

# Development of TPACK Assessment Instruments and Lesson Plan on OBE Integrated with Islamic Values and Local Culture in Mathematics Learning Planning Courses

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## ABSTRACT

This study aims to describe the results of the development of lecture tools for Integrated Islamic Values and Local Culture of Mathematics Learning Planning, in the form of TPACK Assessment Instruments and OBE-Based RPS. The research employed a development approach using the Plomp model, consisting of the preliminary design, experimental design, and perspective analysis stages. Data was collected through questionnaires and semester examination tests and analyzed using quantitative and qualitative descriptive methods. The results show that the OBE-based TPACK and RPS assessment instruments are classified as very valid, with a validity score of 92.24. Small-group trials indicated the tools were practical (76.39), while limited-group trials showed they were very practical (89.42). The effectiveness test revealed that the developed product was effective, with a t-value of 9.465 exceeding the t-table value of 2.004. Students who used the developed lecture tools achieved higher average scores (84.07) than those who did not (74.18). These findings indicate that the developed tools effectively facilitate mathematics learning planning courses for mathematics education students at UIN Suska Riau.

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## INTRODUCTION

Mathematics learning planning is a compulsory course in the mathematics education study program, designed to equip prospective mathematics teachers with the skills to meet the requirements for mathematics learning to both elementary and secondary mathematics. The results of a case study report on mathematics education students at UIN Suska Riau in the 2019 cohort show that there are still many errors made by students when developing mathematics teaching materials, both in terms of mistakes in compiling content and in

choosing appropriate learning experiences (pedagogy and technology), especially in the preparation of selected teaching materials and assessment instruments with appropriate scoring rubrics (Noviarni, 2022). Other studies show that there are still obstacles to mathematics learning, both in technical aspects and in teachers' skills and creativity in facilitating students' learning (Ahmad et al., 2021). Given that so many mathematics learning designs have not been optimised, guidelines are needed to design learning that is more focused and in line with the needs of the previously established Learning Outcomes (LO) or Graduate Learning Outcomes (GLOs).

GLOs in the mathematics education study program at UIN Suska Riau for the mathematics learning planning course are, among others, “able to apply theoretical concepts and didactic-pedagogical principles of mathematics and mathematical science to plan innovative learning based on TPACK (Technological, Pedagogical, and Content Knowledge)/Mathematics Educators who master TPACK”. TPACK was introduced by Lee Shulman (Koehler & Mishra, 2009) and is very suitable for prospective mathematics teachers as beginners in taking the first steps in preparing for teaching. The demands on teachers today require them to be ready to develop learning activities for their students that are appropriate to their needs and the times. This is very much in line with the TPACK components, namely how content (the material being discussed) and pedagogy (the learning stages for delivering content) with the right learning technology form the basis for effective educational integration (Archambault & Crippen, 2009), where each technology used can communicate content elements and support pedagogical aspects so that the desired learning experiences or activities are maximized.

TPACK is defined as teachers' ability to facilitate student learning through pedagogical and technological approaches (Graham, 2009). Another definition holds that TPACK in education comprises a framework for designing learning models by combining three main categories: technology, pedagogy, and content (Hidayati et al., 2018). This is highly relevant to the educational goals of the 21st century, namely that teachers should be proficient in all technologies and their applications to achieve learning objectives. However, the application of lectures here does not necessarily cover all components of TPACK. Instead, prospective teachers need to master learning practices, both in terms of content delivery and pedagogical skills in integrating technology into learning. Technology here is not limited to electronic technology; rather, it is technology capable of enabling students to learn concepts and create innovative tools in line with technological needs and developments (Niess et al., 2009).

Another study on pre-service teachers' self-reported technological pedagogical content knowledge (TPACK) in relation to the use of digital technology in their lesson plans showed that TPACK is a prominent model of teacher expertise for effective teaching with digital technology (Schmid et al., 2021). In this regard, research on Semester Lesson Plans based on Outcome-Based Education (OBE) using TPACK assessment instruments is necessary. OBE is an education with targets in the form of outcomes, not only on mastery of material that must be completed, but also to measure the learning outcomes of students to develop and produce new skills according to global needs and levels, because OBE is a sustainable approach with productive learning activities (Prihatiningsih, T. S., 2023). It is appropriate that the current technological developments can be empowered to produce all the needs to facilitate mathematics education students to be ready and able to make practical mathematics learning tools, which are included in the study of mathematics learning planning course materials, namely designing mathematics learning tools (development of Semester Lesson Plans/Teaching Modules and their attachments) and understanding the importance of learning design for teachers; identifying learning dimensions and activities appropriately; explaining the benefits of learning design or planning for educators; students are able to develop/design materials and their preparation techniques, design objectives/competencies and their preparation techniques, be able to design learning strategies and skill development; design evaluations of mathematics learning and be able to manage learning activities (managing students, solving problems faced by students, working classes and evaluating them), and developing teaching materials and all are arranged for student learning activities that are appropriate to the needs and developments of the current era.

Research on the Semester Lesson Plans assessment rubric, which is then used to evaluate productive Semester Lesson Plans (Hasanuddin & Granita, 2022), the researcher developed a Semester Lesson Plans rubric assessment instrument that is in accordance with the vision and mission of the mathematics education study program, namely, integrating Islamic values and/or local culture. In connection with the Vision of the Mathematics Education Study Program of UIN Suska Riau: "The realisation of the mathematics education study program as a superior study program in mathematics learning based on the integration of science, technology, and art with Islam in Indonesia in 2023". Based on this vision, it is clear that one of the targets of mathematics learning in question is to integrate art (local culture in the student environment) with Islam, thereby providing a basis for this development research.

Research on culture in mathematics learning has shown that mathematics learning is closely related to Indonesian culture (Nuh, 2016; Hasanuddin, 2017). This cultural richness certainly needs to be preserved in mathematics learning so that it truly meets students' needs in their lives. E.B. Tylor's theory holds that the term culture encompasses all human activities (Hasan et al., 2022). Meanwhile, integrating science with religious knowledge can only be achieved by using evidence and the Sunnah as underlying guidelines. This is relevant to previous researchers regarding the concept of scientific and Islamic integration, as well as regarding the Qur'an and Hadith as guidelines in research (Purwaningrum, 2015; Kurniati, 2016). The integration of Islamic values in mathematics learning is an effort to incorporate Islamic religious knowledge into mathematics without altering the distinctiveness of both sciences (Yusuf, 2022). Based on this explanation, it is necessary to develop a TPACK assessment instrument with an OBE-based Semester Lesson Plans integrated with Islamic values and local culture in mathematics lesson planning courses, to facilitate student creativity during lectures. The local culture referred to here aims to present material content aligned with students' culture, so that the presentation is closer to their minds and environment, making it more meaningful, and also to preserve good habits that exist in society.

## **METHODS**

The type of research is development research, which involves stages of development procedures to develop a product in the form of a TPACK Assessment Instrument with an OBE-Based Semester Learning Plan Integrated with Islamic Values and Local Culture in the Mathematics Learning Planning Course, which is then validated for testing, so that the product is expected to be practical and effective. The development of the TPACK Assessment Instrument with OBE-Based Semester Learning Plan Integrated with Islamic Values and Local Culture in the Mathematics Learning Planning Course was made with reference to the development of the Plomp model, which is very relevant for developing learning steps through several phases, namely: (1) the initial investigation phase in the form of a needs analysis and criteria analysis, which involves collecting initial information such as literature reviews, field studies, documentation of previous lecture activities, curriculum analysis, lecture material analysis, product review, and field studies; (2) the design phase, which concerns the content and construction that must be included in the developed product; (3) The development realization phase, which involves producing an initial prototype as a realization of the product design and packaging; (4) The testing, evaluation,

and revision phase, which is the process of collecting data and evaluating whether the prototype can be continued; (5) The product implementation phase in mathematics learning planning lectures in 2023 (Plomp & Nieveen, 2010). The research stages referred to are Preliminary Design, Design Experiment, and Retrospective Analysis, which are outlined in the following cycle in Figure 1.

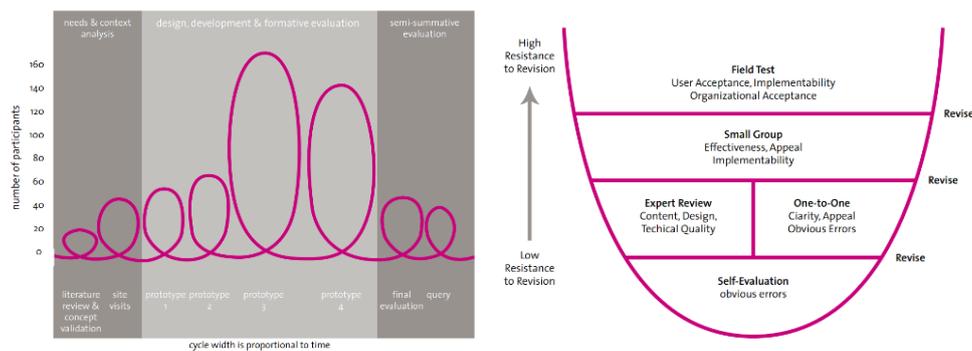


Figure 1. Research Cycle/Procedure

Figure 1 shows that the Preliminary Design includes needs and context analysis, a literature review, and the development of a conceptual or theoretical framework. In contrast, Design Experiment includes micro cycles with formative evaluation as the most critical research activity, offering many possible formative evaluation methods. In this case, it is related to testing the validity of the TPACK assessment instrument with OBE-based Semester Learning Plan integrated with Islamic values and local culture in mathematics learning planning courses in the form of questionnaires or assessments from mathematics learning experts, while the practicality test is a product assessment questionnaire filled out by students after the product is used. Meanwhile, Retrospective Analysis includes semi-summative evaluation to conclude whether it has been fulfilled or produced recommendations for improvement, which is related to the effectiveness of the product taken from the difference in the average final exam scores in the mathematics learning planning course, namely between the scores of students in the class that used the development product as the experimental class (28 students) and the scores of students in the class that did not use the development product as the control class (28 students) using a t-test, where both classes had the same level of ability. The questionnaire used a 5-point scale (strongly agree, agree, somewhat agree, disagree, and strongly disagree). The validity analysis used the P formula, namely:  $P = \frac{\sum f}{N} \times 100\%$ , where P is the final score, f is the score obtained, and N is the maximum score, with the criteria of invalid ( $0\% \leq P \leq 20\%$ ), less than valid ( $20\% < P \leq 40\%$ ), sufficiently valid ( $40\% < P \leq 60\%$ ), valid ( $60\% < P \leq 80\%$ ),

and highly valid ( $80\% < P \leq 100\%$ ) (Riduwan, 2014). The same method and criteria used for validity analysis were also used for practicality analysis. The data analysis techniques used were qualitative descriptive analysis to address questions about the validity and practicality of the developed product, and quantitative analysis to address questions about its effectiveness (Permana, 2017; Prahmana, 2021).

## **RESULT AND DISCUSSION**

The stages carried out by researchers to start developing and producing TPACK assessment instruments with OBE-based Semester Learning Plan integrated with Islamic values and local culture in the mathematics learning planning course include 1) analyzing graduate achievements to be achieved by students (analysis of the mathematics learning planning course syllabus); 2) analyzing the environment and needs of students in the course; 3) analyzing the needs used to produce TPACK instruments and OBS-based Semester Learning Plan integrated with Islamic values and local culture; 4) analyzing the presentation of Semester Learning Plan material and the need for TPACK assessment instruments; 5) analyzing other instruments from the OBS-based Semester Learning Plan that are needed; 6) analyzing positive or negative reinforcement presented in the Semester Learning Plan; 7) analyzing new, continuous, follow-up stimuli related to the content of Semester Learning Plan activities; 8) analyzing follow-up in the form of assessments for each Semester Learning Plan activity item.

The GLOs analysis set for the mathematics learning planning course, it shows that each GLO contains Course Learning Outcomes (CLOs), which are then broken down into Specific Learning Outcomes (SLOs). The results of the needs analysis obtained were then discussed in a Discussion Group Forum with resource persons in the TPACK field and experts in the OBE-based Semester Learning Plan field, along with teachers and student teachers. The results of the first FGD showed that the TPACK instrument was in accordance with the 7 TPACK components, namely Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPCK). Still, it needs to be reorganised to determine which components should be placed to integrate Islamic values and/or cultural values. In the OBE-based Semester Learning Plan, there are still errors in compiling the CLOs, in the use of appropriate and operational SLO verbs, and in the assessment items

used. The presentation of the FGD results related to the assessment of the TPACK assessment instrument with the OBE-based Semester Learning Plan integrated with Islamic values and local culture in the mathematics learning planning course, which instrument experts have filled, TPACK assessment instrument experts and OBE-based Semester Learning Plan in the mathematics learning planning course, expert validators are used as consideration by researchers to improve the product development results.

The validation results of the OBE-Based Semester Learning Plan assessment questionnaire indicate that the questionnaire can continue to be used by validators to assess the quality of the developed product. Based on the results of the product assessment conducted by three expert validators in the field of educational instruments and mathematics learning, the Semester Learning Plan identity section has met the requirements. In contrast, in the course description section, there are still improvements to the breadth and depth of the learning materials in accordance with the applicable curriculum provisions. In general, the formulation of graduate learning outcomes has entered the maximum criteria, and the learning outcomes of the courses and SLOs used have met the maximum criteria. However, there are slight improvements in the study materials, such as the study outlined in the Semester Learning Plan for mathematics learning planning courses, which, before validation, did not fully include the applicable curriculum provisions. The following are details of the validity test results in Table 1.

**Table 1.** Overall Validity Test Calculations

No	Instrument Specialist/Expert	Percentage of Validity Rate	Description
1	Specialist/Expert 1	80.25	Highly valid
2	Specialist/Expert 2	87.45	Highly valid
3	Specialist/Expert 3	92.24	Highly valid
Average		86.64	Highly valid

Table 1 shows that the percentage of the product validity level from each expert/specialist falls within the very valid category, indicating that the overall validity test results are in the very valid category, with an average validity level of 86.64%, where the assessment by Expert/Specialist has increased. Specialist/Expert 1's suggestions and improvements were first corrected before continuing to Specialist/Expert 2. Expert/Specialist 2's suggestions and enhancements were first corrected before proceeding to Expert/Specialist 3, ensuring that Specialist/Expert 3's assessment produced a very valid product with a predicate of 92.24%.

Overall, before the revision, it did not include student activities/activities during the

lecture, so it is clear that the design of the learning experience prepared both structured and independent assignments, which did not meet the maximum criteria; meanwhile, the column for after the revision already contains lecture activities. Viewed from the elements of criteria, indicators, and assessment weight, the lecture contact has met the maximum criteria. It has included the concept of scientific integration, both research science and community service. Still, for reference, it has not met the maximum value because it is not oriented towards novelty/current. Researchers continued the product's practicality test; the results are presented in Table 2.

**Table 2.** Overall Practicality Test Calculations

No		Percentage of Practicality Level	Description
1	<b>Small Group</b>	<b>76.39</b>	Practical
	TK	75.55	
	CK	71.11	
	PK	75.41	
	PCK	76.66	
	TCK	80	
	TPK	78.33	
	TPCK	75.83	
	Semester Learning Plan	77.14	
	Worksheet	80.83	
	Media	73.33	
2	<b>Kelompok Terbatas</b>	<b>89.42</b>	Very Practical
	TK	86.81	
	CK	92.42	
	PK	88.52	
	PCK	88.78	
	TCK	90.3	
	TPK	90.3	
	TPCK	87.5	
	Semester Learning Plan	90.25	
	Worksheet	94.31	
	Media	87.45	

Table 2 shows that the practicality test results for the small-group module (6 respondents) were declared practical, with only statements related to the worksheet in the convenient category. The researcher made improvements based on suggestions from the small group of respondents. After further modifications, trials on a limited group showed that the restricted group (22 respondents) was categorised as very practical. Based on the results of the practicality analysis, it was proven that the module was categorised as very

practical in terms of statements related to TK, CK, PK, PCK, TCK, TPK, TPCK, the Semester Learning Plan (Teaching Module), the worksheet, and the Media used.

The results of the effectiveness test showed that the ability of students who used the results of the development of lecture tools for integrated mathematics learning planning with Islamic values and local culture, in the form of TPACK and Semester Learning Plan assessment instruments based on OBE was better than the ability of students who did not use the results of the development of lecture tools for integrated mathematics learning planning with Islamic values and local culture, in the form of TPACK and Semester Learning Plan assessment instruments based on OBE. The results of the development of lecture tools for integrated mathematics learning planning with Islamic values and local culture, in the form of TPACK and Semester Learning Plan assessment instruments based on OBE, were declared effective, with  $t = 9.465 > t_{table} = 2.004$ . The average value of the class that studied using the product of the development of lecture tools for integrated mathematics learning planning with Islamic values and local culture, in the form of TPACK and Semester Learning Plan assessment instruments based on OBE (84.07), was higher than the average value of the class that studied without using the product of the development (74.18). Based on the results of the ideas for mathematics learning devices produced by students, they have been integrated with cultural values and/or integrated with Islamic values, both in terms of the presentation of material illustrations and in terms of questions and images/ornaments used in the presentation.

Based on the results of the validity, practicality, and effectiveness tests of the product development, it shows that the product development has met and is in accordance with the analysis of the study needs for the material and the GLOs study program. The product development meets the criteria of validity, practicality, and effectiveness. This shows that product development can serve as a guideline for improving the quality of mathematics learning tools for prospective mathematics teacher students. However, the CPL study program in the LO Course still needs to be re-examined regarding its study materials. This is to clarify which assessment is appropriate for future conditions, taking into account cognitive and non-cognitive aspects based on science and technology, which, in this case, already includes TPACK in the GLOs study program. The Semester Learning Plan uses operational verbs appropriate to the abilities to be achieved. The study materials prepared are in accordance with applicable provisions and have synergised with the latest research and community service in accordance with CLOs. This is also shown by the breadth and depth

of the learning materials, which are in accordance with applicable provisions. This indicates that the TPACK component helps students in developing learning tools (Hadi & Kurniawati, 2022).

In addition, the learning activities of students who study using the results of the development of integrated mathematics learning planning lecture tools with Islamic values and local culture, in the form of TPACK assessment instruments and OBE-based Semester Learning Plan have been facilitated, but still contain notes for students that the need for in-depth direction regarding the mastery of solid school mathematics material so that they/students are more assisted in compiling more meaningful worksheet, and need more optimal instructions for students to be able to surf in the use of digital technology to compile an interactive and innovative mathematics learning tool. Students still need to develop their competencies in the pedagogical field, including mathematics education seminars and lesson studies with mathematics subject teachers, as well as conducting ongoing discussions on the analysis of school mathematics learning needs. This is reinforced by previous research (Rafi & Sabrina, 2019) that the need to integrate TPACK in mathematics learning to improve its professionalism.

Regarding the learning format, whether it is purely face-to-face or offline, it has been adjusted again in line with the latest circular on blended learning. If the learning format combines online and face-to-face activities, it is necessary to determine the proportions of each. This is in line with the utilisation of technology as outlined in the study program's vision and mission, seen from a technological perspective, both digital and non-digital technology. The results of this study are in line with previous research that prospective teachers who have high TPACK skills have a positive effect on their ability to develop online mathematics learning tools (Amrina et al., 2022). Related to the methods/strategies used in the RPS, it has included student activities that, in this case, are part of the student learning experience (including independent and structured assignments) in accordance with the previously determined GLOs. Judging from the assessment indicators with assessment criteria that are in accordance with the selected assessment techniques with scoring rubrics that are in accordance with the appropriate assessment weight, this is very relevant to the curriculum provisions that greater assessment is measured from the evaluation of projects resulting from abilities that can be demonstrated/simulated by students, expressed in the form of verbs that describe the combination of knowledge, skills, and attitudes, through learning materials in the courses (breadth and depth according to the level of education) that

are studied and mastered by students.

Based on the results of the preparation of the validity test assessment questionnaire instrument, there is a need for more specific material studies in courses that are indeed directed at abilities, including: LO analysis, analysis of school mathematics learning materials, analysis of learning objective flows, teaching modules that include teaching materials, worksheets, TPACK media, and assessment instruments. The assessment instruments in question include diagnostic assessments or assessments (cognitive and non-cognitive), formative assessments or assessments (cognitive and non-cognitive), summative (mental), and reflection (teachers and students), up to the follow-up stage (remedial and enrichment), but this is in accordance with the established curriculum circular. At the diagnostic assessment stage, researchers have compiled project assignments for students in produce differentiated learning based on the learning styles they identify in students/learners: audio, visual, and kinesthetic. The TPACK assessment instrument used is appropriate and in line with the expected abilities in the OBE Semester Learning Plan, integrated with Islamic values and local culture. The results of students' final skills in the final assignment of the mathematics learning planning course show that the TPACK assessment instrument can be used as a guide for students to carry out the learning process for 1 semester, meaning that students have control over what abilities they must achieve, so that students can be more directed to produce products from the mathematics learning planning course, namely innovative mathematics learning tools, this is in line with the results of previous research (Gunawan et al., 2020) related to mathematics learning tools and TPACK.

## **CONCLUSION AND RECOMMENDATION**

The results of the development of teaching tools for integrated Islamic values and local culture mathematics learning planning, in the form of TPACK and Semester Learning Plan assessment instruments based on OBE, are valid, practical, and effective. Therefore, the developed products can facilitate students in mathematics learning planning courses, where, through the developed products, students are assisted in developing innovative mathematics learning tools. Meaning that the developed product can be used for mathematics learning planning courses, especially for mathematics education students at the Faculty of Tarbiyah and Teacher Training, Sultan Syarif Kasim Riau State Islamic University. The researcher suggests that other researchers develop TPACK and Semester Learning Plan assessment instruments based on OBE integrated with Islamic values and local culture as teaching materials or tools, especially in learning design courses for mathematics education study programs and other study programs, particularly those in the Faculty of Tarbiyah and Teacher Training at Sultan Syarif Kasim Riau State Islamic University. The Islamic values and local culture used as examples in learning are experiences close to students' minds and environments, making the lectures more meaningful.

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