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The development of higher-order thinking skill-based immune system learning tools

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ABSTRACT

Learning tools can assist teachers in facilitating achievement during the learning process. At that time, the learning tools utilized still relied upon the pre-existing 2013 curriculum, lacking the incorporation of higher-order thinking Skills (HOTS) indicators for critical thinking skills, particularly in the context of immune system material. Therefore, research was conducted to create a learning tool immunity that was based on HOTS. The objectives of this study were as follows: 1) To analyze the requirement of HOTS-based biology learning tools in the immune system material for class XI in SMA/MA; 2) To design the product development for HOTS-based biology learning tools in class XI immune system material in SMA/MA; 3) To validating HOTS-based biology learning tool products in class XI immune system material in SMA/MA. This study employed the ADDIE (Analysis, Design, Development, Implementation, Evaluation) a model for instructional design. However, this research was conducted only up to the development stage of the ADDIE model. The sample comprised five experts and three practitioners, namely biology learning experts, lecturers' teachers, and language experts. The purposive sampling technique was employed in this research. The instruments used included product validation sheets and interview sheets. Data collection methods involved distributing product validation sheets and conducting interviews with validators. This research produces a HOTS-based immunity learning tool product which generally falls into the very valid category with a percentage of 94.56%. It means that the development product is valid for use in biology learning at the SMA/MA level.

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Keywords
Learning tools, Critical thinking skills, Immunity HOTS, Problem-based learning.

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INTRODUCTION

The rapid development in the present era requires students to adapt to changes. Education is one way that students can deal with changes over time. In contrast, students must possess a variety of competencies to succeed in 21st-century education. These competencies include critical thinking, problem-solving, collaboration, effective communication, and information and communication technology literacy (Agnafia, 2019). Selecting the appropriate and relevant learning resources is one method to accomplish these objectives through the learning process (Istiqah et al., 2021). This significantly influences how education is carried out, particularly in the development of learning and critical thinking abilities so that students can adjust and fulfill all the demands of the twenty-first century (Simbolon et al., 2022). Consequently, in the context of biology learning, a learning tool is

needed to facilitate the learning process to run effectively and efficiently (Rahayu & FX, 2015). Therefore, the preparation of the learning tools becomes a crucial responsibility for educators.

The planning of the learning process is one of the process standards outlined by Permendiknas Number 56 of 2013, mandating that educators in educational units must possess the ability to create learning tools. These tools are intended to assist students in developing high-level thinking skills particularly in the capacity for critical thinking (Sigit & Ahmad, 2021). This is in line with 21st-century goals, aiming to enhance the student's academic standards, particularly in biology classes by fostering critical thinking abilities (Istiqah et al., 2021). The requirements of the 2013 curriculum for biology instruction call for substantial adjustments to teaching strategies. This is because, in addition to emphasizing teachers' ongoing innovation in technique development, the teaching and learning process itself depends heavily on the availability of learning resources, which further support the biology learning process (Rahayu & FX, 2015).

Based on the findings of preliminary research analysis, which involved interviews at several schools in the Indramayu Regency, including SMAN 1 Krangkeng, SMAN 1 Indramayu, and SMAN 1 Kandanghaur—the most prestigious and excellent SMA schools—it was discovered that: 1) learning tools continue to be pre-existing tools; 2) learning tools are only modified when the curriculum and materials change; 3) HOTS (critical thinking skills) indicators are rarely included in newly created learning tools; and 4) HOTS (critical thinking skills) based questions are rarely created, particularly when it comes to immune system material.

In the meantime, critical thinking abilities are necessary for students to adjust to 21st-century changes. Indicators of critical thinking skills represent thought processes at the highest cognitive level according to Bloom's taxonomy (Siregar & Aghni, 2021). To enhance the standard of instruction and yield the best graduates, the Ministry of Education and Culture is currently developing a government program through the Directorate General of Teachers and Education Personnel (Ditjen GTK) that emphasizes the development of critical thinking abilities (Nursari et al., 2021). consequently, using learning resources that they have created, teachers' primary responsibility is to assist students in developing their critical thinking abilities (Rahmawati et al., 2022).

Maulidah (Istiqah et al., 2021) asserts that high-quality learning resources can help students acquire soft skills and life skills. Additionally, learning tools can support teachers in assisting students in reaching their learning objectives (Purnamasari & Nur Wangid, 2016). The development of effective, comprehensive, and methodical learning tools is the first step toward successful learning (Deviana & Kusumaningtyas, 2019). Because the government is currently implementing the 2013 curriculum to improve students' morals or ethics and another goal of having students have deep thinking abilities, it is necessary to develop HOTS-based learning tools for critical thinking skills (Jefri & Heniwati, 2020). In addition, students will be able to engage with the global community and compete on a worldwide basis (Sakti, 2019). So that students are able to adapt themselves to developments in the 21st century.

One of the topics addressed in biology classes in SMA/MA is the immune system, which was the main subject of this study. Sari et al (2017) revealed that Students regarded the content about the immune system to be challenging or complex. Aside from it, material connected to the environment and the person makes up the immune system. Based on this, for a successful learning

process, it is crucial to prioritize learning tools that can capture the interest of students in the immune system. Therefore the creation and updating of learning tools that stimulate students' critical thinking, are essential.

These issues served as the basis for the development of immune system learning tools. The product resulting from this development is a HOTS-based Lesson Plan on immune system material, learning media, and Learning Instruments.

METHOD

This study falls within the category of development research commonly referred to as R&D or research and development. The ADDIE model is the applied development model in this study. According to (Tegeh & Kirna, 2013), the stages for applying the R&D technique are as follows:

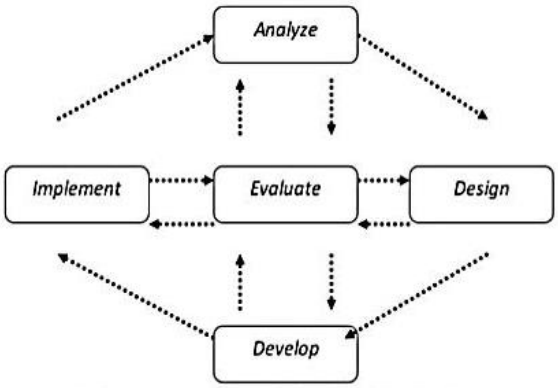

Figure 1 Flow Chart of R&D Method Steps

Because of time constraints, the stages used in this research were analysis, design, and development. Table 1 provides a description of the research phases.

Table 1: Detailed instructions for creating HOTS-based immunity learning tools

No	Development Procedure	Details
1.	Analysis	Need Analysis (field study)
2.	Design	1. Literature Study 2. Product Design
3.	Development	1. Product Creation 2. Lesson Plan Validation 3. PPT Media Validation 4. Learning Evaluation Instrument Validation 5. Product Revision 6. Final Product

The population of this study comprises individuals working as validators in the field of biology education. Purposive sampling was employed to select the research subjects as outlined by (Sugiyono, 2019). The Samples were collected based on the specific needs of the study, which included five experts and three practitioners. The experts included a language expert, a learning tools expert, a learning media expert, and two evaluation instrument experts. Additionally, three practitioners were included: a class XI biology teacher at SMAN 1 Kandanghaur, a class XI biology teacher at SMAN 1 Krangkeng, and a class XI biology teacher at SMAN 1 Indramayu. To ensure

objective validation results and a variety of data sources, validators were chosen from various regions.

The research instruments employed in this study included: 1) an unstructured interview sheet given to biology teachers, 2) a checklist sheet used to determine the completeness of the administrative components of learning tools in the field, 3) an expert validation sheet, and 4) Validity and Reliability Test on question items.

There are two types of data analysis methods employed in this study: 1) Qualitative: In three different schools in the Indramayu Regency, unstructured interviews were conducted to analyze initial needs regarding HOTS-based immunity learning tools. The validator also provided input and suggestions in the suggestion column of the validation sheet regarding the product. This resulted in the generation of qualitative data. 2) Quantitative data: scores from validators' assessments of learning tools comprise quantitative data. These scores are processed and analyzed in percentage form using the following formula, which is based on (Ngalim, 2020):

$$\% = \frac{Gained\ Score}{Total\ Score} x\ 100\% \quad (1)$$

Then a conversion to the achievement level scale is carried out to determine the level of product validity, which is as follows:

Table 2 Validity Level Qualifications Based on Percentage

Percentage (%)	Validity Level
81% - 100%	Very Valid
61% - 80%	Valid
41% - 60%	Fairly Valid
21% - 40%	Invalid
0% - 20%	Very Invalid

(Riduwan, 2015)

RESULT AND DISCUSSION

The initial step, referred to as a needs analysis, is conducted to determine the fundamental requirements of the industry concerning the elements of immune system learning tools that still require development. This is consistent with the viewpoint of Supadma et al (2019) who assert that the needs analysis must be taken into account while developing learning tools. To identify the fundamental issues encountered throughout the learning process, a syllabus analysis is conducted (Destiana, 2020). Unstructured interviews were conducted with biology instructors of class XI at multiple schools in Indramayu Regency, specifically SMAN 1 Krangkeng, SMAN 1 Indramayu, and SMAN 1 Kandanghaur, in order to acquire data for analysis. Table 3 displays the analysis's conclusions.

Table 5 shows the gathered information that learning tools employed in the classroom nowadays do not really assist students in enhancing their critical thinking abilities. Creating a sophisticated lesson plan centered on the students' HOTS is one step that can be taken to address this issue. A component of learning planning is selecting the learning model to be applied. PBL is one of the learning models that can boost students' HOTS.

Existing forms of learning tools have not trained students' critical thinking skills, while students' critical thinking skills are important in facing developments in the 21st century. This observation aligns with the findings of Diharjo et al., (2017) who claimed that critical thinking is a crucial skill that students should develop in order to increase their knowledge. The development of critical thinking abilities for students will encourage their use of cognitive reasoning to learn. Students must acquire critical thinking skills since they must come up with ideas for thinking about the problems they will be studying during the learning process, this is in line with Richmond J.E.D (Putri et al., 2019) who stated that critical thinking abilities can both be powerful tools that help Asian students be prepared to deal with the complicated issues that arise in today's advancements. It is undoubtedly impossible for us to meet the demands of these times without first undergoing training. It is possible to increase critical thinking abilities through thought training. Thus, in order for students to keep up with advancements in science and technology, a critical thinking skills-focused learning process through educational resources is required (Ainun, 2021).

Table 3 Data Result of HOTS-Based Immunity Learning Tools Product Analysis

No	Developed Components	Need Analysis (Field Study)
1.	Lesson Plan	The lesson plans that are being used are simply copies of pre-existing lesson plans; they do not employ the PBL learning model to foster critical thinking in students.
2.	Leaning Media (PPT Media)	The media that is frequently utilized in the educational process is PowerPoint media. The PPT material is still static, not interactive, with each slide displaying simple writing (all text), and it does not yet focus on developing students' critical thinking abilities.
3.	Evaluation Instruments	The developed evaluation tool does not yet foster HOTS-style critical thinking abilities and has a low level of difficulty (LOTS).

Problem-Based Learning (PBL) is a teaching strategy for fostering the development of students' critical thinking abilities. In addition, Chagas (dalam Maryam et al., 2018) assert that the development of PBL is necessary to enhance student engagement with real-world, meaningful problems. This approach not only enables students to solve problems but also learning facilities and gain meaning from the problems. Furthermore, in order to give students the opportunity to integrate both new and old knowledge, teachers encourage them to learn new material and concepts when they solve issues and blend theory and practice (Zainal, 2022). This implies that to make students able to think more clearly, solve problems, and be prepared for challenges in the future, they must always think critically in all areas where critical thinking abilities are crucial to development (Jawadiyah & Muchlis, 2021).

The planning stage for HOTS-based immunity learning tools is the second stage, which is called the design stage. The design step of creating tools of learning is predicated on data from the field requirements analysis, an examination of pertinent literature, an assessment of national education policy, and a consideration of scientific and technological advancements. According to Ennis (Ardiyanti, 2016) the design of this HOTS-based immunity learning tool adjusts to markers of critical thinking abilities.

The initial stages carried out in designing this HOTS-based immunity learning tool were literature study and analysis of field needs. The results of the literature study are to determine learning indicators that are appropriate to Core Competencies and Basic Competencies. These learning indicators are also adjusted to indicators of critical thinking skills. The next step is to design a HOTS-based immune system learning tool consisting of lesson plans, learning media (PPT media), and evaluation instruments. The following learning tools' product design can be seen in Table 4.

Table 4 Product Design of HOTS-Based Immunity Learning Tools

Product	Learning Tools Components	Design Structure (Content)
Learning Tools	Lesson Plan	The components of the Lesson plan are: 1. Lesson plan Identity. 2. Core Competence. 3. Indicators of Competency Achievement (IPK). 4. Learning objectives that use Bloom's taxonomy achievements C3, C4, and C5 5. Learning materials that are designed based on critical thinking indicators train the students to analyze the problems. 6. The learning model and method used is a constructivist model (PBL) which can train students' HOTS. 7. Media, tools, and learning resources. 8. Learning steps adapted to PBL syntax, consisting of: a. Pre - activity b. Whilst - activity c. Post - activity 9. Assessment of learning processes and outcomes using the HOTS assessment instrument
	Learning Media (PPT Media)	The components of PPT consist of: 1. The contents of the PowerPoint (PPT) contain relevant material (the material is presented in the form of literature review points, trigger questions, and contextual problems). 2. The images presented present the material and visualization of problems so that students are trained in analysis and prediction skills.
	Instruments/ Evaluation tools	The components of evaluation tools consist of: 1. Basic Competencies (KD). 2. Indicators of critical thinking skills. 3. Question indicators. 4. Bloom's taxonomy. 5. Immune system material. 6. Form the questions. 7. Answer key. 8. Scoring criteria.

At the development stage, every element of the learning tool will be created in draft form and verified by experts and practitioners.

Expert validators in respective disciplines obtain the validation results for the product validity assessment step. Likert scales with four scales are used in the validation tool. Table 5 displays the findings of the validation of HOTS-based immunity learning tool products by five experts and three practitioners.

Table 5 Data on Overall Results of Product Validation of HOTS-Based Immunity Learning Tools

No	Syllabus Products	Product Validation Result Data	
		Average (%) Scoring	Validity Criteria
1.	Lesson Plan Product	94,71%	Very Valid
2.	Learning Media Product (PPT Media)	95,83%	Very Valid
3.	Evaluation Assessment Product	95%	Very Valid
4.	Grammar of HOTS-Based Immunity Learning Tools Product	87,5%	Very Valid
	Average (%)Validity of the HOTS-Based Immunity Learning Tool	**93,26%**	**Very Valid**

Table 5 demonstrates that with an average validation score of 93.26%, the HOTS-based immunity learning tools meet the criteria for very good validation. This indicates that using the learning tools to study immune system materials is acceptable. Students should consider development and needs, systematicity and relevance, consistency, and coverage while creating learning resources (Rianti et al., 2020). Table 6 shows the Lesson Plan validation results in greater detail.

The validation process for the RPP learning tool involves assessing thirteen aspects, as indicated in Table 6. The overall Lesson plan learning tools generated achieved an average percentage of 94.71% with very valid criteria, according to the Lesson Plan validation results. This suggests that using the Lesson Plan learning tool product to study immune system content is acceptable.

The evaluation outcomes for every facet can be elaborated upon as follows: An average percentage of 87.5% was obtained using very valid criteria in the first aspect, completeness of identity, which comprises education unit, subject, class/semester, time allocation, and academic year. This is in line with research from (Shobirin et al., 2016) which claims that Minister of Education and Culture Regulation Number 103 of 2014 regulates the completeness component of the Lesson Plan identity. Along with recommendations for improvement from the validator, including that time allotment has to be modified by the curriculum and learning goals. With very valid criteria, the second aspect—the appropriateness between Competency Achievement Indicators, Core Competencies, and Basic Competencies—obtained an average percentage of 93.75%. This is in line with that research (Rindarti, 2018) indicates that Core Competencies, Basic Competencies, and Competency Achievement Indicators must exactly match.

With very valid criteria, the third aspect—Appropriateness between Competency Achievement Indicators (IPK), learning objectives, and evaluation tools—achieved an average percentage of 100%. This is in line with the view of (Rachmawati et al., 2020) which asserts that the Lesson Plan needs to include the following: learning objectives, learning materials, teaching and learning process, assessment tools, Competency Achievement Indicators, Core Competencies, and Basic Competencies. To develop students' high-level thinking abilities, the learning objectives in this instance are created utilizing targets from the updated Bloom's taxonomy levels, specifically C3, C4, and C5 (Tasrif, 2022). In order to construct a lesson plan that aligns with the intended curriculum and effectively meets the learning objectives, several interrelated elements must be considered. Appropriateness between the learning model, media, tools, and learning resources, as well as the

major content, received an average percentage of 87.5% using very valid criteria for the fourth component. This is consistent with research (Bararah, 2017) which claims that to prepare lesson plans effectively, a teacher must technically comprehend the Appropriateness of the primary content, learning model, media, tools, and learning resources.

Table 6 Percentage Data on Product Validation Results for Lesson Plan Learning Tools for HOTS-Based Immunity System Material

No	Rated Aspect	Total Score	Ideal Score	Percentage (%)	Criteria
1.	Identity includes: school, subject, class/semester, main material, and time allocation	14	16	87,5%	Very valid
2.	Appropriateness between Core Competencies (KI), Basic Competencies (KD), and Competency Achievement Indicators (IPK)	15	16	93,75%	Very valid
3.	Appropriateness between IPK, learning objectives, and assessment instruments	16	16	100%	Very valid
4.	Appropriateness between subject matter, learning models, media, tools, and learning resources	14	16	87,5%	Very valid
5.	The introductory section contains 6 components (opening and preparation, recording student attendance, apperception, motivating, conveying the title of the lesson, and conveying the learning objectives)	14	16	87,5%	Very valid
6.	Appropriateness between subject matter, apperception, and motivation	15	16	93,75%	Very valid
7.	Appropriateness between PBL 1 syntax, student learning activities, and teacher activities when teaching	16	16	100%	Very valid
8.	Appropriateness between PBL syntax, students' learning activities, and teacher activities when teaching	16	16	100%	Very valid
9.	Appropriateness between 3 PBL syntax, student learning activities, and teacher activities when teaching	15	16	93,75%	Very valid
10.	Appropriateness between 4 PBL syntax, student learning activities, and teacher activities when teaching	15	16	93,75%	Very valid
11.	Appropriateness between 5 PBL syntax, student learning activities, and teacher activities when teaching	15	16	93,75%	Very valid
12.	Closing activities include: 1) concluding the material; 2) reflecting/reinforcing learning material; 3) evaluating; 4) the teacher instructing students to read and understand the material that will be discussed at the next meeting; 5) closing	16	16	100%	Very valid
13.	Appropriateness of assessment to 1) technique; 2) form; dan 3) instrument	16	16	100%	Very valid
		197	**208**	**94,71%**	**Very valid**

The content covered in this Lesson Plan is connected to real-world issues, thus students must be able to recognize, evaluate, and resolve the issues when they arise (Widodo & Kadarwati, 2013). A

problem-oriented learning approach that aligns with the content being delivered is called problem-based learning (PBL) (Jumadi, 2018).

The fifth aspect, the introduction phase, comprises six components: opening and preparation, tracking attendance of students, perception, motivation, stating the lesson's title, and stating the learning objectives. Using very valid criteria, this section received an average percentage of 87.5%. Pre - activities include greeting, getting ready, keeping track of students' attendance, perceiving, inspiring, stating the lesson's title, and stating the learning objectives. These learning steps are connected to determine the process of learning (Permendikbud Number 103, 2013).

With very valid criteria, the sixth aspect—appropriateness between major material, perception, and motivation—obtained an average percentage of 93.75%. This is consistent with a study by Taorina et al., (2018) which emphasizes the need for motivation and perception to match the content being delivered. The seventh factor, the degree of appropriateness between PBL's syntax 1 and the learning activities of both students and teachers during instruction, received a perfect score an average of 100% using very valid criteria. With very valid criteria, the eighth aspect—the appropriateness of PBL 2 syntax with students' learning activities and teachers' activities during instruction—obtained an average percentage of 100%. With very valid criteria, the ninth aspect—the appropriateness between the three PBL syntax, the learning activities of the students, and the teacher's actions during instruction—obtained an average percentage of 93.75%. The tenth aspect, the appropriateness between the four PBL syntax, the learning activities of the students, and the teacher's actions during instruction, received an average score of 93.75% using very valid criteria. With very valid criteria, the eleventh aspect—the appropriateness of the five PBL syntax with the learning activities of the students and the teacher during instruction—obtained an average percentage of 93.75%. The appropriateness of the PBL learning model for syntax 1–5 concerning student and teacher activities during instruction is supported by Indriani et al., (2021) assertion that the lesson plans' introductory, core, and closing activities make use of the PBL learning model. from phase 1 to phase 5, the presentation must be clear and accordance with PBL syntax. The twelfth aspect, closing activities, which include summarizing the material, reflecting/reinforcing learning material, evaluating, the teacher instructs students to read and understand the material that will be discussed at the next meeting, and closing, an average percentage of 100% is obtained with very valid criteria. This is in accordance with research from Sani, (2016) which states that in carrying out lesson-closing activities, the teacher will conclude the material from what has been explained, evaluate, and follow up. With an average percentage of 100%, the thirteenth aspect—Appropriateness of assessment with methodologies, forms, and instruments—is a very valid criterion. This corresponds with Kamilati, (2018) assertion that effective assessment planning is the foundation for effective assessment outcomes. To measure students' HOTS skills, the evaluation tool is based on critical thinking indications.

Three aspects are evaluated for the validation of PPT media learning tools, as shown in Table 7. The PPT media validation findings demonstrate that, when taken as a whole, the created PPT media learning tools achieved an average percentage of 95.83% using very valid criteria. This indicates that the HOTS-based immunity learning process can be aided by the usage of the PPT media learning tool product. According to (Suartawan et al., 2021) the utilization of interactive learning

resources based on PowerPoint can improve learning by streamlining the process and fostering a favorable environment.

Table 7 Percentage Data on Product Validation Results for PPT Media Learning Tools for HOTS-Based Immunity System Material

No	Rated Aspect	Total Score	Ideal Score	Percentage (%)	Criteria
1.	Appropriateness between syllabus, lesson plan, and PPT on immune system material	16	16	100%	Very Valid
2.	Appropriateness between the contents of the ppt containing the main material (according to research needs), questions on the LKPD, and learning activities	14	16	87,5%	Very Valid
3.	Appropriateness between PPT content, indicators of critical thinking skills, and learning activities	16	16	100%	Very Valid
		46	**48**	**95,83**	**Very Valid**

The following is a detailed description of each aspect's assessment results: Concerning the first factor—the degree of appropriateness between the immune system content and the syllabus, RPP, and PPT—an average of 100% was attained using very valid criteria. This is in line with the study by Andriani et al., (2021) which claims that while selecting media, teachers must take into account several aspects, including the syllabus, lesson plans, learning objectives, and teaching materials, as well as the characteristics of the students and the costs involved. In the meantime, an average percentage of 87.5% using very valid criteria was reached for the second element, which is the appropriateness between the questions on the student's worksheet, learning activities, and the major material contained in the PowerPoint presentation (as per study goals). The PPT's material has been tailored to research, with key quotes from the literature, images that highlight issues, and thought-provoking questions to help students develop their identification, analysis, and prediction skills.

According to Pratama et al., (2022) to create high-quality media that is appropriate for its intended use and purpose, PowerPoint (PPT) media must consider the appropriateness of its components. According to Pramesti, (2021) the presentation of content or material that is suited for learning activities can result in high-quality PPT media. Additionally, a very valid criterion yielded an average percentage of 100% in the third aspect—the appropriateness of the PPT material, signs of critical thinking abilities, and learning activities. This is consistent with a study by Asminah et al., (2022) that shows PowerPoint is an interactive tool that uses markers of critical thinking abilities to generate learning activities that meet learning goals.

Four factors are evaluated as part of the validation of the assessment instrument learning tool, as shown in Table 8. The assessment instrument learning tool as a whole received an average percentage of 95% with very valid criteria, according to the evaluation instrument validation results. This indicates that the HOTS-based immunity learning process can be facilitated by using the assessment instrument learning tool product.

The following is a detailed description of each aspect's assessment results: The first element, which measured the degree of appropriateness between the questions' format, content, and markers of critical thinking abilities, yielded an average percentage of 100% using very reliable criteria. This is consistent with the assertion made by Jazuli, (2015) that the assessment of critical thinking skills

is the primary feature of an effective assessment instrument. This is determined by how well the content is suited and how the questions are structured to showcase critical thinking skills With very valid criteria, the second factor—the appropriateness of the questions, critical thinking skill indicators, and the updated Bloom taxonomy—obtained an average percentage of 90%. This is in line with research by Mudaningrat et al., (2022) which claims that the revised Bloom taxonomy, indicators of critical thinking abilities, and question appropriateness are crucial as a reference for determining students' cognitive levels to meet learning objectives.

Table 8 Percentage Data on Product Validation Results for HOTS-Based Immune System Material Evaluation Instrument Learning Tools

No	Rated Aspect	Total Score	Ideal Score	Percentage (%)	Criteria
1.	Appropriateness between indicators of critical thinking skills, material, and form of questions	20	20	100%	Very Valid
2.	Appropriateness between questions, indicators of critical thinking skills, and the revised Bloom's taxonomy	18	20	90%	Very Valid
3.	Appropriateness between questions, answer keys, and scoring criteria	19	20	95%	Very Valid
4.	Completeness of assessment instruments (grid, questions, and value processing methods)	19	20	95%	Very Valid
		76	**80**	**95,83**	**Very Valid**

With very valid criteria, the third factor—the appropriateness of the questions, answer keys, and scoring criteria—obtained an average percentage of 95%. This is in line with a study by Fanani, (2018) that claims that to create contextual questions, you must adhere to the question grid, scoring guidelines (rubric), answer key, and scoring criteria while composing questions. With very valid criteria, the fourth aspect—the completeness of the assessment instruments—grid, questions, and value processing methods—obtained an average percentage of 95%. This is in line with the study by Subkhi et al., (2022) which claims that the first steps in designing an assessment tool include syllabus analysis, question creation, and scoring. According to Kadir, (2015) carefully designed questions make use of the syllabus, organize grids, and assign points. According to Uneputty et al., (2022) creating assessment tools that adhere to the scoring rules and assessment grid, following assessment procedures, and utilizing assessment criteria as a guide can all help students succeed in gaining competency.

CONCLUSION

The need analysis for HOTS-Based immunity learning tools in Class XI at SMA/MA covers several requirements in the learning process: 1) The lesson plan used in the classroom is only copied from the existing 2013 Curriculum lesson plan, there is no Problem-Based Learning model in the lesson plan to train students' critical thinking; 2) PowerPoint (PPT) media is a media that is frequently used in the learning process, but the PPT media used is still monotonous in that each slide only displays all text and does not yet lead to critical thinking skills in students; and 3) The evaluation instrument created has a Low Level of Difficulty (LOTS) and does not yet lead to HOTS type of critical

thinking skills. The product development for the HOTS-based immunity learning tools for SMA/MA class XI is summarized in three components: 1) Lesson Plan; 2) PPT media; and 3) evaluation instruments. The validation of HOTS-based immunity learning tool solutions for class XI typically falls under the category of "very valid". This indicates that the learning tools are suitable for the used in SMA/MA school level. It would be preferable if the verified HOTS-based immunity learning tools for class XI in SMA/MA were carried over to the next phase, all the way to the evaluation step.

REFERENCES

Agnafia, N. D. (2019). Analisis kemampuan berpikir kritis siswa dalam pembelajaran biologi. *Florea*, 6(1), 45-53.

Ainun, N. A. (2021). *Validasi instrumen penilaian terintegrasi keterampilan berpikir kritis, keterampilan berpikir kreatif, dan hasil belajar kognitif biologi*.

Ardiyanti, Y. (2016). Berpikir kritis siswa dalam pembelajaran berbasis masalah berbantuan kunci determinasi. *JPI (Jurnal Pendidikan Indonesia)*, *5*(2), 193. https://doi.org/10.23887/jpi-undiksha.v5i2.8544

Asminah, A., Ningsih, K., & Wahyuni, E. S. (2022). Pengembangan perangkat pembelajaran berbasis problem based learning terhadap kemampuan berpikir kritis siswa. *Jurnal Penelitian Sains Dan Pendidikan (JPSP)*, *2*(2), 113–124. https://doi.org/10.23971/jpsp.v2i2.4020

Bararah, I. (2017). Efektifitas perencanaan pembelajaran dalam pembelajaran pendidikan agama islam di sekolah. *Jurnal MUDARRISUNA*, *7*(1), 131–147.

Deviana, T., & Kusumaningtyas, D. I. (2019). Analisis kebutuhan penyusunan perangkat pembelajaran tematik berbasis HOTS (higher of order thinking skills) pada kurikulum 2013 di SD Muhammadiyah 05 Batu. *Edumaspul: Jurnal Pendidikan*, *3*(2), 64–74. https://doi.org/10.33487/edumaspul.v3i2.141

Diharjo, R. F., Budijanto, & Utomo, D. H. (2017). Pentingnya kemampuan berfikir kritis siswa dalam paradigma pembelajaran konstruktivistik. *Prosiding TEP & PDs*, *4*(39), 445–449.

Eni. (1967). 済無No Title No Title No Title. *Angewandte Chemie International Edition, 6(11), 951–952.*, *2*(Mi), 5–24.

Fanani, M. Z. (2018). Strategi pengembangan soal HOTS pada kurikulum 2013. *Edudeena*, *2*(1), 57–76. https://doi.org/10.30762/ed.v2i1.582

Indriani, Y., Sripatmi, S., Arjudin, A., & Subarinah, S. (2021). Kemampuan mahasiswa Program Studi Pendidikan Matematika FKIP Universitas Mataram dalam membuat RPP dengan menerapkan model problem based learning. *Griya Journal of Mathematics Education and Application*, *1*(4), 490–501. https://doi.org/10.29303/griya.v1i4.112

Istiqah, W., Agustini, R., & Budijastuti, W. (2021). Pengembangan perangkat pembelajaran IPA menggunakan model PBL (problem based learning) pada materi sistem pencernaan manusia untuk meningkatkan keterampilan berpikir kritis peserta didik di SMPN 02 Suboh. *Jurnal Education and Development*, *9*(2), 237–243.

Jawadiyah, A. A., & Muchlis. (2021). Pengembangan LKPD berbasis problem based learning untuk melatihkan keterampilan berpikir kritis pada materi larutan penyangga. *UNESA Journal of Chemical Education*, *10*(2), 195–204.

Jazuli, M., & S. W. (2015). Pengembangan alat evaluasi IPA terpadu topik perubahan materi berbasis kontekstual untuk mengukur kemampuan berpikir kritis siswa. *Unnes Science Education Journal*, *4*(2), 912–918.

Jefri, J., & Heniwati, Y. (2020). Pembuatan perangkat pembelajaran Tari Melayu berbasis high Order thinking skills (HOTS) untuk siswa/i kelas VIII SMP Negeri 1 Tanjung Tiram. *Gesture: Jurnal Seni Tari*, *9*(1), 128. https://doi.org/10.24114/senitari.v9i1.18749

Jumadi, O. (2018). Penerapan model problem based learning (PBL) dalam meningkatkan kemampuan berpikir kreatif dan hasil belajar siswa. *Prosiding Seminar Nasional Biologi Dan Pembelajarannya*, 257–262.

Kamilati, N. (2018). Analisis komponen penilaian pada rencana pelaksanaan pembelajaran sebagai acuan pengembangan kurikulum diklat teknis substantif guru. *EDUKASI: Jurnal Penelitian Pendidikan Agama Dan Keagamaan*, *16*(1), 1–17. https://doi.org/10.32729/edukasi.v16i1.440

Maryam, A., Raharjo, & Purnama, E. R. (2018). Validitas lembar kegiatan peserta didik berbasis problem based learning pada materi sistem peredaran darah untuk melatihkan keterampilan proses. *BioEdu Berkala Ilmiah Pendidikan Biologi*, *7*(2), 201–209.

Mudaningrat, A., Partaya, P., & Yulianti, D. (2022). *Analisis kesesuaian soal evaluasi pembelajaran biologi SMA ditinjau berdasarkan tipe HOTS (high order thinking skills) menggunakan taksonomi bloom*. 50–57.

Nursari, E. V., Setiawati, I., & Lismaya, L. (2021). Analisis perangkat pembelajaran berbasis higher order thinking skill (HOTS) di masa pandemi Covid-19. *ALVEOLI: Jurnal Pendidikan Biologi*, *2*(2), 78–97. https://doi.org/10.35719/alveoli.v2i2.52

Pratama, I. P. A., Sujana, I. W., & Ganing, N. N. (2022). Media pembelajaran interaktif berbasis project based learning pada materi keanekaragaman suku bangsa di Indonesia. *Jurnal Imiah Pendidikan Dan Pembelajaran*, *6*(2), 317–329. https://doi.org/10.23887/jipp.v6i2.47377

Purnamasari, V., & Nur Wangid, M. (2016). Pengembangan perangkat pembelajaran berbasis scientific approach untuk membangun karakter kepedulian dan kedisiplinan. *Jurnal Pendidikan Karakter*, *7*(2), 167–180. https://doi.org/10.21831/jpk.v6i2.12047

Putri, O. D., Nevrita, N., & Hindrasti, N. E. K. (2019). Pengembangan instrumen penilaian keterampilan berpikir kritis siswa SMA pada materi sistem pencernaan. *BIOEDUKASI (Jurnal Pendidikan Biologi)*, *10*(1), 14. https://doi.org/10.24127/bioedukasi.v10i1.2004

Rachmawati, A., Pristiwati, R., & Wagiran, W. (2020). Analisis keselarasan antar komponen RPP pada materi teks prosedur kelas VII SMP. *Linguista: Jurnal Ilmiah Bahasa, Sastra, Dan Pembelajarannya*, *4*(1), 62. https://doi.org/10.25273/linguista.v4i1.6378

Rahayu, R., & FX, E. W. L. (2015). Pengembangan perangkat pembelajaran IPA berbasis problem based learning di SMP. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *45*(1), 29–43.

Rahmawati, M., Ansori, H., & Suryaningsih, Y. (2022). Pengembangan lembar kerja peserta didik elektronik berbasis HOTS melalui pendekatan realistik berbantukan liveworksheet materi sistem persamaan linear dua variabel tingkat SMP. *Jurmadikta*, *2*(2), 26–37. https://doi.org/10.20527/jurmadikta.v2i2.1232

Rindarti, E. (2018). Improvement teacher competence in developing RPP on the 2013 curriculum 2017 revision through accompaniment of sustained in MA Target Central Jakarta Town lesson 2017/2018. *Jurnal Penelitian Kebijakan Pendidikan*, *11*(2), 1–19.

Sakti, I. (2019). *Implementasi model perangkat pembelajaran berorientasi HOTS (high order thinking skills) dan pendidikan karakter melalui PBL (problem based learning) pada mata kuliah fisika dasar*. *VIII*(3), SNF2019-PE-389–400. https://doi.org/10.21009/03.snf2019.01.pe.50

Sani, M. (2016). Kegiatan menutup pelajaran. *Journal of Accounting and Business Education*, *1*(3). https://doi.org/10.26675/jabe.v1i3.6031

Sari, S. L., Widyanto, A., & Kamal, S. (2017). Pengembangan media pembelajaran berbasis video animasi dalam smartphone pada materi sistem kekebalan tubuh manusia untuk siswa kelas XI di SMA Negeri 5 Banda Aceh. *Jurnal Prosiding Seminar Nasional Biotik*, *4*(1), 476–485.

Setiyaningsih, A., Yuwono, M. R., & Wijayanti, S. (2022). Analisis kelengkapan LKPD sebagai media pembelajaran matematika peserta didik. *Jurnal Ilmiah Kependidikan*, *1*(2), 42–47.

Shobirin, M., Rachmadiarti, F., & Isnawati. (2016). Analisis kesesuaian rencana pelaksanaan pembelajaran (RPP) yang dikembangkan guru dengan kurikulum 2013 pada materi virus kelas X SMA. *BioEdu: Berkala Ilmiah Pendidikan Biologi*, *5*(3), 406–410.

Sigit, S., & Ahmad, H. (2021). *Jurnal Ilmiah Profesi Pendidikan Pengembangan perangkat pembelajaran model core untuk*. *6*(4), 800–806.

Simbolon, J., Nasution, H., & Simanjorang, M. (2022). pengembangan perangkat pembelajaran berbasis HOTS menggunakan model pembelajaran contextual teaching learning untuk meningkatkan kemampuan critical thinking dan self-confidence. *Jurnal Cendekia : Jurnal*

Pendidikan Matematika, *6*(3), 2498–2514. https://doi.org/10.31004/cendekia.v6i3.1486

Siregar, M. N. N., & Aghni, R. I. (2021). Pengembangan perangkat pembelajaran berbasis problem based learning (PBL) untuk meningkatkan higher order thinking skill (HOTS). *Jurnal Pendidikan Akuntansi (JPAK)*, *9*(2), 292–301. https://doi.org/10.26740/jpak.v9n2.p292-301

Subkhi, N., Lesy Luzyawati, & Kusumaningrum, R. S. (2022). Development of inquiry based-metacognitif skills on water pollution materials for high school. *Mangifera Edu*, *6*(2), 98–114. https://doi.org/10.31943/mangiferaedu.v6i2.132

Supadma, I. K., Kusmariyatni, N. N., & Margunayasa, I. G. (2019). Jurnal riset pendidikan dasar development of learning tools guided inquiry based on HOT. *Jurnal Riset Pendidikan DAsar*, *02*(2), 106–115.

Taorina, R. M., Chandra, T. D., Sisworo, & Parta, I. N. (2018). Pengetahuan calon guru matematika tentang kurikulum 2013 dalam penyusunan RPP. *Jurnal Pendidikan: Teori, Penelitian Dan Pengembangan*, *3*(12), 1520–1529.

Tasrif, T. (2022). Higher Order Thinking Skills (HOTS) dalam pembelajaran social studies di sekolah menengah atas. *Jurnal Pembangunan Pendidikan: Fondasi Dan Aplikasi*, *10*(1), 50–61. https://doi.org/10.21831/jppfa.v10i1.29490

Tegeh, I. M., & Kirna, I. M. (2013). Pengembangan bahan ajar metode penelitian pendidikan dengan ADDIE model. *Jurnal IKA*, *11*(1), 16.

Uneputty, V. C., Huliselan, E. K., & Malawau, S. (2022). Analisis standar perencanaan penilaian, kaidah penulisan soal dan kriteria butir soal pilihan ganda tes sumatif fisika kelas X pada SMA Kristen 1 Amahai, Kabupaten Maluku Tengah. *Physikos Journal of Physics and Physics Education*, *1*(1), 38–45.

Volkers, M. (2019). No TitleΕΛΕΝΗ. *Αγαη*, *8*(5), 55.

Widodo, T., & Kadarwati, S. (2013). To improve learning achievement. *Cakrawala Pendidikan*, *32*(1), 161–171.

Zainal, N. F. (2022). *Jurnal basicedu*. *6*(3), 3584–3593.