Assimilation: Indonesian Journal of Biology Education
ISSN 2621-7260 (Online)
Journal homepage: https://ejournal.upi.edu/index.php/asimilasi

Developing technological, pedagogical, and content knowledge (TPACK) booklet in biology subject to provide the TPACK materials for prospective biology teachers at UIN Sunan Kalijaga Yogyakarta

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OPEN ACCESS

ARTICLE HISTORY
Received: 27 December 2023
First Revised: 04 March 2024
Accepted: 30 March 2024
First Available Online: 31 March 2024
Publication Date: 31 March 2024

KEYWORDS
Booklet
Prospective Teachers
TPACK

ABSTRACT

This research aims to develop a valid and practical Technological, Pedagogical, and Content Knowledge (TPACK) booklet for biology subjects to provide the TPACK materials of Biology Education students, Faculty of Tarbiyah and Education, UIN Sunan Kalijaga Yogyakarta. This research is development research that is carried out in three stages, namely the analysis, design, and evaluation stages. The analysis stage consists of literature study and identification needs. The design stage includes formulating objectives, preparing material, and designing the TPACK booklet for biological material. The evaluation stage itself is divided into self-evaluation, expert review, one-to-one, and small group stages. This research was carried out only at the small group stage. The product research results were categorized as 'very valid' by the media validator with a score of 3.83 and the material validator with a score of 4. The development of the TPACK Booklet for biology subjects received a one-to-one and small group trial assessment with scores of 3.66 and 3.65 respectively in the 'very practical' category. It can be concluded that the TPACK Booklet for biology subjects is categorized as 'very valid' and 'very practical'.

INTRODUCTION

In the 21st century, technological developments are developing very rapidly. All lines of life need technology, including education. Technology has brought new challenges for teachers in learning, namely, how to integrate technology with certain learning materials and pedagogy (Juanda et al., 2021). In responding to rapid technological advances, teachers must master technology to use supporting media in learning activities and change teaching approaches and pedagogy (Akmal, 2017). Technological, Pedagogical, and Content Knowledge, abbreviated as TPACK, is a framework developed to integrate learning materials, learning methods, and technology into a harmonious whole (Mishra & Koehler, 2006; Riandi et al., 2019). TPACK is a framework that supports teachers in the planning, implementation, and reflection on their teaching method with appropriate use of their domain of education which is Technology Pedagogy & content knowledge (Singh et al., 2022). The initial acronym for the Technological, Pedagogical, and Content Knowledge framework was TPCK, but due to its composition of only consonants, causing difficulty for some individuals (Thompson & Mishra, 2008).The acronym was changed in 2008 from TPCK to TPACK, a modification that remains in use today (Thompson & Mishra, 2008).

TPACK also has a significant role in biology learning at school. According to Unaida & Fakhrah (2021), technology can help teachers illustrate material, assist students in the investigation process, and increase their learning motivation in biology teaching. As educators who prepare future generations, teachers must be responsive to technological changes (Pasani, 2018). Biology teachers must be able to integrate technology well into biology material and pedagogy to produce correct TPACK integration (Bwalya et al., 2023; Unaida & Fakhrah, 2021).

Unfortunately, the published TPACK framework still does not explain how TPACK can be applied, implemented, and evaluated (Riandi et al., 2019). Several studies on TPACK that have been carried out in Indonesia still focus on describing the capabilities and specificities of TPACK on certain materials (Gunanto & Supriyadi, 2021; Yulisman et al., 2020). Riandi et al. (2019) added that the implementation of TPACK in the classroom will be based on a teacher's knowledge, experience, and application. Teachers will tend to teach material in class according to the teacher's capacity. Teachers must have high knowledge and creativity to combine technology, learning materials and pedagogy (TPACK) so that learning in the classroom is more effective, interactive, and enjoyable for students (Istiningsih, 2022).

Thus, TPACK is a necessary framework for teachers to think about what knowledge a teacher must have to integrate technology into teaching and how teachers can continue to develop an understanding of TPACK (Schmidt et al., 2009). Schmidt et al. (2009) also added that TPACK can measure the teaching knowledge of teachers and prospective teachers, so TPACK will impact the training and professional development of teachers and prospective teachers. There are also differences in professions and qualifications needed by future generations, so prospective teachers must be prepared with 21st-century skills (Afandi et al., 2019; Akmal, 2017).

Lecturers, as directors and coaches of prospective teachers, have a significant role in preparing prospective teachers to face the challenges of the 21st century. A student must be equipped to overcome current developments, such as understanding and using information, media and technology (Pasani, 2018). Based on a survey conducted by researchers as lecturers and staff at the Faculty of Tarbiyah and Education, UIN Sunan Kalijaga Yogyakarta on Biology Education students in semesters 4, 6 and 8, it shows that students need to be equipped with knowledge about TPACK. In fact, students must start to get used to integrating technology, pedagogy, and content so that the teaching carried out later is not only focused on content. If not, the same results will occur as reported by Riandi et al. (2019), teachers have separate knowledge regarding technology, pedagogy and content, and teachers only focus on pursuing the learning content determined in the national syllabus. The results showed that the TPACK-focused Science

DOI: https://doi.org/10.17509/aijbe.v7i1.66063
e-ISSN 2621-7260

Methods course had an impact on pre-service teachers' TPACK to varying degrees (Canbazoglu-Bilici et al., 2016; Valtonen et al., 2022).

There is a need for additional material to increase the knowledge capacity of prospective Biology Education teachers, Faculty of Tarbiyah and Education, UIN Sunan Kalijaga Yogyakarta. Explanation of the material using a booklet is an alternative that can be done. In Indonesian, a booklet is a small book that functions as a leaflet (Badan Pengembangan dan Pembinaan Bahasa, Kementerian Pendidikan, Kebudayaan, Riset, 2016). As print media, booklets have a role in learning innovation, and they can contain material interestingly and flexibly (Andreansyah, 2015). Therefore, developing TPACK booklets in biology subjects is necessary to improve the TPACK abilities of prospective Biology Education teachers at UIN Sunan Kalijaga Yogyakarta. Hence, the aim of this research is to develop a valid and practical Technological, Pedagogical, and Content Knowledge (TPACK) booklet for biology subjects to provide the TPACK materials of Biology Education students, Faculty of Tarbiyah and Education, UIN Sunan Kalijaga Yogyakarta as a supplement material.

METHODS

The research method used in this research is the development research method (Development Research/DR) by van den Akker (1999). Development research is divided into 3 major stages, namely the analysis stage, the design stage, and the evaluation and revision stage. The three stages are depicted in a spiral with the end to achieve the research objectives, as in the Figure 1: following picture:

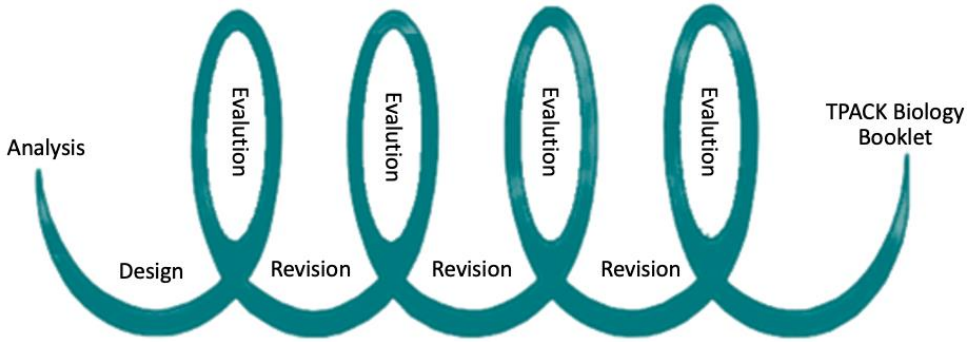


Figure 1. Development research stage (van den Akker, 1999)

Research procedure

At the analysis stage, researchers will conduct a literature study to examine material related to TPACK and biology education. After that, the need for booklet development was identified. Continuing in the design stage, activities were carried out by designing a TPACK booklet for biology subjects. In the evaluation and revision stage, the research will use formative evaluation by Tessmer (1993). Formative evaluation consists of 5 stages: self-evaluation, expert evaluation, one-to-one, small group, and field test. Limited product trials in this research were limited to the small group evaluation stage.

The researchers carried out the self-evaluation stage to minimise product deficiencies. The self-evaluation results are in prototype I, which will then be entered into the expert evaluation stage to test product validity. Validators or experts are selected by appointing someone competent or experienced to evaluate and assess the booklet (Sugiyono, 2010). Assessment of the validity or suitability of the product produces rationality for the suitability of the booklet. Experts or experts consist of material and media experts. This expert assessment stage is carried out by filling out a material and media validation sheet. If the results of prototype I are not feasible, then improvements must be made according to input from experts.

DOI: https://doi.org/10.17509/aijbe.v7i1.66063
e-ISSN 2621-7260

Next, three Biology Education students from the sample class are needed at the one-to-one stage who represent high, medium, and low cognitive ability groups (Tessmer, 1993). The practicality of using booklets is the goal of implementing the one-to-one stage. Students will assess the practicality aspect of the booklet by filling out a practicality questionnaire. The results of the questionnaire sheet will serve as a guide for carrying out revisions that will produce prototype II. Prototype II then entered the small group evaluation stage.

The small group evaluation stage requires a small group of 12 Biology Education Study Program students as research subjects. The research participants were chosen by the representation of high, medium, and low cognitive ability groups (Tessmer, 1993). Research subjects were asked to understand the booklet and then complete a practicality questionnaire. The results of the small group evaluation will be a guide for improving prototype II. The results of improvements to prototype II are the final product of this development research, namely the Technological, Pedagogical, and Content Knowledge (TPACK) Booklet in Biology Subjects to Improve the TPACK Ability of Prospective Biology Education Teachers at UIN Sunan Kalijaga Yogyakarta.

Research instruments

Booklets were assessed quantitatively and qualitatively using validation sheets and questionnaires. The assessment includes the quality of the booklet product and responses regarding the TPACK booklet for biology subjects. Data on product quality results were assessed by material experts, media experts, Biology Education lecturers, and students. The criteria for determining the validity of the TPACK Booklet for biology subjects used in this research include content quality, presentation, linguistic, and graphic aspects. Next, the researchers asked for assessments from Biology Education students to see the practicality of the TPACK Booklet. By using validation sheet instruments and questionnaire sheets, it is hoped that the resulting TPACK Booklet product for biology subjects will be valid and practical.

Data analysis technique

This research uses three data analysis techniques: descriptive analysis, validation sheet data analysis, and questionnaire sheet data analysis. Descriptive analysis is carried out by analyzing data from documentation results, namely analysis of results from literature reviews. The literature reviewed in the development of this booklet is various literature ranging from national and international articles to websites for developing TPACK booklet material for biology subjects. Next, researchers identified the need to create a TPACK module for biological material as analysis material.

Data analysis of the validation sheet uses a Likert scale in its assessment. The Likert scale used has 4 categories: very good, good, bad, and very bad. Next, the data is analysed by looking for the average validation value and converted to interpret the value using Table 1 below:

Table 1. Validation sheet value conversion

Average Value	Notes
1.00 – 1.75	Very Invalid
1.76 – 2.50	Invalid
2.51 – 3.25	Valid
3.26 – 4.00	Very Valid

Analysis of questionnaire sheet data uses a Likert scale in its assessment. The Likert scale used has 4 categories: strongly agree, agree, disagree, and strongly disagree. Next, the data is

DOI: https://doi.org/10.17509/aijbe.v7i1.66063
e-ISSN 2621-7260

analyzed by looking for the average practicality value and converted to interpret this value using Table 2 below:

Table 2. Questionnaire sheet value conversion

Average Value	Notes
1.00 – 1.75	Very Impractical
1.76 – 2.50	Impractical
2.51 – 3.25	Practical
3.26 – 4.00	Very Practical

RESULTS AND DISCUSSION

The development of the TPACK booklet for biology subjects went through three stages: the analysis stage, design stage, and evaluation stage, which consisted of self-evaluation, expert review, and one-to-one and small-group trials.

Analysis stage

The analysis stage is the first stage carried out in this development research. Researchers conducted a literature study first to examine material related to TPACK and biology education. Researchers refer to the primary sources of TPACK, namely articles in international journals and websites from trusted sources regarding the history and development of TPACK. Researchers also reviewed information related to the application of TPACK in biology material so that TPACK can be implemented in biology subjects in the classroom.

After that, the need to develop a TPACK booklet for biology subjects was identified. So far, TPACK research has only focused on exploring technological capabilities, pedagogy, and content without referring more deeply to specific subjects. Based on the researchers' survey, they found that biology education students at the Faculty of Tarbiyah and Education, UIN Sunan Kalijaga Yogyakarta, still needed to be equipped with knowledge about TPACK. This is supported by research conducted by Riandi et al. (2019), which states that teachers have separate knowledge regarding technology, pedagogy and content, and teachers only focus on pursuing learning content determined in the national syllabus. Balancing technology, pedagogy, and content in the classroom is crucial (Rapanta et al., 2021). The purpose of the integration of technology, pedagogy, and content is to make learning more effective (Koehler et al., 2013; Santos & Castro, 2021). Hence, the development of TPACK implementation capabilities must continue to be improved (Nugraha et al., 2022). Students who are still in their learning capacity to become teachers must have TPACK skills (Nursyifa et al., 2020). For this reason, researchers developed this TPACK booklet because no booklet actually discusses the application of TPACK in biology content.

Design stage

At the design stage, the first step must be to formulate the purpose of using the booklet. In developing a booklet, one should know the definition of a booklet first. A booklet is “a very thin book with a small number of pages and a paper cover, giving information about something”. Both Atiko (2019) and Syamsurizal et al. (2021) explained that students will not get bored reading a booklet because a booklet consists of attractive pictures and language that is easy to understand. The characteristic of the developed booklet is prioritizing the practicality of TPACK framework implementation in biology teaching and learning process. The booklet emphasizes the importance of using TPACK in learning by providing detailed information starting from the history and components of TPACK, to analyse the use of TPACK in biology classes and provide real examples

DOI: https://doi.org/10.17509/aijbe.v7i1.66063
e-ISSN 2621-7260

of how to use the TPACK framework clearly in biology classes. The aim of this booklet is to enable pre-service science teachers to develop learning plans using the TPACK framework matrix and analysis. The matrix and analysis developed in this booklet are adapted from the work of Ghana Image Learning, supported by the Global Partnership for Education (GPE) (2021).

Therefore, researchers developed the TPACK booklet for biology subjects with the aim that students of Biology Education, Faculty of Tarbiyah and Education, UIN Sunan Kalijaga can: (1) Understand the importance of TPACK in learning; (2) Understand the history of the development of the TPACK framework; (3) Differentiate the components in the TPACK framework; (4) Analyze TPACK research in biology learning in the classroom; (5) Evaluate the matrix and analysis in the TPACK framework; and (6) Develop a learning plan using the TPACK framework matrix and analysis.

Next, the preparation of TPACK material for biology subjects was carried out. This TPACK booklet discusses various things, such as the following: (a) Introduction; (b) History of TPACK; (c) TPACK components; (d) TPACK Research in Biology Subjects; (e) TPACK in Biology Learning; (f) Example of TPACK in Biology Subjects; and (g) TPACK Matrix and Analysis Templates in Learning.

The final step in the design stage is to design the booklet being developed. The following are the appearances of the booklet designs that have been developed (Figure 2-4).

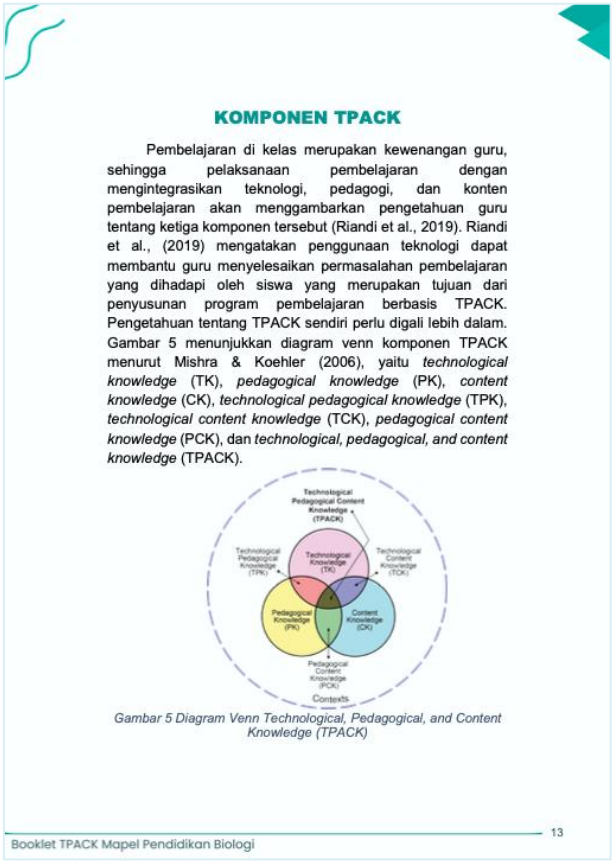
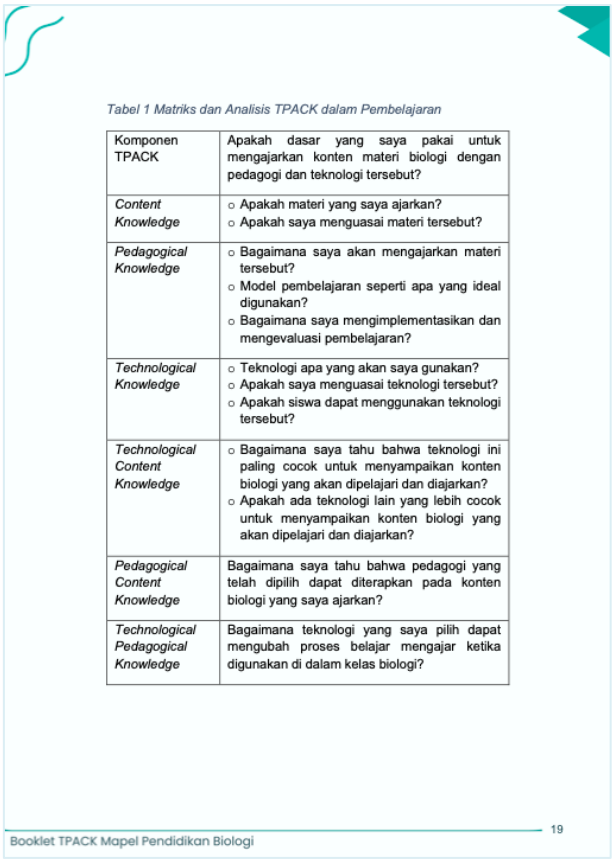


Figure 2. TPACK components explanation in the booklet

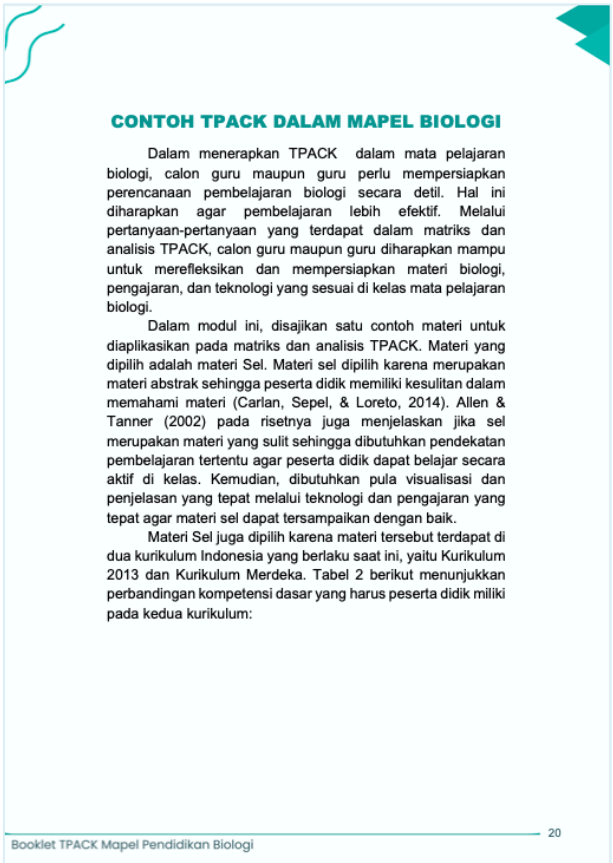
DOI: https://doi.org/10.17509/aijbe.v7i1.66063
e-ISSN 2621-7260



Tabel 1 Matriks dan Analisis TPACK dalam Pembelajaran

Komponen TPACK	Apakah dasar yang saya pakai untuk mengajarkan konten materi biologi dengan pedagogi dan teknologi tersebut?
Content Knowledge	○ Apakah materi yang saya ajarkan? ○ Apakah saya menguasai materi tersebut?
Pedagogical Knowledge	○ Bagaimana saya akan mengajarkan materi tersebut? ○ Model pembelajaran seperti apa yang ideal digunakan? ○ Bagaimana saya mengimplementasikan dan mengevaluasi pembelajaran?
Technological Knowledge	○ Teknologi apa yang akan saya gunakan? ○ Apakah saya menguasai teknologi tersebut? ○ Apakah siswa dapat menggunakan teknologi tersebut?
Technological Content Knowledge	○ Bagaimana saya tahu bahwa teknologi ini paling cocok untuk menyampaikan konten biologi yang akan dipelajari dan diajarkan? ○ Apakah ada teknologi lain yang lebih cocok untuk menyampaikan konten biologi yang akan dipelajari dan diajarkan?
Pedagogical Content Knowledge	Bagaimana saya tahu bahwa pedagogi yang telah dipilih dapat diterapkan pada konten biologi yang saya ajarkan?
Technological Pedagogical Knowledge	Bagaimana teknologi yang saya pilih dapat mengubah proses belajar mengajar ketika digunakan di dalam kelas biologi?

Figure 3. TPACK matrix and analysis in learning



CONTOH TPACK DALAM MAPEL BIOLOGI

Dalam menerapkan TPACK dalam mata pelajaran biologi, calon guru maupun guru perlu mempersiapkan perencanaan pembelajaran biologi secara detil. Hal ini diharapkan agar pembelajaran lebih efektif. Melalui pertanyaan-pertanyaan yang terdapat dalam matriks dan analisis TPACK, calon guru maupun guru diharapkan mampu untuk merefleksikan dan mempersiapkan materi biologi, pengajaran, dan teknologi yang sesuai di kelas mata pelajaran biologi.

Dalam modul ini, disajikan satu contoh materi untuk diaplikasikan pada matriks dan analisis TPACK. Materi yang dipilih adalah materi Sel. Materi sel dipilih karena merupakan materi abstrak sehingga peserta didik memiliki kesulitan dalam memahami materi (Carlan, Sepel, & Loreto, 2014). Allen & Tanner (2002) pada risetnya juga menjelaskan jika sel merupakan materi yang sulit sehingga dibutuhkan pendekatan pembelajaran tertentu agar peserta didik dapat belajar secara aktif di kelas. Kemudian, dibutuhkan pula visualisasi dan penjelasan yang tepat melalui teknologi dan pengajaran yang tepat agar materi sel dapat tersampaikan dengan baik.

Materi Sel juga dipilih karena materi tersebut terdapat di dua kurikulum Indonesia yang berlaku saat ini, yaitu Kurikulum 2013 dan Kurikulum Merdeka. Tabel 2 berikut menunjukkan perbandingan kompetensi dasar yang harus peserta didik miliki pada kedua kurikulum:

Figure 4. Example of the application of TPACK in biology subject

DOI: https://doi.org/10.17509/aijbe.v7i1.66063
e-ISSN 2621-7260

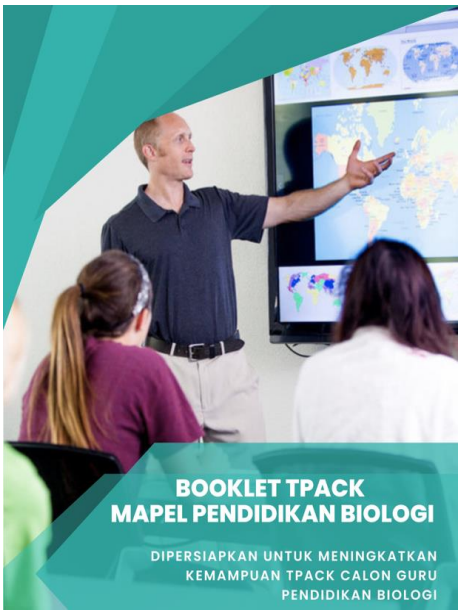
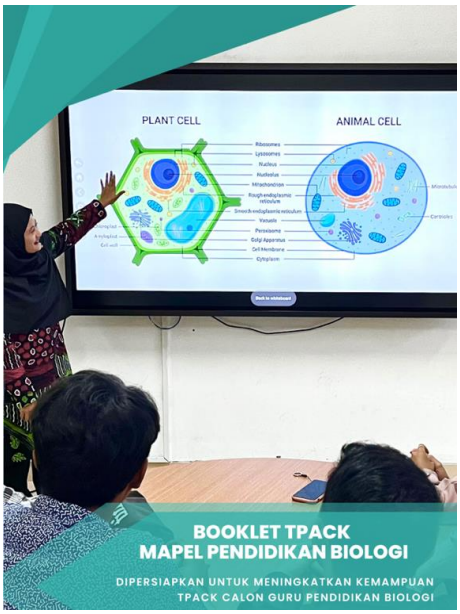
Evaluation stage

The evaluation stage is the final stage in development research. This stage was carried out to test the validity and practicality of the booklet that had been developed. The following is a description of the evaluation stages by stage:

a. Self-evaluation

Self-evaluation is an evaluation carried out by the researcher himself. The initial product design developed by the researcher was looked at again to ensure that the initial research product, in this case, the booklet, was of good quality. There are several improvements from the self-evaluation stage, which can be seen in Table 3. Table 3 compares the appearance of the booklet before and after self-evaluation. There are two improvements regarding the cover page and icons to differentiate the evaluation and student reflection sections. After the self-evaluation stage, it is deemed sufficient. The research continues to the expert/expert evaluation stage or expert review.

Table 3. Appearance of the revision results of the self-evaluation stage

Initial Prototype Before Revision	Initial Prototype After Revision
	
Note: The cover page uses someone else's image and does not show more specific biological material.	Note: The cover page has been improved using our images and interprets technology, pedagogy, and biology content, such as cell material.
Setelah membaca materi di atas, cari dan analisislah artikel terkini mengenai penelitian TPACK pada mata pelajaran biologi!	 Setelah membaca materi di atas, cari dan analisislah artikel terkini mengenai penelitian TPACK pada mata pelajaran biologi!
Note: There is no difference between the evaluation and reflection sections in the booklet and the contents of the booklet.	Note: Providing book and pen icons can differentiate the evaluation and reflection sections in the booklet.

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b. Expert review

Two experts evaluated the TPACK booklet product for Biology Subjects. The two experts are divided into experts in the media and experts in biology education materials, especially the use of technology.

Media validator

The media validator is a lecturer at the Faculty of Tarbiyah and Education at UIN Sunan Kalijaga Yogyakarta, who teaches the Learning Media course. After evaluating the booklet, the media validator assesses the booklet by filling in a validation sheet. Several technical revisions must be carried out by researchers, namely calling tables and figures in the text that have not been done, contrasting images, foreign terms that have not been written according to Indonesian writing rules, and explaining evaluation icons that are not yet contained in the instructions for using the booklet. After revisions, the researcher validated the product again with the validator. Table 4 shows the final assessment of the media validators:

Table 4. Media validator final assessment

No.	Statement	Score
Booklet Size Aspects		
1.	The size of the booklet complies with the standard.	4
2.	The size of the margins and paper on the booklet is appropriate.	3
Booklet Cover Design Aspects		
3.	The booklet cover illustration depicts the contents of the learning material.	3
4.	Appropriate font combination.	4
5.	The booklet title colour contrasts with the background colour.	4
6.	The proportion of letters for the title, subtitle and author's name corresponds to the size of the booklet.	3
Booklet Content Design Aspects		
7.	The use of letter variations is not excessive.	3
8.	Image conformity with text message (material).	4
9.	Compliance of the table with the text message (material).	3
10.	The space between lines in normal text.	4
11.	Normal spacing between letters.	4
12.	The appearance of the TPACK Biology Subject booklet is attractive.	3
	Final Score	**3,83**
	Category	**Very Valid**

The final assessment results from the media validator showed that the TPACK booklet product for biology subjects was very valid, with a score of 3.83. The media validator had no further criticism or suggestions and concluded that the TPACK booklet for biology subjects was suitable for trials without revision.

Material validator

The material validator is a lecturer at the Faculty of Tarbiyah and Education, UIN Sunan Kalijaga Yogyakarta, a lecturer who teaches the Biology Media and Learning Resources Development course and has an educational certificate in Biology Education. After evaluating the booklet, the material validator assesses the booklet by filling in a validation sheet. The material validator suggested clarifying the booklet title by changing the booklet title to TPACK Booklet for biology subjects. Previously, there was a writing error in the booklet's title, namely the TPACK Booklet for

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e-ISSN 2621-7260

biology education subjects. The researcher revised and revalidated the booklet to the validator. Table 5 shows the final validation results from the material validator:

Table 5. Material validator final assessment

No.	Statement	Score
Content Feasibility Aspect		
1.	Suitability of learning objectives in the booklet with the contents of the booklet.	4
2.	Completeness of learning material in sequential and systematic booklets.	4
3.	The Technological Pedagogical Content Knowledge (TPACK) material in the booklet is easy for students to understand.	4
4.	The Technological Pedagogical Content Knowledge (TPACK) material in the booklet can improve students' TPACK abilities.	4
5.	The Technological Pedagogical Content Knowledge (TPACK) material in the booklet is appropriate to the student's level of knowledge.	4
6.	TPACK Matrix and Analysis in Biology Subjects are in accordance with TPACK material.	4
7.	Examples of TPACK in Biology Subjects are in accordance with TPACK material.	4
8.	References in the booklet support students' understanding of TPACK.	4
Linguistic Feasibility Aspects		
9.	The language used is easy for students to understand.	4
10.	The sentences used to explain the material are easy to understand.	4
11.	The sentences used do not have double meaning.	4
12.	Conformity with good and correct Indonesian language rules.	4
13.	The language used is appropriate to the level of development of students' thinking.	4
Feasibility of Independent Study Aspects		
14.	TPACK booklets in Biology Subjects can attract students' interest in learning.	4
15.	The TPACK Booklet in Biology Subjects can help students learn independently.	4
	Final Score	**4**
	Category	**Very Valid**

The final assessment results from the material validator showed that the TPACK booklet product for biology subjects was very valid, with a score of 4. The material validator provided information that the product was ready to be implemented. The material validator concluded that the TPACK booklet for biology subjects was suitable for trials without revision.

c. One-to-one

At the One-to-one trial stage, researchers tested the booklet product on three biology education students, Faculty of Tarbiyah and Education, UIN Sunan Kalijaga Yogyakarta. Three students were selected based on high, medium, and low abilities. The One-to-One stage was carried out to test the practicality of the booklet. Testing is carried out by filling out a practicality questionnaire sheet. Practical means the product produced is easy for students to use. The results of students' practicality assessment of the booklets that have been developed can be seen in Table 6 below:

Table 6. One-to-one trial assessment

No.	Statement	Score (N=3)
Booklet Design Aspects		
1.	The appearance of the TPACK Biology Subject booklet is attractive.	3.67
2.	This TPACK Biology booklet can make learning fun.	3.33
3.	This TPACK biology booklet makes me more enthusiastic about learning how to combine technology, pedagogy, and biology content.	3.67
4.	The picture illustrations in the biology TPACK booklet can help me understand the TPACK material, especially in biology subjects.	3.67

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No.	Statement	Score (N=3)
5.	The table in the biology TPACK booklet can help me understand the TPACK material, especially in biology subjects.	3.67
Material Aspects		
6.	The material presented in this module is easy for me to understand.	3.33
7.	This TPACK Biology booklet helps me to integrate technology, pedagogy, and biology content.	4
8.	This TPACK biology booklet supports me in mastering how to combine technology, pedagogy, and biology content.	3.33
9.	The presentation of the material in the TPACK Biology booklet encouraged me to reflect on my understanding of the integration of technology, pedagogy, and biology content.	3.67
10.	This TPACK Biology booklet contains an evaluation that can test how far I understand the integration of technology, pedagogy, and biology content.	4
Linguistic Aspect		
11.	The sentences and paragraphs used in the TPACK Biology booklet are clear and easy to understand.	4
12.	The language used in the TPACK Biology booklet is simple and easy to understand.	3.67
13.	The letters used are simple and easy to read.	3.67
Final Score		**3.66**
Category		**Very Practical**

Table 6 shows the results of the booklet assessment, which received a score of 3.66. The conversion results show that the Biology Subject TPACK booklet is very practical and ready for the next stage, namely the Small Group trial.

d. Small-group

At the small group trial stage, researchers tested the booklet product on 12 biology education students, Faculty Tarbiyah and Education, UIN Sunan Kalijaga Yogyakarta. Students are selected based on high, medium, and low abilities. The Small Group stage was carried out to test the practicality of the booklet. Testing is carried out by filling out a practicality questionnaire sheet. The results of students' practicality assessment of the booklets that have been developed can be seen in Table 7 below:

Table 7. Small-group trial assessment

No.	Statement	Score (N=12)
Booklet Design Aspects		
1.	The appearance of the TPACK Biology Subject booklet is attractive.	3.58
2.	This TPACK Biology booklet can make learning fun.	3.58
3.	This TPACK biology booklet makes me more enthusiastic about learning how to combine technology, pedagogy, and biology content.	3.67
4.	The picture illustrations in the biology TPACK booklet can help me understand the TPACK material, especially in biology subjects.	3.67
5.	The table in the biology TPACK booklet can help me understand the TPACK material, especially in biology subjects.	3.75
Material Aspects		
6.	The material presented in this module is easy for me to understand.	3.75
7.	This TPACK Biology booklet helps me to integrate technology, pedagogy, and biology content.	3.75
8.	This TPACK biology booklet supports me in mastering how to combine technology, pedagogy, and biology content.	3.58

DOI: https://doi.org/10.17509/aijbe.v7i1.66063
e-ISSN 2621-7260

No.	Statement	Score (N=12)
9.	The presentation of the material in the TPACK Biology booklet encouraged me to reflect on my understanding of the integration of technology, pedagogy, and biology content.	3.5
10.	This TPACK Biology booklet contains an evaluation that can test how far I understand the integration of technology, pedagogy, and biology content.	3.58
Linguistic Aspect		
11.	The sentences and paragraphs used in the TPACK Biology booklet are clear and easy to understand.	3.67
12.	The language used in the TPACK Biology booklet is simple and easy to understand.	3.58
13.	The letters used are simple and easy to read.	3.83
Final Score		**3.65**
Category		**Very Practical**

Table 7 shows the results of the booklet assessment, which received a score of 3.65. The conversion results show that the Biology Subject TPACK booklet is very practical. The final product is the TPACK Biology Subject Booklet, which has successfully passed the small-group stage. The TPACK Biology Subject Booklet was developed following the analysis, design and evaluation stages and categorized as very valid and very practical.

CONCLUSION

Based on the research that has been carried out, the following conclusions can be drawn:

1. The results of developing the TPACK booklet product in Biology Subjects obtained a media expert assessment of 3.83, considered very valid, and a material expert assessment of 4, considered very valid. The TPACK booklet product in the Biology Subject is stated to provide the TPACK materials for prospective Biology teachers.
2. The results of the TPACK booklet product development in the Biology Subject obtained a One-to-One trial assessment of 3.66, considered very practical, and a Small-Group trial assessment of 3.65, regarded as very practical. The TPACK booklet product in the Biology Subject is stated to provide the TPACK materials for prospective Biology teachers.

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Acknowledgment

This research is funded by Research Institutions and Community Service, UIN Sunan Kalijaga Yogyakarta as part of Building/Capacity Research Cluster Grant Number 75.3 Year 2023.

Authors' Note

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

How to Cite this Article

Utami, Aprillyana D., Harahap, G., & Khoiriyah, A. N. (2024). Developing technological, pedagogical, and content knowledge (TPACK) booklet in biology subject to provide the TPACK materials for prospective biology teachers at UIN Sunan Kalijaga Yogyakarta. *Assimilation: Indonesian Journal of Biology Education*, *7*(1), 67-80. https://doi.org/10.17509/aijbe.v7i1.66063