# Development and Validity of Biology Learning Tool Using the Tpack Framework with Guided Inquiry Settings to Improve Student's Science Literacy Skills

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**Abstract.** This research is a development research that aimed to describe the development and validity of biology learning tool based on guided inquiry integrated TPACK to improve scientific literacy skills in the digestive system material. This research method used a 4D research and development model developed by Thiagarajan. The stages of 4D development consist of the stages of define, design, develop, and disseminate. In this study, the stages of development in sequence have been described, namely the definition, design and development of learning tool products. The instrument used in this research is a validation questionnaire as a measure of the validity of the learning tool product and a response questionnaire as a measure of the practicality of using the learning tool that has been developed. The quality of the developed learning tool products was tested through the validation stage which was carried out with the help of a validation questionnaire for 2 validators, then a practicality test would be carried out by reviewing the responses of teachers and students. Data analysis used quantitative descriptive method. The results showed that the learning tools developed were valid with the validity values obtained for the lesson plans, worksheets and instruments about students' scientific literacy skills, namely 3.7; 3.42; 3.5 with the average of the three components included in the valid category. After the degree of validity was obtained, then an effort was made to determine the degree of practicality and the response scores of teachers and students were 84% and 81.01%, respectively, in the practical category, supported by results classified as classically categorized, it is known that the development and used of biology learning tools based on guided inquiry and integrated TPACK is valid and practical.
**Keywords:** Development, TPACK, Validty.

## INTRODUCTION

21st century learning applies the concept of learning that requires students to be actively involved in learning, but the reality that occurs in schools is basically still applying the concept of teacher-centered learning. The application of 21st century learning culture is expected to replace the role of the teacher as an information center to become a facilitator in the student learning process. Students are expected to be more active through various processes that involve their various senses so that learning materials can be understood properly. Using science and technology advances in learning is the right thing because it can familiarize students to adapt to the surrounding environment so that later they are ready to serve the community. Meaningful learning will be useful for students in the future because the times are growing, technology is advancing rapidly,

information in every place flows quickly and is no longer constrained by places so that information is very easy to spread, for this reason, high student curiosity is needed for various phenomena that occur. is around. This is closely related to the essence of learning biology, which is often the object of study of living things and the surrounding environment. Biology learning is an interaction between students and the object they are studying, so to be able to understand, communicate and apply biological concepts in real life, the ability in the form of scientific literacy is needed.

The right learning model to be adapted to the hope of forming a scientific literacy-oriented character that is oriented to 21st century learning is guided inquiry. one of the inquiry learning models that requires students to investigate based on the problems posed by the teacher, but the students themselves determine the investigation procedure. Meanwhile, the teacher facilitates and guides students in the investigation activities they design (Sofiani, 2011). Efforts to improve scientific literacy through the development of learning tools have been carried out by several researchers, including (Azmah, 2020; Fahmiati, Susantini, & Rachmadianti, 2017; Latip & Permanasari, 2015; Muasik, 2017; Putranta & Supahar, 2019; Yuniarti, Ni Wayan; Sadia, 2018). Menurut penelitian yang dilakukan oleh Purnawati, Maison, & Haryanto (2020); Suyamto (2020); Oktasari & Jumadi, (2019) it is known that the development of the resulting TPACK-based E-LKPD is categorized as very feasible to be used in physics learning for class X material on Temperature and Heat. Likewise with the results of research proposed by (Ayuningtyas, W, and Supardi, 2015). Another similar study conducted by (Apriliani, 2017) showed that the application of TPACK-based learning tools could improve students' understanding of concepts in the relationship diagram material between entities and students' responses to the learning media used got a positive response.

Therefore, it is important to conduct research on the development of learning tools using the TPACK framework with guided inquiry settings to improve students' scientific literacy skills. It aims to stimulate students' desire to find out the object being studied. To realize this, learning devices that meet the valid category are needed which can later be used if they have gone through the validation stage. Based on this, this study aims to determine the validity of learning tools using the TPACK framework with guided inquiry settings to improve students' scientific literacy skills that have been developed in the hope that in the future it can help the student's observation and learning process.

## RESEARCH METHOD

### Types of Research

This research is a research and development research using the 4D development research model developed by S. Thiagarajan Dorothy S. Sammel and Melvyn I. Semmel consisting of four stages namely define (definition), design (design), development (development). and disseminate. The stages of development in this research include define, design and development.

### Research Subject

The research subjects were 2 experts validator lecturers. The research instruments were in the form of product validation questionnaires and teacher response questionnaires and student response questionnaires to review the practicality of using learning tools that had been developed and went through the validation stage.

### Data Collection Technique

The data collection technique used in this research is a questionnaire. The questionnaire used is a validation questionnaire. The data analysis used is validity data analysis.

The validity degree is determined through a validation formula referring to the research of Hobri, 2010. The data will be analyzed through the following stages:

### Validity Analized

a. Data recapitulation

Recapitulating the data on the results of the assessment of the validity of the devices and instruments into a table which includes: aspects (Ai), Criteria (Ki) and the results of the validator assessment (Va) through predetermined scoring guidelines (Likert scale).

b. Scoring

Determining the score of the validation results is carried out in stages through determining the average assessment results of all validators for each criterion using the formula:

$$\overline{Ki} = \frac{\sum_{j=1}^{n} Vij}{n} \qquad (2.1)$$

Description:

$\overline{Ki}$ : mean criteria of i

$Vij$ : the score of j validator's assessment of the criteria -i

$n$ : number of validators

Determine the average of each aspect using the formula:

$$\overline{Ai} = \frac{\sum_{j=1}^{n} \overline{Kij}}{n} \quad (2.2)$$

Description:
$\overline{Ai}$ : mean criteria of i
*Kij* : the mean for the I aspect of the j criteria
*n* : the number of criteria in the i-th aspect

Next, determine the mean by the total formula:

$$\text{Va} = \frac{\sum_{j=1}^{n} \overline{Ai}}{n} \quad (2.3)$$

Description:
Va : total mean
$\overline{Ai}$ : the mean aspect of i
*n* : the number of aspects
c. Analysis of the validity of the product of biology learning tools

The validity of the learning device product is determined by the percentage value for each validator. Furthermore, the percentage value from the validator is then matched with the assessment category of the validation results in Table 1 as follows:

Table 1. Category of Validation Achievement Assessment

| No. | Value | description |
|---|---|---|
| 1. | 3,51 ≤ Va =4,0 | Very valid |
| 2. | 2,91 ≤ Va < 3,50 | Valid |
| 3. | 1,91 ≤ Va < 2,90 | Unvalid |
| 4. | 1,0 ≤ Va <1,90 | Very unvalid |

The category used to conclude that the developed learning device has a degree of validity with the total mean value for all aspects is at least in the valid category and the value for each aspect is at least in the valid category. If this is not the case, it is necessary to make revisions based on suggestions from the validator or by reviewing aspects that have less value. Furthermore, it is re-validated and then re-analyzed. And so on until it meets the valid category (Nurdin, 2007).

To measure the level of practicality of product development, the following analytical techniques are used:

a. Data tabulation

The tabulation of data obtained from the response of teachers in the field on the use of biology learning tools was recapitulated so that a total score could later be obtained.

b. Scoring

The average value of the score is converted into a qualitative value, but before that it is necessary to use the formula:

$$P = \frac{\sum_{i=1}^{5} Xi}{\sum_{j=1}^{5} Xj} \text{ x } 100\% \qquad (2.4)$$

Information:

Q: percentage of choice

Xi: score of answers assessed by experts (teachers and students)

Xj : total score of the highest answer

After calculating the percentage of the teacher's assessment, then determining the response criteria that have been given to the percentage of practicality analysis results based on the practicality assessment guideline for product development according to Arikunto, 2009 as shown in Table 2.

Table 2. Guidelines for Practical Product Development Assessment

| Persentase(%) | Category | Description |
|---|---|---|
| 80-100 | Very practical | No revision |
| 66-79 | Praktical | No revision |
| 55-65 | Practical enough | No revision |
| 40-54 | Less practical | Revision |
| 30-39 | unpractical | Revision |

The practicality analysis refers to the results of the evaluation of teacher and student response questionnaires. If a positive response of 80% is found, the learning device can be categorized as practical to apply (Arikunto, 2009).

## RESULTS AND DISCUSSION

### Define

The definition stage is carried out through several analytical activities to determine the learning profile by conducting an initial analysis, students from material constraints at the beginning. The purpose of this stage is to determine the learning requirements by analyzing the objectives of the material constraints at the beginning. This stage includes: First, the initial analysis which aims to determine the basic problems faced by students in the subject. The results of the analysis show that learning in schools is still teacher centered so that students are passive in the learning process. Second, the results of student analysis show that students' academic abilities are categorized as low because students do not play an active role in learning. Third, task analysis includes content structure analysis and procedural analysis. Fourth, concept analysis includes the formulation of learning objectives and identification of learning materials.

### Design

The second stage of the 4D development research model is design. The design of learning device development is made at this stage. The design consists of several stages, namely the preparation of the test, the selection of the design format, the design of the learning device and the creation of the design document. The design stage consists of a more mature preparation composition to facilitate the development stage later.

### Development

The results from the definition stage and design stage will then be compiled into a development product in the form of lesson plans, LKPD, and guided inquiry-based Science Literacy questions using the TPACK framework on digestive system materials. At this stage, it also includes guaranteeing the quality of learning device products through the results of validity and practicality tests.

### 1. Validation

Validation is carried out on learning tools such as the Learning Implementation Plan (RPP) and LKPD with a focus on different aspects of the assessment. In RPP validation there are 6 aspects of assessment while in LKPD validation there are 5 aspects of assessment. The result of this research is the product of developing biology learning tools using the TPACK framework with guided inquiry settings to improve students' scientific literacy skills that are valid. This product was designed by the researcher himself based on the student's learning needs that had been analyzed beforehand, none other than to obtain appropriate learning tools for use in the classroom to help realize a fun learning process and all

student-centered learning. Validation activities are carried out by two expert validators who provide an assessment of the learning device products developed. The learning device developed using the TPACK framework with guided inquiry settings and specifically on the instrument for evaluating scientific literacy abilities contains scientific literacy indicators in it so that students are indeed required to be proficient in responding to the given learning situation.

**a. RPP Validity**

The validity of the RPP is viewed from 6 aspects of the assessment, namely the completeness of the identity format, the formulation of Competency Achievement Indicators and learning objectives, Approaches, Models, Methods, Media and Learning Resources, learning steps, language, and the TPACK Framework (Technological Pedagogical Content and Knowledge). The initial stage of the validity of the RPP is declared not yet valid. This is because the indicators of competency achievement and learning objectives need to be harmonized, the selection of operational verbs (KKO) is expected to be HOTS (High Order Thinking Skills) oriented. Input from the expert validator, the RPP is revised and developed according to the advice of the expert validator. After passing the revision stage, this RPP was re-validated and declared valid. Validity analysis that has been done is known to the degree of validity of each product.

Table 3. RPP validation results

| No. | Rated aspect | Validator Score ($V_{Ki}$)of- | | $\overline{Ai}$ |
|---|---|---|---|---|
| | | 1 | 2 | |
| A. | Completeness of RPP Format and Identity | 4.00 | 4.00 | 4.00 |
| B. | Formulation of IPK and Learning Objectives | 3.62 | 3.25 | 3.43 |
| C. | Approaches, Models, Methods, Media and Learning Resources | 3.78 | 3.33 | 3.55 |
| D. | Learning Steps | 3.89 | 3.78 | 3.84 |
| E. | language | 3.14 | 3.57 | 3.36 |
| F. | TPACK framework (*Technological pedagogical Content and Knowledge*) | 4.00 | 4.00 | 4.00 |
| Rata-rata ($V_a$) | | | | 3.7 |

RPP with a degree of validity of 3.70 is in the very valid category. The lesson plans were developed using a guided inquiry model. Guided

inquiry is a way of teaching and learning that is intentionally designed to direct students to gain an in-depth understanding of a content that can later be used to develop literacy and social skills (Kuhlthau, Maniotes, & Caspari, 2015). There are various inputs given by the validator during the validation period and have been considered as a form of revision to obtain a truly valid degree of validity.

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**b. LKPD Validity**

The right step in realizing conditions that are in accordance with learning objectives is to develop LKPD which is a manifestation of the stages of guided inquiry learning such as orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses and making conclusions, the guided inquiry process is carried out under the guidance of the teacher. Guided inquiry is also known to value the process of student discovery to define what they have learned in understanding information. In cognitive theory, the learning process begins when the stimulus activates the sensory domain and the sensor activates sensory memory. The sensory memory will be processed into short term memory and long term memory. Jean Piaget suggested three main principles of cognitive learning, namely 1) active learning, 2) learning through social interaction, 3) learning through his own experience (Lailiah, Wardani, & Edi Sutanto, 2021). The following aspects are assessed in the LKPD validation process

Table 4. LKPD validation results

| No. | Rated aspect | Validator Score ($V_{Ki}$) of- | | $\overline{Ai}$ |
|---|---|---|---|---|
| | | 1 | 2 | |
| A. | Presentation Aspect | 3.80 | 3.80 | 3.80 |
| B. | Content Aspect | 3.38 | 3.13 | 3.26 |
| C. | Display Aspect | 3.22 | 3.67 | 3.45 |
| D. | Language Aspect | 3.13 | 3.50 | 3.32 |

| No. | Rated aspect | Validator Score ($V_{Ki}$) of- | | $\overline{Ai}$ |
|---|---|---|---|---|
| | | 1 | 2 | |
| E. | TPACK framework aspect (*Technological pedagogical Content and Knowledge*) | 3.50 | 3.00 | 3.25 |
| Rata-rata ($V_a$) | | | | 3.42 |

In the LKPD validity process, there are several things that become the focus of attention in the validation process, namely the LKPD it is necessary to pay attention to the size of the use of letters, the selection of colors and the layout used. In line with research conducted by (Herawati & Muhtadi, 2018) (Ricu Sidiq & Najuah, 2020) which states that the selection of appropriate colors is an attraction for learning products developed, for example, the selection of varied colors can increase enthusiasm and high graphic value in learning. the presentation.

**c. Instrument Validity of Scientific Literacy Ability Evaluation Questions**

Scientific literacy is a multidimensional aspect that does not only affect the understanding of sans knowledge, but can improve higher-order thinking skills and increase the understanding of the knowledge gained in everyday life, as well as understanding the relationship between sans and other disciplines. Scientific literacy skills can cover all areas of life so that they are categorized as multidimensional. The scientific literacy category is the basis for various disciplines, namely science as the mother of science, science as an investigation, science as a way of thinking and the interaction of science, technology and society (Harahap, Syafi'I and Wulandari, 2020).

Based on this, it is important to integrate scientific literacy into the learning stage and also become an ability that is expected to be possessed by students, so that in the development of learning tools, efforts are made to cover the essence of scientific literacy. The learning material that is closely related to everyday life is the digestive system. In the development of all learning devices, it is based on KD. 3.7 regarding the digestive system. In the question instrument there are some words that are not used correctly so it is recommended to use other words with more or less the same meaning. Based on the suggestions received by the author by the validator, it has been considered and implemented through revisions so that it can achieve an average value with a valid category and the validation results state that the product is feasible to use.

Product development in the form of an instrument for evaluating students' scientific literacy abilities is also interesting because it is

necessary to integrate aspects of scientific literacy into the questions so that the questions that have been developed are expected to represent every aspect of scientific literacy so that students' scientific literacy skills can be measured. The following aspects are assessed in the instrument validation process for evaluating students' scientific literacy:

Table 5. Results of the Validation of Scientific Literacy Question Instruments

| No. | Indicator | Validator score ($V_{Ki}$) of- | | |
|---|---|---|---|---|
| | | 1 | 2 | $\overline{Ai}$ |
| A. | Material Aspect | 3.75 | 2.50 | 3.13 |
| B. | Construction Aspect | 4.00 | 4.00 | 4.00 |
| C. | Aspects of Compatibility with Scientific Literacy | 3.67 | 3.00 | 3.34 |
| D. | Language Aspect | 3.00 | 4.00 | 3.50 |
| Rata-rata ($V_a$) | | | | 3.5 |

Based on this, the results of the validation of the learning tools in terms of the results of the validation of the RPP, LKPD and instruments of scientific literacy questions, the following results are obtained:

Table 6. Results of Validation of All Components of Learning Devices

| No. | Product development | Degree of validity | Description |
|---|---|---|---|
| 1. | RPP (6 items) | 3.70 | Very valid |
| 2. | LKPD (5 items) | 3.42 | Valid |
| 3. | Instruments for evaluating scientific literacy skills (4 items) | 3.50 | Valid |
| Average ($V_a$) | | 3.54 | Valid |

## 2. Prakticality

The assessment of the learning tools that have been developed will then be reviewed in terms of practicality after going through the validation and application stages in learning. The value of practicality is obtained from the teacher's response and the student's response by filling out the assessment sheet for the overall learning device, namely RPP, LKPD, and instruments about students' scientific literacy abilities. The results of practicality are obtained from the total score of all aspects assessed. The total score is then adjusted according to a predetermined formula, here is the number of participants for the practicality test.

Table 7. Number of Practicality Test Participants

| No. | Informant | Amount |
|---|---|---|
| 1. | Biology teacher | 7 |
| 2. | Student | 72 |

The results of the practicality assessment through the teacher's response questionnaire obtained an average value of the practitioner validator, namely 84%. The value obtained is classified as high because in terms of the percentage criteria it is in the 80-100% category with the information "very practical" referring to Arikunto (2009), when described it will appear as follows:

Table 8. Teacher's Assessment of Learning Devices

| No. | Rated aspects | Total number | Percentage of teacher responses | Practical criteria | description |
|---|---|---|---|---|---|
| 1. | Prsentation | 12 | 75% | Praktical | No revision |
| 2. | Use | 33 | 75% | Praktical | No revision |
| 3. | Legibility | 7 | 87.5% | Very practical | No revision |
| 4. | Time | 4 | 100% | Very practical | No revision |
| Persentage averasge | | | 84% | Very practical | No revision |

The practicality assessment is also viewed from the aspect of student responses during learning activities using the TPACK framework learning device using the guided inquiry setting. The results of practicality are obtained from the total number of scores obtained compared to the maximum score and then multiplied by 100%. The results of student responses are in the following table:

Table 9. Student Assessment of Learning Devices

| No. | Class | Total Value | Total students | Average of P (Percentage of Practicality) | Practical Criteria | Description |
|---|---|---|---|---|---|---|
| 1. | XI IPA 2 | 2932.895 | 36 | 81.46 % | Very practical | No revision |
| 2. | XI IPA 3 | 2900 | 36 | 80.55 % | Very practical | No revision |
| The total average | | | | 81.01 % | Very practical | No revision |

The results of the practicality assessment through student response questionnaires were then analyzed so that an average value of 81.01% was obtained. Based on the practicality table criteria, the percentage of all equipment with this value is classified into the percentage criteria at 80-100% with the category "very practical" with the description "not revised".

The results of the practicality test that have been carried out have obtained a very practical category for both respondents from both teachers and students. So that it can be said that the learning tools, namely RPP, LKPD, and instruments about scientific literacy skills can be well received. This is in accordance with the results of research (Irmita & Atun, 2017) which states that combining learning tools with the TPACK approach with an appropriate learning model encourages students to find solutions to the challenges that students receive in their learning process.

The learning tools developed are expected to trigger an increase in students' scientific literacy scores as one aspect that is loved in the era of 21st century learning. Scientific literacy is recognized as one of the keys in facing various challenges of the 21st century. 21st century learning encourages students to be able to construct the knowledge they have acquired and solve scientific problems independently. Scientific literacy is not only about scientific skills but in a broad sense can penetrate the individual, national and even global spheres because it is related to things as simple as communication, it sounds simple but is quite crucial in its role in everyday life, especially in the academic sphere which is expected to be active in interacting. to support the advancement of knowledge. Learning carried out in the classroom generally uses the lecture method, the source of information is only based on the knowledge of the teacher, so that students do not dare to explore further their understanding through their own search process so that the value of students' scientific literacy is low because of the monotonous activity. Learning that is carried out with proper planning, such as using models and methods that follow the characteristics of the material to be delivered can have a positive impact on students (Wardani and Djukri, 2019).

## CONCLUSION

To support fun learning for students, learning tools need to be developed, before they can be used on a limited or wide scale, it is necessary to test product feasibility through validity testing. The value of the validity of the product RPP, LKPD, Science Literacy evaluation questions are 3.70; 3.42; and 3.50 with very valid category; valid; and valid with an average value of 3.54 validation results with a valid category. it can be concluded that the development of biology learning tools using the

TPACK framework with guided inquiry settings has met the valid requirements. In addition to validity, also in terms of the practicality of the learning tools that have been developed, the percentages are 84% (teachers' responses) and 81.01% (students' responses). The two percentages can be categorized as high because they are in the 80-100% range so it can be emphasized that the biology learning tools developed are valid and practical, then the learning tools can be widely used on condition that they need to go through an effectiveness test.

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