Evaluating the Validity of TPACK Training Module for University Teachers in Qingdao: Insights from Experts

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Abstract
In recent years, the rapid integration of technology and education has transformed teaching practices, highlighting the necessity for university teachers to develop the ability to effectively integrate technology, pedagogy, and content knowledge. Various TPACK capability enhancement trainings have emerged, but there are no unified standards for the quality of training content and the management of the training process. This study employs the expert scoring method to evaluate the TPACK (Technology, Pedagogy, and Content Knowledge) training module designed for teachers at Qingdao University. Using purposive sampling techniques, five experts in the field of TPACK were invited and consulted to evaluate the content, structure, and applicability of the modules through a systematic scoring process. The TPACK training module includes content from 6 units consisting of 19 sub-units, as well as the implementation plan for the training. The results of the study indicate that the TPACK training module received a high score for its effectiveness, reflecting its relevance and potential for improvement in higher education teaching practices. This research provides valuable insights into the evaluation of professional training modules for university teachers, emphasizing the importance of expert validation in ensuring the quality and effectiveness of such projects.
Keywords: TPACK, University Teachers, Training Modules, Expert Scoring

Introduction
Currently, the digital technology penetration rate in Chinese universities has reached 100%, and the Ministry of Education of China has also proposed various policies to promote the development of educational digitization, such as the "Teachers' Digital Literacy" (Ministry of Education, 2022) and the "Education Informatization 2.0 Action Plan" (Ministry of Education, 2018). With the widespread adoption of digital technology in universities, ensuring that university teachers have the skills to effectively utilize technology in teaching practice has become an important task. In Qingdao, a region known for its vibrant educational landscape, there is increasing attention on the demand for professional development programs based on the TPACK framework. However, despite scholars having developed various training

modules to address TPACK-related competencies, there are still issues regarding the effectiveness and efficiency in meeting the specific needs of university teachers. The focus of this study is to evaluate the TPACK training module designed for university teachers in the Qingdao area. By employing the expert rating method, the study aims to evaluate the content, structure, and applicability of the module, providing evidence for its potential to enhance teaching practice.

Literature Review
TPACK Framework
Koehler and Mishra (2005) proposed the Technological Pedagogical Content Knowledge (TPACK) framework, highlighting that teachers need to develop a personalized learning system referred to as "technological internalization" to meet the demands of digitalization. This framework aims to integrate Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) in teaching, providing a critical theoretical foundation for the effective application of technology in education.

TPACK is defined as a framework for teachers' knowledge in integrating technology into teaching. It comprises three primary components: Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). These components interact and combine to generate four additional elements: Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPACK), as illustrated in Figure 1.
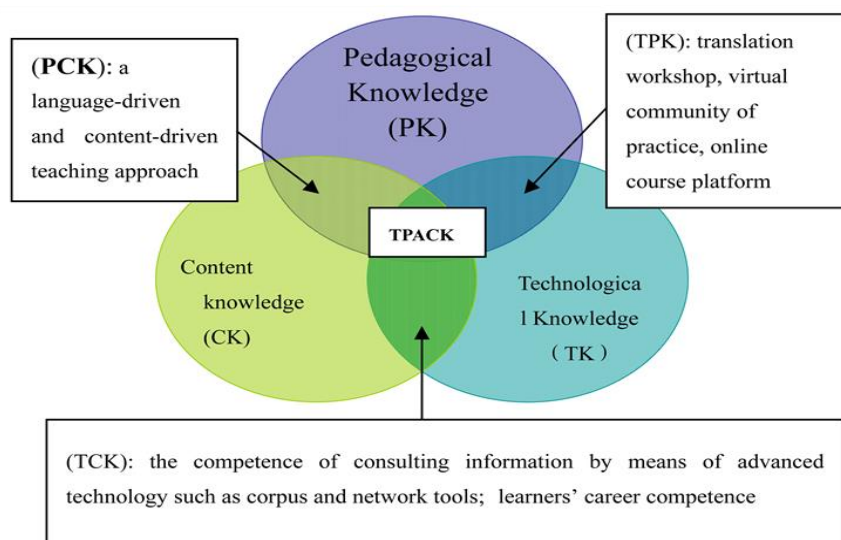

Figure 1 TPACK Framework
Source: Koehler and Mishra (2005)

Expert Scoring Method Application in TPACK Training Module Evaluation
Expert rating method involves systematically assessing educational programs or tools by utilizing the professional knowledge of domain experts (Kua *et al.*, 2021). It is typically composed of experts from relevant fields (e.g., pedagogy, technology integration, specific content education) (Forkosh-Baruch *et al.*, 2021). Scoring rules or frameworks are established to guide the assessment process, ensuring the consistency of the evaluation

results (Faheem., 2021). A comprehensive analysis is conducted by combining numerical scores with descriptive feedback. This method is particularly suitable for verifying training modules where existing metrics are insufficient or subjective judgments play a significant role (Liao *et al.*, 2021).

Expert ratings are often used to assess whether training modules align with the core components of the TPACK framework. For example, Al-Harth *et al.* (2018) utilized expert review to validate TPACK course plans and ensure consistency with educational standards. Experts evaluate whether the module content is accurate, comprehensive, and suitable for the target audience. Yurtseven et *al.* (2020) used this method to evaluate technology-focused professional development programs. Training modules are assessed for their ability to promote meaningful learning experiences, effectively integrate technology, and encourage active engagement. Experts evaluate whether the module integrates technology in innovative and practical ways, as described in the TPACK model. The involvement of experts adds credibility and depth to the assessment process (Bhuiyan *et al.*, 2020). Relying on expert judgment, assessments can more effectively address the multi-dimensional aspects of TPACK. Experts typically provide detailed qualitative insights to guide module improvements (Al-Gerafi *et al.*, 2024).

However, the expert scoring method also has certain limitations and mitigation strategies. Even though experts are knowledgeable, their evaluations may still be influenced by personal biases (Bonaccorsi *et al.*, 2020). Therefore, using multiple experts and applying inter-rater reliability indicators to enhance objectivity is necessary (Mancar & Gülleroğlu, 2022). The method requires a significant effort to recruit experts, design scoring rules, and conduct assessments. Digital tools can simplify the assessment and analysis process. Experts may have different opinions on certain aspects of the module. Therefore, techniques such as the Delphi method or consensus-building methods can be used to resolve disagreements (Mustakim *et al.*, 2023). Although expert scoring is an effective method, further research and development are needed to create standardized scoring rules for TPACK evaluation; explore combining automated scoring systems with expert judgment to improve efficiency; and use hybrid methods, including expert evaluation, to investigate the long-term impact of TPACK training (Slimi & Villarejo-Carballido, 2024).

The expert scoring method plays a critical role in evaluating TPACK training modules, addressing challenges related to complexity, effectiveness, and reliability. It ensures that training programs align with the TPACK framework while providing actionable insights for improvement. However, its effectiveness depends on careful implementation, mitigation of biases, and integration with assessment methods.

Research Questions
Specifically, this study addressed the following research questions:

i: How is the quality of the TPACK training module content, and to what extent does it meet the needs of university teachers ?

ii: To what extent does the TPACK training implementation plan support the implementation of this training module?

Through this survey, the study aims to contribute to the growing body of research on professional development for university teachers and to provide practical insights for the design and evaluation of TPACK-focused training programs. These findings are enlightening for educational administration departments and researchers dedicated to improving the quality of higher education in the digital age, while also ensuring effective training modules for university teachers undergoing training, thus guaranteeing the quality of the training.

Research Method
This study employed a quantitative approach to evaluate the effectiveness of the TPACK training modules for university teachers in Qingdao, using an expert scoring method. The research design focused on systematically assessing the content, structure, and applicability of the modules through the perspectives of experts. The key components of the research methodology are as follows: Participants were recruited to form a group of 5 experts to evaluate the training modules. All experts were individuals from the field of higher education with years of experience in TPACK research. The study utilized the training course evaluation scoring sheet issued by China's Ministry of Education, which includes 2 primary indicators and 15 secondary indicators, with different scores assigned based on the importance of the indicators and detailed descriptions of the content, as is shown in table 1. Experts independently reviewed the materials and, combining the content of the indicators, provided scores based on their professional judgment. The training module materials and the expert scoring sheets were sent to the experts via email, and the scoring results were collected within one week. Analysis was conducted based on the experts' scoring outcomes. The structure of the expert scoring sheet is shown in table 1.

Table 1
Training Module Quality Expert Scoring Table

No.	Primary Indicators	Primary Indicator Categories	Secondary Indicators	Secondary Indicator Categories
1	2	Quality of training content (1-10), Training implementation plan (11-15)	15	Teaching adaptability (15), Cognitive regularity (10),Construction integrity (10), Progressive Level (8), Systematic level (8), theoretical level (8), ideological level (8), logicality (7),Language (3), Diagram (3), training organization (4), Training schedule (4), training pattern (4), training management (4), Training guarantee(4)

The Expert Scoring Method is a commonly used evaluation approach that involves inviting experts within a field to score or evaluate a particular subject to ensure the scientific and authoritative nature of the results. This method is widely applied in education, healthcare, engineering, and other areas, especially suitable for assessing research subjects that do not yet have clear quantitative indicators, such as the effectiveness of course designs, teaching modules, or innovative plans. The Expert Scoring Method ensures systematic and scientific evaluation of the effectiveness of training modules by inviting multiple education experts familiar with the TPACK framework and using structured scoring criteria. For this study, researchers contacted experts via phone and email to describe the objectives and methods

of the research and requested their consent to participate. Although Lawshe's technique requires only at least four experts in the group, the researchers chose to invite as many experts as possible to increase the value of the model. Using purposive sampling, five professional experts were selected from five universities based on the aforementioned criteria. These experts are currently engaged in TPACK-related research and have published many authoritative papers and monographs in the field. In addition, researchers also invited experts to share their suggestions at the end of the scoring sheet. Table 2 summarizes the information of the expert group.

Table 2
List of Experts

No.	Experts	University	Years of Working	Working Position/Title	Expertise
1	E1	Beijing Normal University	29	Dean of Education Department	Teacher Education
2	E2	East China Normal University	33	Director of the Educational Technology Department	Educational Information Technology
3	E3	Qingdao University	41	Dean of the Normal university	Pedagogy
4	E4	Nanyang Technological University	23	Senior Academician	Information Technology
5	E5	Brigham Young University	25	Vice Dean of Education Faculty	Educational Technology

To verify the reliability and validity of the expert scoring table, this study employed the inter-rater reliability method. This method tests reliability by calculating the consistency of ratings among experts. The Cohen's Kappa coefficient is used to quantify the degree of agreement among experts' ratings. The higher the coefficient value, the more consistent the rating standards among experts, and thus the higher the reliability. This method is widely used in research to assess the degree of consistency among different raters when evaluating the same set of items. The formula for calculating Cohen's Kappa is: $K = (p_o - p_e) / (1 - p_e)$, where p_o represents the observed relative agreement among raters; p_e represents the hypothetical probability of chance agreement. The value of Cohen's Kappa is always between 0 and 1, where 0 indicates no agreement between two raters, and 1 indicates complete agreement between two raters (Cohen, 1960). The table below summarizes how to interpret different values of Cohen's Kappa:

Table 3
Interpretation for Cohen's Kappa

Cohen's Kappa	Interpretation
0	No agreement
0.10-0.20	Slight agreement
0.21-0.40	Fair agreement
0.41-0.60	Moderate agreement
0.61-0.80	Substantial agreement
0.81-0.99	Near perfect agreement
1	Perfect agreement

Source: Cohen(1960)

The Cohen's kappa inter-rater reliability values for the five pairs of experts are as follows:

Table 4
Cohen's Kappa for The Expert Scoring Table

The three pairs of experts	Cohen's Kappa	Interpretation
Expert 1 and Expert 2	0.46	Moderate Agreement
Expert 1 and Expert 3	0.54	Moderate Agreement
Expert 1 and Expert 4	0.56	Moderate Agreement
Expert 1 and Expert5	0.59	Moderate Agreement
Expert 2 and Expert 3	0.76	Substantial Agreement
Expert 2 and Expert 4	0.65	Substantial Agreement
Expert 2 and Expert 5	0.68	Substantial Agreement
Expert 3 and Expert 4	0.78	Substantial Agreement
Expert 3 and Expert 5	0.71	Substantial Agreement
Expert 4 and Expert 5	0.63	Substantial Agreement

The data from this table indicates varying levels of agreement between the pairs, with the highest agreement observed between Expert 3 and Expert 4 (CK=0.78, Substantial Agreement). The Cohen's Kappa results suggest that the scoring process has a reasonable level of reliability. However, moderate agreement between other pairs indicates some inconsistency in scoring practices, which could impact the perceived validity of the expert evaluations. By addressing these inconsistencies through rubric refinement and rater training, the reliability and validity of the expert scoring process can be significantly improved.

Findings
Based on the scoring results of experts' evaluation on the TPACK training module in table 6, the total average score of the training module (Table 6) on all primary and secondary indicators was 91.4, indicating that according to experts, the module has reached a high standard of quality both in the training content and the implementation plan. According to the table 5, the TPACK training module reached an excellent level. Among the five experts, the scores given by the three Chinese experts were above 90, while the scores from the two Western experts were lower which might reflected their different understanding of the assessment mechanisms (seen in table 6). Alexander et al. (2021) indicate that cultural backgrounds significantly influence perceptions of usability and system performance. These suggest that the slightly lower scores from Western experts could stem from differing cultural interpretations of the assessment mechanisms, rather than actual deficiencies in the training system's quality.

Table 5
The Standards for the Experts Scoring

No.	Scoring ranges	Interpretation
1	Below 60	Not qualified
2	60-69	Qualified
3	70-79	Ordinary
4	80-89	Good
5	90-100	Excellent

Source: Ministry of Education (2014)

Table 6
The total Score Collection of Experts Scoring

No.	Experts	Scoring	Interpretation
1	E1	92.1	Excellent
2	E2	93	Excellent
3	E3	92.6	Excellent
4	E4	89.9	Good
5	E5	89	Good
AVG		91.4	

Table 7
The Mean Value of Each Indicators of the Expert Scoring Table

No.	Primary Indicators	Secondary Indicators	Score	Mean Value	Percentage
1		Teaching adaptability	15	14.2	94.67%
2		Cognitive regularity	10	9.1	91%
3		Construction integrity	10	9.1	91%
4		Progressive level	8	7.2	90%
5		Systematic level	8	6.8	85%
6	Quality of training content (80)	Theoretical level	8	7.3	91.25%
7		Ideological level	8	7.1	88.75%
8		Logicality	7	6.4	91.43%
9		Language	3	2.7	90%
10		Diagram	3	2.8	93.33%
11		Training organization	4	3.7	92.5%
12		Training schedule	4	3.8	95%
13	Training implementation plan (20)	Training pattern	4	3.8	95%
14		Training management	4	3.7	92.5%
15		Training guarantee	4	3.7	92.5%
Total			100	91.4	

Source: "Ministry of Education Higher Education Textbook (Lecture Notes) Evaluation Index System and Expert Evaluation Form"

By examining the multiple secondary indicators of the quality of training content, it can be found from table 7 that the scores and percentages for various aspects of training content quality are high. Among them, teaching adaptability received the highest score (full score 15, average score 14.2, percentage of 94.67%), indicating that the module has well adapted to teaching needs; cognitive regularity and construction integrity both scored 9.1 (full score 10, percentage of 91%), demonstrating strong cognitive consistency and comprehensive structure. This is consistent with previous research emphasizing the importance of content relevance and cognitive engagement in professional training programs. Mishra and Koehler (2006) emphasizes that effective training modules must seamlessly integrate pedagogy, technology, and content. Furthermore, Chen and Bell (2024) indicate that well-structured modules often receive higher evaluations in terms of cognitive regularity and coherence.

It can be seen from the table 7 that the four levels score vary. The system level and the ideological level are relatively low (average score 6.8 & 7.1, percentage: 85% & 88.75%), indicating that there is room for improvement in presenting training content in a more systematic and ideological level. As for the language and graphics indicators, the scores are relatively high (full score of 3, average scores are 2.7 and 2.8, percentages are 90% and 93.33% respectively), reflecting acceptable but slightly insufficient results in clarity and visualization. Lundgard & Satyanarayan (2021) found that the impact of language and visualization is less than that of content and structure. However, this study shows that even small differences in language and graphics can affect satisfaction. AlShaikh et al. (2024) found that multimedia learning emphasizes the crucial role of visualization in enhancing understanding, indicating that even a slight deficiency in graphic clarity can affect the overall effect.

For the second primary indicator in table 7, the overall training implementation plan got 18.7 (full score 20), with its secondary indicators all showing strong consistency. Among these, training schedule and training pattern received the highest scores in this category (full scores are 4, average scores are 3.8, percentages are 95%), highlighting a well-arranged schedule and innovative training pattern. Training organization, training management, and training guarantee each scored 3.7 (full scores are 4, percentages are 92.5%), which showed that the training implementation plan as a whole was strong enough to support the training module. Elmaadaway and Abouelenein (2023) have repeatedly emphasized the importance of clear organization and time management as key factors in professional development programs. Zhang and Zhou (2023) showed that a well-planned schedule is associated with increased participant satisfaction and perceived effectiveness. The findings of this study suggest that the training model was well received, which may be because it was tailored to a specific audience--university teachers.

Conclusion
In summary, the module excels in terms of teaching adaptability, training time, and training mode, which are key aspects to ensure that training effectively meets the needs and expectations of participants. The high percentage in the logic and theoretical level dimension indicates that the module provides a strong intellectual and teaching foundation. However, the module is relatively weak at the systemic level. The systematic organization of content can be improved to enhance the coherence and fluency of the training materials. Although still within an acceptable range, the average scores for language and graphics are relatively low. It is recommended that the training module be improved by refining the clarity of the

language and incorporating visual aids such as images and videos to better convey concepts. The module is particularly strong in terms of teaching adaptability, training organization, and innovative scheduling. However, attention should be paid to improving the systemic presentation of content and using clear language and visual effects to further enhance the overall effectiveness of the module.

The TPACK training module has received an overall excellent evaluation. By combining with the expert suggestions, it is found that in terms of advancement, the training should include the new progress of TPACK research and development (Chaipidech, 2021). In terms of systematization, experts recommend strengthening the cross integration between modules. In terms of ideology, experts pointed out that the spirit of carrying forward national culture was not highlighted. In this regard, it is necessary to integrate ideological and political education constructs into the teaching design of TPACK training courses to enhance teachers' professional ethics and emotions of loving their countries (Afari-Yankson, 2021).

To further improve the training, attention should be given to: Improving the systematic approach to content presentation; Ensuring clearer language; Enhancing diagram quality, and strengthening training guarantees. By addressing these areas, the training module can be further refined and its effectiveness maximized.

Contribution
This research makes significant contributions in both theoretical and practical aspects. Theoretically, it enriches the knowledge related to the evaluation of TPACK training modules. By systematically expounding on the TPACK framework and the application of the expert scoring method in the evaluation of its training modules, and by analyzing in detail the advantages, limitations, and coping strategies of the expert scoring method, it provides a theoretical reference for subsequent research. At the same time, the multi - dimensional analysis of the quality of training modules, such as the assessment from aspects like teaching adaptability and cognitive regularity, expands the theoretical perspective of TPACK training effectiveness evaluation.

Practically, through the empirical research on the TPACK training module for university teachers in Qingdao, the paper provides practical guidance for educational management departments and researchers. The research results clarify the advantages and disadvantages of the training module. For example, it has strong teaching adaptability but needs improvement in systematicness. This provides a direction for the optimization of the training module, which is helpful for improving the quality of university teacher training, promoting the digital development of higher education, and is of great significance for improving the design and implementation of university teacher professional development programs.

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