identified codes and themes. This process evaluated the consistency and agreement between two independent coders, thereby enhancing the study's credibility. Twelve codes were cross-analysed using Cohen's kappa, a widely accepted measure of agreement (O'Connor and Joffe 2020). Coder 1 developed the initial coding framework, systematically segmenting and labelling the data, which was saved in a "clean" file and passed to Coder 2. Using the same framework, Coder 2 independently coded the transcriptions. Agreement was assessed at the unit level, with

each code assigned a nominal value: "1" for agreement and "0" for disagreement. This binary categorisation allowed for the calculation of Cohen's kappa. The analysis was conducted using SPSS, yielding a kappa value of $k = 0.63$, $p < 0.05$, indicating a moderate level of agreement. This result aligns with the threshold levels proposed by Landis and Koch (1977), as detailed in Table 4. These findings demonstrate the methodological rigour of the study and support the reliability of the coding process and the validity of the emergent themes.

Table 4: ICR symmetric measures

| | | Value | Asymptotic standardised error[a] | Approximate T[b] | Approximate significance |
|---|---|---|---|---|---|
| Measure of agreement | Kappa | 0.63 | 0.13 | 3.55 | – |
| N of valid cases | | 12 | | | |

*Notes:* a. Not assuming the null hypotwhesis; b. Using the asymptotic standard error assuming the null hypothesis.

Based on the analysis presented, the study demonstrated a "substantial agreement" between coders, as measured against the threshold of agreement outlined in Table 3. This outcome validates the reliability of the coding process and establishes a robust foundation for the findings discussed in the subsequent sections.

## QUANTITATIVE RESULTS

### PLS-SEM Measurement Models Used in the Study

Despite some of the loading values falling below the recommended threshold of > 0.708, as proposed by Hair et al. (2019), the researchers in this study decided to proceed with the analysis by setting the cutoff point for loading values to > 0.600. This decision was based on the average variance extracted (AVE) values and ensuring that no more than 15% of the items were eliminated to maintain the reliability and validity of the construct. It should be noted that the cutoff value for loading values can vary depending on the specific context and research question, and thus, a careful judgment must be made while selecting the threshold value (Hair et al. 2019). The findings presented in Table 5 indicate that some indicators, namely PK1 and FA1, were removed from the analysis as they had loading values below 0.600. Moreover, the internal consistency reliability measures, namely Cronbach's alpha and CR, demonstrated satisfactory levels of reliability, with values being above the minimum threshold of 0.600 and below the maximum threshold of 0.950. These results imply that the questionnaire used in this study is a reliable instrument for measuring the constructs of interest.

The discriminant validity of the constructs was evaluated using the Fornell-Larcker criterion and cross-loading criterion, and the results are displayed in Tables 4 and 5, indicating that the values satisfy the criteria. The values on the diagonal of the matrix represent the variance extracted for each construct, while the values on the off-diagonal represent the correlations between the different constructs. As Table 6 illustrates, the AVE values for each construct exceed the corresponding off-diagonal values, which is indicative of good discriminant validity. Good discriminant validity is vital to ensure that each construct measures a unique and distinct concept rather than being redundant or overlapping with other constructs. Thus, it is a crucial aspect of construct validity in any research study.

Table 5: Measurement model of PCK and formative assessment

| Construct | Item | VIF | Loading | AVE | CR | α |
|---|---|---|---|---|---|---|
| CK | CK1 | 1.222 | 0.794 | 0.565 | 0.795 | 0.618 |
| | CK2 | 1.215 | 0.703 | | | |
| | CK3 | 1.229 | 0.755 | | | |
| PK | PK2 | 1.540 | 0.727 | 0.511 | 0.862 | 0.809 |
| | PK3 | 1.588 | 0.753 | | | |
| | PK4 | 1.433 | 0.663 | | | |
| | PK5 | 1.469 | 0.707 | | | |
| | PK6 | 1.514 | 0.712 | | | |
| | PK7 | 1.592 | 0.725 | | | |
| PCK | PCK1 | 1.345 | 0.738 | 0.586 | 0.809 | 0.649 |
| | PCK2 | 1.382 | 0.802 | | | |
| | PCK3 | 1.175 | 0.755 | | | |
| FA | FA10 | 2.563 | 0.734 | 0.539 | 0.938 | 0.928 |
| | FA11 | 2.926 | 0.733 | | | |
| | FA12 | 2.807 | 0.728 | | | |
| | FA13 | 2.365 | 0.691 | | | |
| | FA14 | 3.191 | 0.733 | | | |
| | FA2 | 2.197 | 0.645 | | | |
| | FA3 | 4.847 | 0.800 | | | |
| | FA4 | 4.228 | 0.809 | | | |
| | FA5 | 2.574 | 0.737 | | | |
| | FA6 | 3.911 | 0.751 | | | |
| | FA7 | 2.257 | 0.653 | | | |
| | FA8 | 3.683 | 0.744 | | | |
| | FA9 | 3.089 | 0.768 | | | |

*Notes:* CK = content knowledge; PK = pedagogical knowledge; PCK = pedagogical content knowledge; FA = formative assessment.

Table 6: Fornell-Larcker criterion

| Construct | CK | FA | PCK | PK |
|---|---|---|---|---|
| CK | 0.752 | | | |
| FA | 0.475 | 0.734 | | |
| PCK | 0.431 | 0.640 | 0.765 | |
| PK | 0.686 | 0.689 | 0.660 | 0.715 |

*Notes:* CK = content knowledge; PK = pedagogical knowledge; PCK = pedagogical content knowledge; FA = formative assessment.

The results of the cross-loading analysis, as presented in Table 7, indicate that the loading value of an indicator on its corresponding construct is substantially higher than its loading value on other constructs. This finding confirms the construct validity of the research model and suggests that the indicators utilised in this study are capable of effectively measuring their intended constructs without significant influence from other constructs. This is an essential aspect of construct validity, as it helps to ensure that the measures employed in the study accurately capture the construct of interest and are not influenced by extraneous factors. The results of the study demonstrate that the construct validity of the research model is supported, indicating that teachers' PCK is a suitable framework for understanding formative assessment practices among secondary school IRE teachers.

Table 7: Outer loading results

| Item | CK | FA | PCK | PK |
|---|---|---|---|---|
| CK1 | 0.794 | | | |
| CK2 | 0.703 | | | |
| CK3 | 0.755 | | | |
| FA10 | | 0.734 | | |
| FA11 | | 0.733 | | |
| FA12 | | 0.728 | | |
| FA13 | | 0.691 | | |
| FA14 | | 0.733 | | |
| FA2 | | 0.645 | | |
| FA3 | | 0.800 | | |
| FA4 | | 0.809 | | |
| FA5 | | 0.737 | | |
| FA6 | | 0.751 | | |
| FA7 | | 0.653 | | |
| FA8 | | 0.744 | | |
| FA9 | | 0.768 | | |
| PCK1 | | | 0.738 | |
| PCK2 | | | 0.802 | |
| PCK3 | | | 0.755 | |
| PK2 | | | | 0.727 |
| PK3 | | | | 0.753 |
| PK4 | | | | 0.663 |
| PK5 | | | | 0.707 |
| PK6 | | | | 0.712 |
| PK7 | | | | 0.725 |

*Notes:* CK = content knowledge; PK = pedagogical knowledge; PCK = pedagogical content knowledge; FA = formative assessment.

Table 8 displays the results of the HTMT ratio, which is employed to assess the discriminant validity of the proposed model. The study found that the HTMT values of all constructs were below 0.850, which is the recommended threshold for good discriminant validity. These results suggest that the research model, along with the instruments utilised in the study, is both reliable and valid.

Table 8: HTMT results

| Construct | CK | FA | PCK | PK |
|---|---|---|---|---|
| CK | | | | |
| FA | 0.615 | | | |
| PCK | 0.670 | 0.809 | | |
| PK | 0.848 | 0.776 | 0.797 | |

*Notes:* CK = content knowledge; PK = pedagogical knowledge; PCK = pedagogical content knowledge; FA = formative assessment.

After establishing the measurement model, the researchers subsequently present the descriptive statistics in Table 9. The table presents descriptive statistics and correlations among four latent variables: formative assessment, content knowledge, pedagogical knowledge, and PCK. Formative assessment has a mean of 3.90 and a standard deviation (SD) of 0.60, indicating a moderate average rating with some variability. Content knowledge exhibits a slightly higher mean of 4.08 with a lower SD of 0.44, suggesting that respondents tend to rate this variable higher with less variability. Pedagogical knowledge has a mean of 3.98 and an SD of 0.47, showing high ratings with moderate variability, while PCK has a mean close to pedagogical knowledge at 3.93 but with a slightly higher SD of 0.48. The correlation between formative assessment and the other variables shows moderate associations, with 0.49 to content knowledge, a stronger 0.67 to pedagogical knowledge, and 0.64 to PCK. Content knowledge and pedagogical knowledge have a substantial correlation of 0.71, and both have notable correlations with PCK at 0.54 and 0.75, respectively. These correlations indicate that while each latent variable shares a relationship with the others, they represent distinct but related constructs within the domain being studied, with PCK showing the highest correlation with pedagogical knowledge, suggesting a particularly close relationship between these two variables.

Table 9: Descriptive statistics and association among latent variables

| Latent variable | Mean | SD | FA | CK | PK | PCK |
|---|---|---|---|---|---|---|
| FA | 3.90 | 0.60 | 1.00 | | | |
| CK | 4.08 | 0.44 | 0.49 | 1.00 | | |
| PK | 3.98 | 0.47 | 0.67 | 0.71 | 1.00 | |
| PCK | 3.93 | 0.48 | 0.64 | 0.54 | 0.75 | 1.00 |

*Notes:* CK = content knowledge; PK = pedagogical knowledge; PCK = pedagogical content knowledge; FA = formative assessment.

## Assessment Model

The study examined the potential issue of collinearity among the predictors of content knowledge, pedagogical knowledge, and PCK that influence formative assessment among Malaysian secondary school IRE teachers. The findings revealed that the VIF values for all three sets of predictors were below the threshold of 3, suggesting that there was no significant collinearity among them. The relationships reported in the structural model were also significant at a 5% level of significance, indicating the reliability and robustness of the proposed model in explaining the factors that influence formative assessment practices (as shown in Table 10 and Figure 2). In terms of predicting formative assessment, the study found that pedagogical knowledge was the most significant construct, with a path coefficient of 0.447, followed by PCK, with a coefficient of 0.342. However, content knowledge did not show a significant relationship with formative assessment, with a coefficient of 0.014. These findings suggest that among Malaysian secondary school IRE teachers, pedagogical knowledge and PCK are crucial in predicting formative assessment practices, while content knowledge is not significant in predicting them. The study's results underscore the importance of pedagogical knowledge and PCK in enhancing the effectiveness of formative assessment practices.

Table 10: Path coefficient, *t* values, and *p* values

| Hypothesis | Path | Path coefficient (β) | *t* | *p* | Significance ($p < 0.005$) |
|---|---|---|---|---|---|
| H1 | CK → FA | 0.014 | 0.213 | 0.831 | No |
| H2 | PK → FA | 0.447 | 6.280 | 0.000 | Yes |
| H3 | PCK → FA | 0.342 | 5.772 | 0.000 | Yes |

*Notes*: CK = content knowledge; PK = pedagogical knowledge; PCK = pedagogical content knowledge; FA = formative assessment.

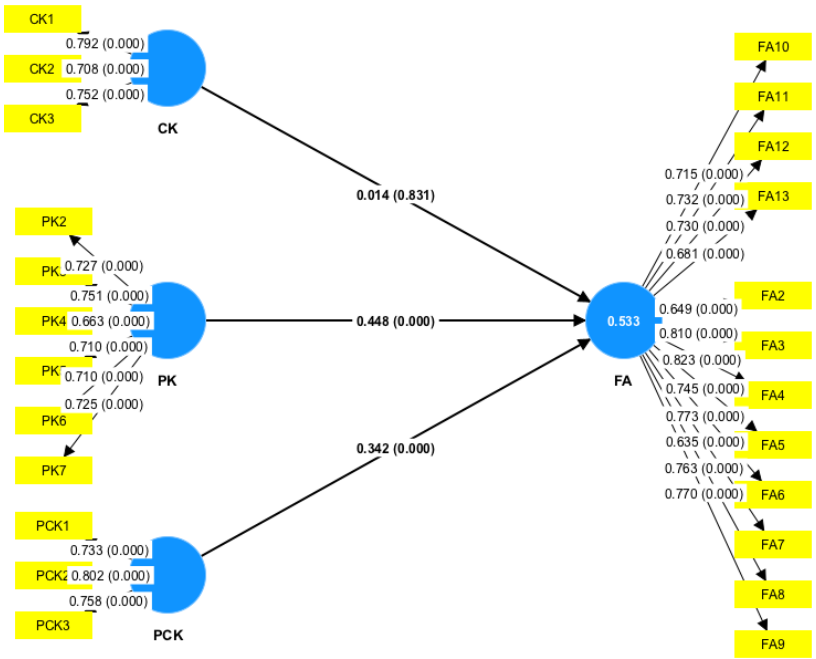


Figure 2: The structural equation model that was estimated.

## Common method bias

Measurement inaccuracies resulting from methodological problems are referred to as common method bias. For example, using the same measurement scale (e.g., a 5-point Likert scale) for all survey questions may result in common method bias. Podsakoff et al. (2003) outlined several statistical treatments for common method bias, each with advantages and disadvantages. Harman's single-factor test, which is the most commonly used, is used in this study. The researchers used the 24-item loading on one latent factor to perform unrotated exploratory factor analysis. Only 40% of the average variance is explained by a single factor, which is significantly less than the recommended cutoff point of 50%. So, in this study, common method bias is not a problem.

## Assess the Level of R2

The coefficient of determination ($R^2$) measures the proportion of variance in the dependent variable that is explained by the independent variables in the model. In PLS-SEM, an $R^2$ value of 0.8 or greater is considered an acceptable fit of the model to the data, while an R2 value of less than 0.5 indicates a poor fit. In Table 11, the calculation of the $R^2$ is presented. The $R^2$ score for the formative assessment was found to be 0.472, reflecting a moderate level of explained variance of the dependent variable by the model. This indicates a satisfactory fit of the model to the data and a significant degree of accuracy in its prediction.

Table 11: Results of $R^2$ of the integrated model

| | $R^2$ | Consideration |
|---|---|---|
| FA | 0.491 | Moderate |

*Note:* FA = formative assessment.

## Assess the f2 Effect Size

The magnitude of the $f^2$ value is indicative of the strength of the relationship between the latent variable and its indicators. A higher $f^2$ value implies a robust connection between these two elements and suggests that the latent variable effectively captures the underlying construct being assessed.

According to Hair et al. (2019), small, medium, and large effect sizes are categorised as 0.02, 0.15, and 0.35, respectively. In accordance with the hypotheses, Table 12 presents the values of $f^2$ for the endogenous constructions and the exogenous constructs or predictors: content knowledge, pedagogical knowledge, and PCK. The findings reveal that two exogenous constructs, namely pedagogical knowledge and PCK, have significant effect sizes on the endogenous construct, formative assessment. The effect sizes were determined using the $f^2$ values, and moderate effect sizes were found for PCK → formative assessment (0.342), and large effect sizes were found for pedagogical knowledge → formative assessment (0.447).

Table 12: Results of $f^2$ of the integrated model

| | $f^2$ | Effect size |
|---|---|---|
| CK → FA | 0.014 | Small |
| PK → FA | 0.448 | Large |
| PCK → FA | 0.342 | Moderate |

*Notes:* CK = content knowledge; PK = pedagogical knowledge; PCK = pedagogical content knowledge; FA = formative assessment.

## Assessing the Predictive Relevance, $Q^2$

The predictive relevance of the model was assessed by utilising the blindfolded techniques in SmartPLS 4 version 4.1.0 (SmartPLS GmbH, Bönningstedt, Germany) (Hair et al., 2019) to obtain the $Q^2$ value. The $Q^2$ value is a measure of the capacity of a latent variable to predict the dependent variable in the model. A high $Q^2$ value signifies that the latent variable holds a robust predictive ability towards the dependent variable, whereas a low $Q^2$ value indicates a weak predictive ability. Furthermore, the predictive relevance of the model for the endogenous construct was evaluated using the $Q^2$ value, which showed a value of 0.514 in Table 13, indicating good predictive relevance. These results suggest that the proposed model has good predictive power and can accurately predict the influence of pedagogical knowledge and PCK on formative assessment among Malaysian secondary school IRE teachers.

Table 13: Results of $Q^2$ of the integrated model

| | $Q^2$ | Predictive relevance |
|---|---|---|
| FA | 0.514 | Large |

*Note:* FA = formative assessment.

# QUALITATIVE RESULTS

This section presents the findings derived from interviews with three IRE teachers, focusing on their practices related to formative assessments in the context of Aqidah and Fiqh. The analysis draws on the relationship between three key aspects of teaching: PCK, pedagogical knowledge, and content knowledge, as they relate to formative assessment practices.

## PCK in Formative Assessment

The relationship between teachers' PCK and their formative assessment practices was significant. Teachers' deep understanding of Islamic religious content enabled them to design assessments that measured students' retention and encouraged the application of knowledge in real-life contexts. Teacher 1 (T1) emphasised the importance of engaging students through relevant and practical scenarios to assess their understanding of Fiqh:

> I might ask students to brainstorm everyday scenarios where Fiqh applies, ensuring they can relate theoretical knowledge to their daily lives. (T1)

This approach reflects T1's strong PCK, as she uses real-world applications to assess both knowledge and understanding in formative assessments. Teacher 2 (T2), on the other hand, emphasised the use of memorisation and Quranic verses to assess foundational knowledge. This highlights the role of content knowledge in assessing students' grasp of fundamental religious concepts.

> I emphasise memorisation of key Quranic verses and their meanings. This forms the bedrock of their understanding in Islamic studies and is critical in formative assessments to check their retention. (T2)

## Pedagogical Knowledge in Formative Assessment Practices

Teachers' pedagogical knowledge was evident in their strategies for assessing students' engagement and understanding through diverse pedagogical approaches. This included the use of interactive methods, formative assessments based on reflective journaling, and collaborative group work to encourage deeper thinking and internalisation of concepts. Teacher 3 (T3) focused on reflective assessments and class discussions to assess students' grasp of complex Islamic concepts. She stated:

> I assess students through reflective essays and oral recitations, ensuring they deeply understand the spiritual significance behind what they learn. (T3)

This formative assessment method demonstrates T3's pedagogical knowledge, as she integrates reflection with assessment to promote intellectual and spiritual growth. In contrast, T2 employs oral tests and Q&A sessions to evaluate student comprehension more directly. His approach is rooted in pedagogical methods that value verbal communication as a tool for assessing understanding in real-time.

> Oral tests and discussions are my primary assessment tools. This method helps me gauge whether students are able to articulate their understanding. (T2)

## Content Knowledge and Formative Assessment

The teachers' content knowledge plays a critical role in shaping how formative assessments are designed. A deep understanding of Aqidah, Fiqh, and Tafsir allows teachers to create assessments that go beyond rote learning, assessing knowledge, application, and ethical development. T1 integrates multimedia resources like videos and Islamic apps to supplement her content knowledge and provide students with diverse perspectives on Islamic teachings. She noted:

> I recommend platforms like Al-Kahfi app, Islamic YouTube channels, and encourage visits to Islamic art museums or community events like Maulidur Rasul. (T1)

This suggests that T1's content knowledge extends beyond textbooks and is enhanced through the integration of digital resources, which enrich her formative assessment practices. Similarly, T3 draws on classical Islamic texts and sermons to ground her assessments in traditional knowledge. This approach reflects T3's deep content knowledge, which informs her formative assessment strategies.

> I follow the textbook but prioritise Islamic classical texts and their interpretations. These resources are crucial for ensuring that students are well-versed in the traditional teachings of Islam. (T3)

## Integrating Pedagogical and Content Knowledge for Formative Assessment

A key finding of this study is integrating PCK and content knowledge to create formative assessments that evaluate academic understanding and promote personal development. All three teachers employed strategies that combined intellectual content with the application of Islamic virtues, ensuring that students internalised the values associated with Aqidah and Fiqh. T1, for instance, combines formative assessment with character development – "I ask students to reflect

on how Tawheed impacts their life, ensuring that they can connect the concept of Tawheed with their personal actions" (T1). This highlights the intersection of content knowledge (Tawheed) with pedagogical strategies aimed at fostering virtue, such as honesty and integrity.

T2 used comparison activities to assess the student's ability to critically evaluate different interpretations of Quranic verses. This reflects the application of pedagogical and content knowledge in formative assessments, as stated by T2, "I emphasise comparison activities, such as analysing different interpretations of a verse, which encourages students to think critically about the content they learn".

### Addressing Misconceptions and Differentiated Instruction in Formative Assessment

A common theme across the teachers' approaches is the use of formative assessments to identify and address misconceptions. The teachers also emphasised the importance of differentiated instruction, adapting assessments to meet diverse learning needs. T1 uses open discussions to clarify misconceptions, stating that "I hold open discussions to clarify doubts and encourage students to refer to authentic sources".

This practice ensures that formative assessments are used as tools for measuring knowledge and as opportunities for deepening understanding. Similarly, T2 uses real-life analogies to redirect students when they make errors in understanding. This method emphasises the role of pedagogical knowledge in shaping how formative assessments address student misunderstandings. T2 stated that "I use real-life analogies to explain errors and redirect students toward correct practices".

Meanwhile, T3 adapts the difficulty of assessments based on students' proficiency levels. Thus, it highlights the significance of differentiated assessment strategies in ensuring that all students are appropriately challenged and supported in their learning. As T3 stated, "I provide additional explanations for weaker students and challenge stronger students with advanced questions".

## DISCUSSION

This study explored the influence of content knowledge, pedagogical knowledge, and PCK on the formative assessment practices of IRE teachers in Malaysian secondary schools. Quantitative findings revealed that pedagogical knowledge was the strongest predictor of formative assessment practices, followed by PCK, while content knowledge had no significant effect. This supports prior research identifying pedagogical knowledge as a key determinant of teaching competence (König and Kramer 2016; Tröbst et al. 2018). It suggests that IRE teachers' effectiveness in applying formative assessment depends largely on their understanding of how to teach the subject meaningfully.

Pedagogical knowledge includes the ability to design and implement lessons, manage classrooms, motivate learners, and assess and respond to students' needs (Neumann et al. 2019; Abdul Razak et al. 2023). In the IRE context, this enables teachers to communicate complex Islamic concepts effectively (Leighton and Gómez 2018). Additionally, PCK, as defined as the specialised understanding of how to teach specific content, was also found to significantly influence formative assessment practices, echoing findings from Gess-Newsome et al. (2019) and Ramollo and Kanjee (2023). Strengthening PCK is therefore essential to improving assessment practices and informing policy interventions.

Interestingly, content knowledge did not significantly predict formative assessment practices, diverging from studies that emphasise its role in shaping academic achievement and instructional quality (Keller et al. 2017; Lee et al. 2018; Abdul Razak et al. 2023). While deep content understanding is crucial for student success, the findings suggest that in assessment contexts, other factors such as pedagogical adaptability, classroom engagement strategies, or teachers' beliefs may be more influential. This reinforces the need to focus professional development on integrating pedagogy with content, rather than content knowledge alone.

The qualitative findings enriched these results by highlighting how teachers integrate PCK, pedagogical knowledge, and content knowledge into their formative assessment practices. Teachers designed assessments not only to evaluate retention but also to promote real-life application and moral development rooted in Islamic teachings. For instance, T1 used real-world scenarios to assess students' understanding of Fiqh, enabling learners to apply theoretical concepts to daily life. This mirrors Mat Yusoff et al.'s (2024a) findings that real-life integration enhances conceptual understanding and engagement.

T2's emphasis on memorisation and Quranic verses reflected the traditional roots of IRE, where foundational knowledge underpins formative assessment (Che Hassan et al. 2023). This indicates that while pedagogical innovation is vital, content mastery still plays a critical supporting role in shaping assessment practices. Similarly, T3's use of reflective essays and oral recitations exemplified how pedagogical knowledge fosters intellectual and spiritual growth. As Crawford et al. (2023) argue, such strategies prompt deeper engagement and self-reflection, reinforcing the dual objectives of IRE. Mohamad Marzaini et al. (2024) also support this, noting that active learning strategies, like discussions and journaling to enhance critical thinking and deepen conceptual understanding.

Moreover, the integration of digital tools and multimedia resources, as seen in T1's use of Islamic apps and videos, diversified content delivery and made formative assessments more accessible. This approach aligns with findings by Mohamad Marzaini et al. (2024), Mat Yusoff et al. (2025), and Lijie et al. (2024), who advocate for the use of educational technologies to support assessment and cater to diverse learning needs. T3's use of classical Islamic texts further reinforced the importance of deep content foundations, echoing Yousef et al.'s (2024) view on the necessity of traditional scholarship in mastering Aqidah, Fiqh, and Tafsir.

Another key insight was the teachers' proactive efforts to identify and correct misconceptions through formative assessment. T2's use of real-life analogies helped clarify misunderstandings, supporting the findings of Dai et al. (2024), who highlight the cognitive benefits of analogical reasoning in addressing conceptual errors. T3's differentiated assessment strategies, tailored to varying student proficiencies, reflect a student-centred approach supported by Abdul Razak et al. (2023), who found that customised assessments enhance learner outcomes and support inclusive education.

In sum, the findings underscore the centrality of pedagogical knowledge and PCK in shaping effective formative assessment practices among IRE teachers. While content knowledge remains essential, its direct influence on formative assessment appears secondary to pedagogical application and integration. Future professional development and policy initiatives should prioritise training that enhances teachers' ability to bridge content with instructional strategy and assessment design, particularly within the nuanced context of religious education.

## CONCLUSION

Based on the findings, this study has provided valuable insights into the significant role that PCK plays in shaping formative assessment practices in IRE within Malaysian secondary schools. By exploring the intricate relationships between content knowledge, pedagogical knowledge, and PCK, the research highlights how teachers' ability to blend theoretical knowledge with practical teaching strategies results in assessments that not only gauge student understanding but also encourage the application of Islamic principles in real-life contexts. The study reveals that teachers who integrate real-world scenarios into assessments, emphasise foundational knowledge such as Quranic verses, and utilise reflective and interactive pedagogical methods are more successful in fostering both intellectual and spiritual growth among students. These practices ensure that formative assessments go beyond rote memorisation, enabling students to internalise and apply Islamic teachings meaningfully. Ultimately, the research underscores the importance of a holistic approach to teaching, where the integration of PCK enhances the quality and depth of formative assessments, making them not only tools for academic evaluation but also for the moral and ethical development of students.

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## COMPLIANCE WITH ETHICAL STANDARDS

The present study was approved by the Educational Policy Planning and Research Division of the Ministry of Education Malaysia, under reference number KPM.600-3/2/3-eras (13277). Participants were informed that their participation in this non-experimental research was voluntary and that they were free to withdraw at any time without any penalties or adverse consequences. They were also advised of the absence of any known risks associated with participating in the study. The data collected was kept confidential, and all efforts were made to maintain the anonymity of the participants. All participants provided their informed consent to participate in the study.

## CONFLICT OF INTEREST

The author(s) declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## NOTES

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## REFERENCES

Abdul Razak, R., Mat Yusoff, S., Chin, H. L. and Mohamad Marzaini, A. F. 2023. Evaluating teachers' pedagogical content knowledge in implementing classroom-based assessment: A case study among ESL secondary school teachers in Selangor, Malaysia. *PLOS One* 18 (12): e0293325. https://doi.org/10.1371/journal.pone.0293325

Adom, D., Adu-Mensah, J. and Dake, D. A. 2020. Test, measurement, and evaluation: Understanding and use of the concepts in education. *International Journal of Evaluation and Research in Education* 9 (1): 109–119. https://doi.org/10.11591/ijere.v9i1.20457

Amzat, I. H. (ed.). 2022. *Supporting modern teaching in Islamic schools: Pedagogical best practice for teachers*. London: Routledge. https://doi.org/10.4324/9781003193432

Auerbach, A. J., Higgins, M., Brickman, P. and Andrews, T. C. 2018. Teacher knowledge for active-learning instruction: Expert–novice comparison reveals differences. *CBE–Life Sciences Education* 17 (1): ar12. https://doi.org/10.1187/cbe.17-07-0149

Bryman, A. 2008. *Social research methods*, 3rd ed. Oxford, UK: Oxford University Press.

Carlson, J., Daehler, K. R., Alonzo, A. C., Barendsen, E., Berry, A., Borowski, A., et al. 2019. The refined consensus model of pedagogical content knowledge in science education. In *Repositioning pedagogical content knowledge in teachers' knowledge for teaching science*, eds. Hume, A., Cooper, R. and Borowski, A., 77–94. Singapore: Springer. https://doi.org/10.1007/978-981-13-5898-2_2

Chappuis, J., Stiggins, R. J., Chappuis, S. and Arter, J. A. 2012. *Classroom assessment for student learning: Doing it right-using it well*. Upper Saddle River, NJ: Pearson.

Che Hassan, S. H., Wan Shamsuddin, S. N. and Yusof, N. H. 2023. Towards designing a framework for adaptive gamification learning analytics in Quranic memorisation. *PERTANIKA Journal of Science and Technology* 31 (1): 257–278. https://doi.org/10.47836/pjst.31.1.16

Chua, Y. P. 2012. *Mastering research methods*. Selangor, Malaysia: Mcgraw-Hill Education Asia.

Crawford, R., Jenkins, L. E. and Wan, L. 2023. Experiential learning projects as assessment in initial teacher education. *Australian Journal of Teacher Education* 48 (1): 37–54. https://doi.org/10.14221/1835-517X.5787

Creswell, J. W. 2012. *Educational research: Planning, conducting and evaluating quantitative and qualitative research*, 4th ed. Boston, MA: Pearson Education.

_____. 2011. Controversies in mixed methods research. *The Sage Handbook of Qualitative Research* 4: 269–284.

Dai, Y., Lin, Z., Liu, A., Dai, D. and Wang, W. 2024. Effect of an analogy-based approach of artificial intelligence pedagogy in upper primary schools. *Journal of Educational Computing Research* 61 (8): 1695–1722. https://doi.org/10.1177/07356331231201342

Dalail, R., Chan, Y. F. and Sidhu, G. K. 2018. Teachers' workload capacity in the implementation of standard-based assessment system in Malaysian primary schools. *International Journal of Academic Research in Business and Social Sciences* 7 (5): 86–102. https://doi.org/10.6007/ijarbss/v7-i14/3654

_____. 2016. Standard-based performance assessment's scoring practice in primary schools. In *Assessment for learning within and beyond the classroom: Taylor's 8th Teaching and Learning Conference 2015 Proceedings*, eds. Siew, F. T. and Logonnathan, L., 315–325. Singapore: Springer. https://doi.org/10.1007/978-981-10-0908-2_26

Douglass, S. L. and Shaikh, M. 2004. Defining Islamic education: Differentiation and applications. *Current Issues in Comparative Education* 7 (1): 5–18. https://doi.org/10.52214/cice.v7i1.11386

Gess-Newsome, J., Taylor, J. A., Carlson, J., Gardner, A. L., Wilson, C. D. and Stuhlsatz, M. A. M. 2019. Teacher pedagogical content knowledge, practice, and student achievement. *International Journal of Science Education* 41 (7): 944–963. https://doi.org/10.1080/09500693.2016.1265158

Goggin, S. E. 2018. A quantitative study of the implementation of formative assessment strategies in the classroom. PhD diss., Ashland University, US.

Gray-Hildenbrand, J. and King, R. 2019. Teaching in contexts: Designing a competency-based religious studies program. *Teaching Theology and Religion* 22 (3): 191–204. https://doi.org/10.1111/teth.12495

Grieser, D. R. and Hendricks, K. S. 2018. Review of literature: Pedagogical content knowledge and string teacher preparation. *Update: Applications of Research in Music Education* 37 (1): 13–19. https://doi.org/10.1177/8755123318760970

Habibi, A., Mukminin, A., Yaqin, L. N., Parhanuddin, L., Razak, R. A., Nazry, N. N. M., Taridi, M., Karomi, K. and Fathurrijal, F. 2021. Mapping instructional barriers during COVID-19 outbreak: Islamic education context. *Religions* 12 (1): 50. https://doi.org/10.3390/rel12010050

Hair, J. F., Black, W. C., Babin, B. J. and Anderson, R. E. 2010. *Multivariate data analysis*, 7th ed. Englewood Cliffs: Prentice Hall.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P. and Ray, S. (2021). *Partial least squares structural equation modeling (PLS-SEM) using R: A workbook*. Cham, Switzerland: Springer Nature.

Hair, J. F., Risher, J. J., Sarstedt, M. and Ringle, C. M. 2019. When to use and how to report the results of PLS-SEM. *European Business Review* 31 (1): 2–24. https://doi.org/10.1108/ebr-11-2018-0203

Hashim, A., Saili, J. and Che Noh, M. A. 2015. The relationship between pedagogical content knowledge and al-Quran Tajweed performance among students KKQ in Malaysia. *Procedia-Social and Behavioral Sciences* 197: 1530–1537. https://doi.org/10.1016/j.sbspro.2015.07.106

Hasim, Z., Di, S. and Barnard, R. 2018. Eliciting teachers' understanding and their reported practices on school-based formative assessment: Methodological challenges. *Indonesian Journal of Applied Linguistics* 8 (1): 158–166. https://doi.org/10.17509/ijal.v8i1.11476

Hong, Q. N., Pluye, P., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., et al. 2019. Improving the content validity of the mixed methods appraisal tool: A modified e-Delphi study. *Journal of Clinical Epidemiology* 111: 49–59. https://doi.org/10.1016/j.jclinepi.2019.03.008

Hume, A., Cooper, R. and Borowski, A. 2019. *Repositioning pedagogical content knowledge in teachers' knowledge for teaching science*. Singapore: Springer. https://doi.org/10.1007/978-981-13-5898-2

Jacob, F., John, S. and Gwany, D. M. 2020. Teachers' pedagogical content knowledge and students' academic achievement: A theoretical overview. *Journal of Global Research in Education and Social Science* 14 (2): 14–44.

Kaya-Capocci, S., O'Leary, M. and Costello, E. 2022. Towards a framework to support the implementation of digital formative assessment in higher education. *Education Sciences* 12 (11): 823. https://doi.org/10.3390/educsci12110823

Keller, M. M., Neumann, K. and Fischer, H. E. 2017. The impact of physics teachers' pedagogical content knowledge and motivation on students' achievement and interest. *Journal of Research in Science Teaching* 54 (5): 586–614. https://doi.org/10.1002/tea.21378

Koh, J. H. L., Chai, C. S. and Tsai, C. C. 2010. Examining the technological pedagogical content knowledge of Singapore pre-service teachers with a large-scale survey. *Journal of Computer Assisted Learning* 26 (6): 563–573.

König, J. and Kramer, C. 2016. Teacher professional knowledge and classroom management: On the relation of general pedagogical knowledge (GPK) and classroom management expertise (CME). *ZDM Mathematics Education* 48: 139–151. https://doi.org/10.1007/s11858-015-0705-4

Landis, J. R. and Koch, G. G., 1977. An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. *Biometrics* 33 (2): 363–374. https://doi.org/10.2307/2529786

Lee, Y., Capraro, R. M. and Capraro, M. M. 2018. Mathematics teachers' subject matter knowledge and pedagogical content knowledge in problem posing. *International Electronic Journal of Mathematics Education* 13 (2): 75–90. https://doi.org/10.12973/iejme/2698

Leech, N. L., Dellinger, A. B., Brannagan, K. B. and Tanaka, H. 2010. Evaluating mixed research studies: A mixed methods approach. *Journal of Mixed Methods Research* 4 (1): 17–31. https://doi.org/10.1177/1558689809345262

Leighton, J. P. and Bustos Gómez, M. C. 2018. A pedagogical alliance for trust, wellbeing and the identification of errors for learning and formative assessment. *Educational Psychology* 38 (3): 381–406. https://doi.org/10.1080/01443410.2017.1390073

Lijie, H., Mat Yusoff, S. and Mohamad Marzaini, A. F. 2024. Influence of AI-driven educational tools on critical thinking dispositions among university students in Malaysia: a study of key factors and correlations. *Education and Information Technologies* 30: 8029–8053. https://doi.org/10.1007/s10639-024-13150-8

Luik, P., Taimalu, M. and Suviste, R. 2018. Perceptions of technological, pedagogical and content knowledge (TPACK) among pre-service teachers in Estonia. *Education and Information Technologies* 23: 741–755. https://doi.org/10.1007/s10639-017-9633-y

Lynn, M. R. 1986. Determination and quantification of content validity. *Nursing Research* 35 (6): 382–386. https://doi.org/10.1097/00006199-198611000-00017

Mahat, H., Anuar, N. A., Hashim, M., Nayan, N. and Saleh, Y. 2021. Pelaksanaan pentaksiran pembelajaran dan pemudahcaraan (PDPC) berasaskan teknologi di sekolah. *E-Jurnal Penyelidikan dan Inovasi* 8 (1): 1–24. https://doi.org/10.53840/ejpi.v8i1.1

Mat Yusoff, S., Leng, C. H., Razak, R. A. and Mohamad Marzaini, A. F. 2022. Determining conceptions of assessment among in-service secondary school teachers. International *Journal of Academic Research in Business and Social Sciences* 12 (12): 686–698. https://doi.org/10.6007/ijarbss/v12-i12/15579

Mat Yusoff, S., Leng, C. H., Razak, R. A., Basal, M. H. and Mohamad Marzaini, A. F. 2024a. Conceptions of assessment: Perceptions of physical and health education teachers in Selangor, Malaysia. *Pertanika Journal of Social Sciences and Humanities* 32 (1): 189–216. https://doi.org/10.47836/pjssh.32.1.09

Mat Yusoff, S., Lijie, H., Mohamad Marzaini, A. F. and Basal, M. H. 2024b. An investigation of the theory of planned behavior in predicting Malaysian secondary school teachers' use of ICT during teaching and learning sessions. *Journal of Nusantara Studies* 9 (1): 97–120. https://doi.org/10.24200/jonus.vol9iss1pp97-120

Mat Yusoff, S., Mohamad Marzaini, A. F., Zakaria, N. and Lijie, H. 2025. Exploring the implementation of classroom-based assessment in Malaysian secondary schools: Alignment with policy and teacher practices. *Malaysian Online Journal of Educational Management* 13 (1): 81–101.

Mellati, M. and Khademi, M. 2018. Exploring teachers' assessment literacy: Impact on learners' writing achievements and implications for teacher development. *Australian Journal of Teacher Education* 43 (6): 1–18. https://doi.org/10.14221/ajte.2018v43n6.1

Mesci, G., Schwartz, R. S. and Pleasants, B. A.-S. 2020. Enabling factors of preservice science teachers' pedagogical content knowledge for nature of science and nature of scientific inquiry. *Science and Education* 29 (2): 263–297. https://doi.org/10.1007/s11191-019-00090-w

Ministry of Education Malaysia. 2013. *Malaysia Education Blueprint* 2013–2025 (preschool to post-secondary education). Putrajaya, Malaysia: Ministry of Education Malaysia.

Mohamad Marzaini, A. F. and Mat Yusoff, S. B. 2022. Assessing CEFR-readiness test in Malaysian ESL classroom: An insight from English language teachers in Pulau Pinang. *Asian Journal of Assessment in Teaching and Learning* 12 (1): 1–9. https://doi.org/10.37134/ajatel.vol12.1.1.2022

Mohamad Marzaini, A. F., Mat Yusoff, S., Zakaria, N., Basal, M. H., Haslee Sharil, W. N. E. and Supramaniam, K. 2024. A Discovery on Malaysian ESL teachers' adherence to policy mandates in classroom based assessment practices. *Malaysian Journal of Learning and Instruction* 21 (1): 249–284. https://doi.org/10.32890/mjli2024.21.1.9

Mohamad Marzaini, A. F., Sharil, W. N. E. H., Supramaniam, K. and Yusoff, S. M. 2023. Evaluating teachers' assessment literacy in enacting CEFR-aligned classroom-based assessment in Malaysian secondary schools ESL classroom. *International Journal of Academic Research in Progressive Education and Development* 12 (1): 611–624. https://doi.org/10.6007/ijarped/v12-i1/15691

Mohd Arif, F. K., Zubir, N. Z., Mohamad, M. and Md Yunus, M. 2019. Benefits and challenges of using game-based formative assessment among undergraduate students. *Humanities and Social Sciences Reviews* 7 (4): 203–213. https://doi.org/10.18510/hssr.2019.7426

Neumann, K., Kind, V. and Harms, U. 2019. Probing the amalgam: The relationship between science teachers' content, pedagogical and pedagogical content knowledge. *International Journal of Science Education* 41 (7): 847–861. https://doi.org/10.1080/09500693.2018.1497217

Novianti, R. and Febrialismanto, F. (2020). The analysis of early childhood teachers' pedagogical content knowledge. *Journal of Educational Sciences* 4 (2): 404–413.

O'Connor, C. and Joffe, H. 2020. Intercoder reliability in qualitative research: Debates and practical guidelines. *International Journal of Qualitative Methods* 19. https://doi.org/10.1177/1609406919899220

Panadero, E., Fernández-Ruiz, J. and Sánchez-Iglesias, I. 2020. Secondary education students' self-assessment: The effects of feedback, subject matter, year level, and gender. *Assessment in Education: Principles, Policy and Practice* 27 (6): 607–634. https://doi.org/10.1080/0969594x.2020.1835823

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y. and Podsakoff, N. P. 2003. Common method biases in behavioural research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology* 88 (5): 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Ramollo, J. K. and Kanjee, A. 2023. Supporting teachers to develop formative assessment knowledge and skills in no-fee schools. *South African Journal of Childhood Education* 13 (1): 1247–1260. https://doi.org/10.4102/sajce.v13i1.1247

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L. and Koole, M. 2020. Online university teaching during and after the COVID-19 crisis: Refocusing teacher presence and learning activity. P*ostdigital Science and Education* 2: 923–945. https://doi.org/10.1007/s42438-020-00155-y

Retnawati, H., Djidu, H., Kartianom, Apino, E. and Anazifa, R. D. 2018. Teachers' knowledge about higher-order thinking skills and its learning strategy. *Problems of Education in the 21st Century* 76 (2): 215–230. https://doi.org/10.33225/pec/18.76.215

Russo, J. and Hopkins, S. 2019. Teaching primary mathematics with challenging tasks: How should lessons be structured? *The Journal of Educational Research* 112 (1): 98–109. https://doi.org/10.1080/00220671.2018.1440369

Sarstedt, M., Hair, J. F., Pick, M., Liengaard, B. D., Radomir, L. and Ringle, C. M. 2022. Progress in partial least squares structural equation modeling use in marketing research in the last decade. *Psychology and Marketing* 39 (5): 1035–1064. https://doi.org/10.1002/mar.21640

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J. and Shin, T. S. 2009. Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education* 42 (2): 123–149. https://doi.org/10.1080/15391523.2009.10782544

Sekaran, U. and Bougie, R. 2016. *Research methods for business: A skill building approach*, 7th ed. West Sussex, UK: John Wiley & Sons Ltd.

Shepard, L. A., Penuel, W. R. and Pellegrino, J. W. 2018. Using learning and motivation theories to coherently link formative assessment, grading practices, and large-scale assessment. *Educational Measurement: Issues And Practice* 37 (1): 21–34. https://doi.org/10.1111/emip.12189

Shulman, L. S. 1986. Those who understand: Knowledge growth in teaching. *Educational Researcher* 15 (2): 4–14. https://doi.org/10.3102/0013189x015002004

Sidhu, G. K., Kaur, S. and Lee, J. C. 2018. CEFR-aligned school-based assessment in the Malaysian primary ESL classroom. *Indonesian Journal of Applied Linguistics* 8 (2): 452–463. https://doi.org/10.17509/ijal.v8i2.13311

Smith, M. and Ahmadun, J. 2017. Changing trainee teachers' perceptions of school-based assessment in Malaysia: An exploratory study. *Language Education in Asia* 8 (1): 25–45. https://doi.org/10.5746/leia/17/v8/i1/a03/smith_ahmadun

Sothayapetch, P., Lavonen, J. and Juuti, K. 2013. A comparative analysis of PISA scientific literacy framework in Finnish and Thai science curricula. *Science Education International* 24 (1): 78–97.

Tambak, S., Ahmad, M. Y., Sukenti, D. and Siregar, E. 2022. Faith, identity processes and science-based project learning methods for madrasah teachers. AL-ISHLAH: *Jurnal Pendidikan* 14 (1): 203–216. https://doi.org/10.35445/alishlah.v14i1.1184

Tanjung, E. F., Harfiani, R. and Nurzannah, N. 2020. Implementation of cooperative learning methods in the learning of Islamic religious education in Darur Rahmad Sambas. Paper presented at the International Conference on Language and Literature, 30 January 2020, Medan, Indonesia.

Tröbst, S., Kleickmann, T., Heinze, A., Bernholt, A., Rink, R. and Kunter, M. 2018. Teacher knowledge experiment: Testing mechanisms underlying the formation of preservice elementary school teachers' pedagogical content knowledge concerning fractions and fractional arithmetic. *Journal of Educational Psychology* 110 (8): 1049–1065. https://doi.org/10.1037/edu0000260

Tuna, M. H. 2022. The professionalisation of Islamic religious education teachers. *British Journal of Religious Education* 44 (2): 188–199. https://doi.org/10.1080/01416200.2021.1999905

Ucan, A.D. and Wright, A. 2019. Improving the pedagogy of Islamic religious education through an application of critical religious education, variation theory and the learning study model. *British Journal of Religious Education* 41 (2): 202–217. https://doi.org/10.1080/01416200.2018.1484695

Yousef, W., Al Murshidi, G., Asrori, A., Hadi, M. F., Huda, M. and Lovat, T. 2024. The development of Islamic education curriculum from the Quranic perspective. *Ar-Fachruddin: Journal of Islamic Education* 1 (2): 93–123.