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Research Artikel

DEVELOPING TEACHING GUIDES FOR BIOLOGY-BASED COURSES: INTEGRATING PROJECT-BASED LEARNING, CASE STUDIES, AND 21ST CENTURY SKILLS FOR PRE-SERVICE TEACHERS

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Abstract

This study aims to develop teaching guides for biology-based courses, including Microbiology, Plant Anatomy, and Agribusiness, designed for pre-service teachers. These guides integrate project-based learning and case studies to cultivate 21st-century skills. Using the ADDIE model (Analyze, Design, Development, Implementation, Evaluation) within a Research and Development (R&D) framework, the guides were systematically developed and evaluated. Results show high feasibility, with average scores of 97% for content appropriateness, 95% for presentation quality, and 100% for language clarity, demonstrating their validity, practicality, and effectiveness.

Keywords*: Biology courses; case study; microbiology; teaching guide, project learning.*

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INTRODUCTION

Today's world changes are very fast and complex. To keep up with these changes, skills are needed that can adapt quickly and successfully in today's digital and globalization era. 21st century skills are skills that are considered important to have in today's modern world of work and life. 21st century skills, also referred to as soft skills (Aparecio et al., 2024) which are also defined as skills that involve thinking (creativity and innovation, critical thinking, problem solving, decision making), working with others (eg, communication, collaboration), use of tools (information technology literacy), and general life skills (Binkley et al., 2014). Students must develop a foundation of these skills to prepare for the workplace (Rios et al., 2020).

Project-based learning and case studies oriented to 21st century skills are both closely related to the development of 21st century skills (Doppelt, 2003; Yusup et al., 2022). Project-based learning involves students in real projects that require them to apply the knowledge and skills they have learned. Meanwhile, case studies provide students with the opportunity to learn subject matter through case analysis related to the topic being studied (Yin, 2017). Project-based learning and case studies oriented to 21st century skills require students to collect information, analyze data, and solve problems that help students develop critical thinking skills. These activities are also often carried out in groups that help students develop collaboration skills and communicate effectively with fellow group members and with teachers, and increase students' sustainability awareness (Woodward & Ceccucci, 2010; Nurazizah et al., 2024)). In project-based learning, students can explore new ideas and create creative solutions to problems given, thereby developing creativity skills. This learning process often involves the use of technology such as the internet, software, and multimedia equipment that develop technological skills (Bell, 2010). Thus, project-based learning and case study-oriented 21st century skills can help students to develop 21st century skills needed for future success.

In the process of its application, biology learning can be more interesting and effective by using project-based learning and case studies oriented to 21st century skills (Sapawer, 2023). In project-based learning, students can be given projects to create models of certain plants, animals or microorganisms. In case studies, students analyze problems related to organisms and their environment. Both approaches can help students understand biological concepts better and also develop skills such as critical, analytical, and creative thinking which are part of 21st century skills.

Project-based learning and case study-oriented teaching guides for 21st century skills are one of the learning guides that develop students' problem-solving skills and critical thinking skills. This learning approach places students at the center of learning and learns subject matter through real experiences in relevant situations through group activities, thus optimizing students' communication skills. Through this teaching guide, it is hoped that students' 21st century skills can develop well. Critical thinking and problem-solving skills, communication skills, collaboration skills, and creativity skills are evidence to appear and have a future to be more developed during each stage of the Project-based learning learning process (Suryaningsih et al., 2024)

This study offers an innovative approach to developing teaching guides oriented to 21st century skills by integrating two well-known learning models, namely Project-Based Learning (PjBL) and Case-Based Learning (CBL). This approach is innovative since the study incorporates two active learning techniques into a guideline that optimizes their respective benefits rather than just combining them. While CBL offers real-world scenarios that enable students to assess events and make important judgments, PBL, which focuses on long-term projects, gives students the chance to delve into complicated challenges (Sutrisno & Syukur, 2023). This combination produces a guide that supports holistic learning, where students can develop problem-solving, critical thinking, and in-depth analysis skills simultaneously.

Furthermore, the created teaching guidelines not only focus on academic accomplishment but are also aimed to build critical 21st century abilities such as creativity, teamwork, communication, and

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digital literacy (Pohan et al., 2023). This study demonstrates how PBL and CBL integration may be specially tailored to develop these abilities, which are crucial in the global and digital world of today (Ghafara et al., 2023). The recommendations derived from this study provide a method that requires little modification and may be used immediately in the classroom. This guideline functions as a versatile tool that can be applied to a range of educational levels and disciplines by offering pertinent case studies and projects that can be customized to fit diverse educational contexts.

Although there is a substantial amount of literature discussing PBL and CBL separately, research that specifically combines these two methods into a teaching guideline for developing 21st century skills is still quite limited. Some research gaps in this study include: first, most existing research tends to focus on the individual application of PBL or CBL without considering the synergistic potential of their integration. PBL is often used for long-term projects that require teamwork and problem-solving, while CBL is typically used to understand specific cases or scenarios in depth. By creating a guideline that integrates both approaches, this study fills that gap and offers a more comprehensive and organized style of instruction focused on practical skills. Second, a lot of current teaching recommendations continue to emphasize traditional cognitive accomplishments like technical skills and theoretical knowledge. However, learning designs often ignore or fail to specifically include 21st century abilities like critical thinking, communication, and teamwork (Wijaya, 2023). This study explicitly designs a guide that aims to develop these skills, making it relevant to the needs of today's increasingly complex and digitally connected education; and these three studies also contribute by providing a guide that is responsive to the dynamics of change in the world of education, where teaching methods must continue to evolve to meet the demands of the modern world of work and society (Lubis et al., 2023). The combination of PBL and CBL offered in this guide is designed to support the development of skills needed in uncertain and challenging situations, such as those often faced by students in the 21st century. The above aspects underline the innovative aspects and significant contributions of this study to the development of teaching guides that are relevant to the demands and challenges of education in the modern era.

METHOD

The research method used in this study is Research and Development (R&D) with an ADDIE approach (Analyze, Design, Development, Implementation, Evaluation) (Hidayat, F., & Nizar, M., 2021; Ni'mah, 2014). This method aims to develop teaching guidelines that include learning tools, student worksheets, and evaluation instruments based on project-based learning and case studies oriented towards 21st century skills in the biology topics of Microbiology, Plant Anatomy, and Agribusiness. The guidelines qualify well by considering two feasibility components: content feasibility and design feasibility, each encompassing two quality aspects: validity and practicality, as well as effectiveness.

This study is a component of a development project that aims to provide lecturers with teaching guidelines that include learning resources, student worksheets, and assessment tools based on project-based learning and case studies focused on 21st century skills. Its specific goal is to help students develop 21st century abilities, which include collaboration, communication, critical thinking and problem solving, creativity, and innovation. With a methodical flow of activities, this development technique is built to address learning challenges pertaining to learning materials that cater to learners' requirements and characteristics, especially with reference to 21st century abilities. According to Lodico et al. (2006) and Lodico, M., Spaulding, D. & Voegtle (2010), this development design consists of five stages: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation (Ni'mah, 2014). Visually, these ADDIE stages can be seen in Figure 1.

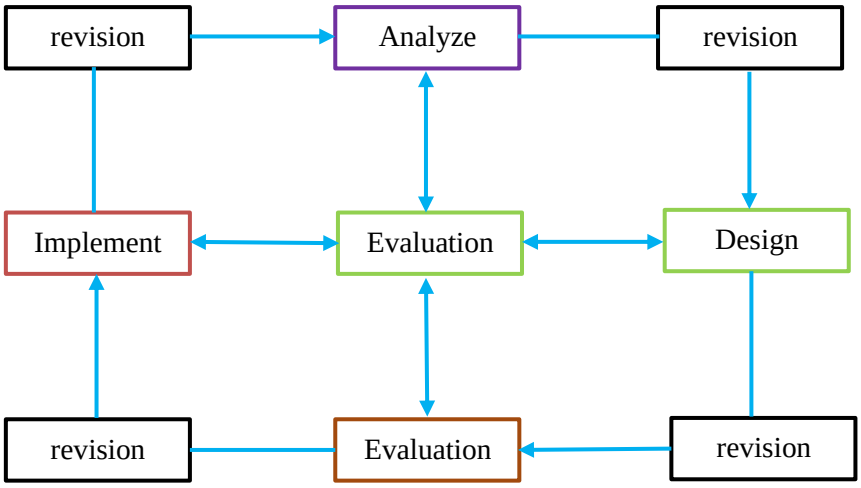

Figure 1. ADDIE Design

Analyze

The main activity is to analyze the need for the development of new learning tools, namely project-based learning teaching guides and case studies oriented to 21st century skills in Biology courses in the form of learning tools, Student activity sheets, evaluation instruments to analyze the feasibility and requirements for developing learning tools. The development of new learning tools begins with problems in terms of sources/teaching materials or learning strategies that have been implemented. After analyzing the problem of the need to develop new learning tools, researchers also need to analyze the feasibility and requirements for developing these new learning tools. In this analysis, there should not be a design for learning tools in the form of project-based learning teaching guides and case studies oriented to 21st century skills that are good but cannot be implemented due to several limitations. Analysis of new learning tools in the form of project-based learning teaching guides and case studies oriented to 21st century skills needs to be done to determine the feasibility if they are later implemented. The final activity of this analysis stage is to revise for improvements.

Design

The design stage is similar to designing a learning device product. This activity is a systematic process that includes the content and construction of learning devices in the form of project-based learning guides and case studies oriented to 21st century skills starting from setting learning objectives, designing scenarios or teaching and learning activities, designing learning materials, activity sheets and learning outcome evaluation tools in the developed learning device. The design of this learning device product is still conceptual and will underlie the next development process. At this design stage, researchers also collaborate or ask for advice and input, even services from experts for consultations related to product design. The final activity of this design stage is to revise for improvements.

Development

The Development Stage in ADDIE design contains the activities of realizing the design of learning device products in the form of project-based learning teaching guides and case studies oriented to 21st century skills which include lesson plans, student activity sheets, and evaluation tools. The conceptual and construction frameworks have been prepared at the design stage. At the

 | p-ISSN 1979-7281 | e-ISSN 2443-1281

development stage, the framework that is still conceptual is realized into a product that is ready to be implemented. Activities carried out at the development stage include: (a) collecting materials, (b) formulating and compiling learning device products in the form of project-based learning teaching guides and case studies oriented to 21st century skills from lesson plans, student activity sheets, and evaluation tools, (c) independent testing, (d) distribution, and (e) expert trials. At the development stage, several activities are carried out such as: searching and collecting various relevant sources to enrich the content, creating learning scenarios, student worksheets, evaluation tools that are in accordance with project-based learning experiences and case studies oriented to 21st century skills. In addition, at this development stage, activities are carried out to validate the draft of the development product and revisions after input from experts (judges), namely expert validators of learning devices, expert validators of materials, and expert validators of teaching practitioners. So at the development stage, assessment instruments are also prepared to test the components of content feasibility and design feasibility including validation aspects and aspects of practicality and product effectiveness. The final activity of this development stage is to revise for improvements.

Implementation

At this stage, the design of the learning device product in the form of a teaching guide based on project learning and case studies oriented to 21st century skills and the methods that have been developed are implemented. During implementation, the design of the new learning device product that has been developed is applied to actual conditions. At this stage, the results of the development are applied, namely assessed by experts (Judgement experts), namely expert validators of learning devices, expert validators of materials, and expert validators of teaching practitioners and users (students) to get responses and determine its effectiveness in learning. The implementation is carried out in small groups to get input from students as users and experts/judgers, namely expert validators of learning devices, expert validators of materials, and expert validators of teaching practitioners as material for improving the product draft. After the implementation stage, an initial evaluation is carried out to provide feedback on the use of the feasibility of the next product.

Evaluation

After implementation, the design of the learning device product in the form of a project-based learning teaching guide and a 21st century skills-oriented case study that has been developed is applied to actual conditions, namely a limited-scale trial on users, namely students. Evaluation is carried out to provide feedback on the implementation of the learning device product in the form of a project-based learning teaching guide and a 21st century skills-oriented case study. In this study, only an initial evaluation was carried out, because this type of evaluation is related to the development research stage to improve the resulting learning device development product. Evaluation in the development research design with the ADDIE approach is carried out step by step to collect data at each stage used for refinement or revision so that the quality of the new learning product learning device in the form of a project-based learning teaching guide and a 21st century skills-oriented case study is known. The final results of this evaluation stage are analyzed to determine the overall quality of the product including 1) content feasibility components and 2) design feasibility, in a) validation aspects and b) aspects of practicality and product effectiveness.

RESULTS AND DISCUSSIONS

The final output is a teaching guide that covers language evaluation, presentation feasibility, and topic feasibility with an emphasis on 21st century skills. It is based on project-based learning and case studies. You can view the product in Figure 2.


BAB 2

Pembelajaran Biologi Berbasis Proyek

Pembelajaran Biologi berbasis proyek (*Project-Based Learning* atau PBL) merupakan pendekatan yang melibatkan pembelajar dalam penyelesaian suatu proyek yang relevan dengan topik Biologi tertentu. Pendekatan ini mengedepankan pembelajaran aktif, yang memfasilitasi pembelajar untuk belajar melalui pengalaman langsung dan penerapan pengetahuan dalam konteks dunia nyata. PBL mendorong pembelajar untuk berpikir kritis, berkolaborasi, dan mengembangkan keterampilan praktis yang akan berguna dalam kehidupan sehari-hari.

Salah satu alasan mengapa PBL sangat efektif dalam pembelajaran Biologi adalah karena topik-topik dalam Biologi sering kali abstrak dan kompleks. Dengan PBL, pembelajar dapat melakukan eksperimen, observasi lapangan, atau penelitian yang berhubungan langsung dengan fenomena biologis. Hal ini memungkinkan mereka untuk memahami konsep-konsep yang sulit dipahami hanya melalui teori. Misalnya, mereka dapat melakukan penelitian tentang keberagaman spesies dalam


BAB 3

Pembelajaran Biologi Berbasis Studi Kasus

Pembelajaran Biologi berbasis studi kasus adalah pendekatan pembelajaran yang memanfaatkan analisis kasus nyata untuk membantu pembelajar memahami dan mengaplikasikan konsep-konsep Biologi dalam situasi dunia nyata. Pendekatan ini mengutamakan pemecahan masalah yang kompleks melalui investigasi mendalam terhadap kasus-kasus yang relevan dengan topik-topik Biologi tertentu. Dengan menggunakan studi kasus, pembelajar tidak hanya mempelajari teori, tetapi juga terlibat aktif dalam proses berpikir kritis, analisis, dan pengambilan keputusan berdasarkan data yang ada.

Studi kasus dalam pembelajaran Biologi dapat mencakup berbagai isu aktual, seperti dampak perubahan iklim terhadap keanekaragaman hayati, masalah kesehatan terkait penyakit menular, atau penerapan bioteknologi dalam pertanian. Pembelajaran berbasis studi kasus ini memungkinkan pembelajar untuk menghubungkan pengetahuan teori dengan realitas yang terjadi di lapangan, membuatnya lebih relevan dan menarik. Seperti yang diungkapkan oleh Herreid (1998), studi kasus dapat


LEMBAR KERJA MAHASISWA (LKM)
BERBASIS PROYEK

Mata Kuliah : Genetika
Tingkat / Semester : II / 1 (Ganjil)
Topik : Materi Genetik dan Pengaturan Ekspresi Gen

Capaian Pembelajaran
- Menganalisis struktur dan fungsi materi genetik makhluk hidup dan mekanisme pengaturan ekspresi gen
- Merancang proyek media representatif tentang struktur, fungsi, dan mekanisme pengaturan ekspresi gen

Prosedur Kegiatan
Setelah menyimak penayangan video pembelajaran tentang struktur dan fungsi materi genetik dan mekanisme pengaturan ekspresi gen, rancanglah sebuah proyek berkaitan dengan media representasi yang dapat dipilih tentang materi struktur dan fungsi materi genetik dan mekanisme pengaturan ekspresi gen sesuai hasil identifikasi masalah yang ditentukan dalam penayangan video pembelajaran!

1. Identifikasi Masalah
Pelajarilah materi tentang struktur dan fungsi materi genetik dan mekanisme pengaturan/regulasi ekspresi gen melalui video pembelajaran yang dapat disimak melalui scan barcode berikut:

Barcode 1 Barcode 2 Barcode 3

Berdasarkan tayangan video diatas, identifikasilah masalah yang terkait konsep struktur dan fungsi materi genetik dan mekanisme pengaturan ekspresi gen. Tentukan masalah hasil identifikasi dan tuliskan!

Figure 2. The Product of Developed Teaching Guide

Six indicators make up the content feasibility aspect: 1) The teaching materials' applicability to case study and project-based learning models; 2) The components of the teaching guide; 3) The learning phases; 4) The way the materials are presented; 5) Supporting learning resources; and 6) The materials' currency. There are four indicators that make up the presentation feasibility aspect: 1) Methods of presentation; 2) Supporting presentations; 3) Educational presentations; and 4) Presentation completeness. Six indicators make up the third component, language assessment: 4) Adaptability to students' developmental stage, 5) Coherence and integration of intellectual processes, 6) Use of terminology, symbols, or iconography, 3) Communicativeness, 4) Dialogic and interactive, and 5) Clarity. The information gathered from every ADDIE step is shown as follows.

Analyze

The needs and issues that lecturers and students encounter during the learning process are determined during the analysis phase. The needs analysis revealed that lecturers' current teaching resources, which emphasize project-based learning and case studies in compliance with the most recent curriculum standards, do not yet satisfy the expectations of 21st century capabilities. Given this circumstance, a more methodical methodology for creating instructional materials is required. The teaching guide is a crucial instrument for educators and curriculum expectations to communicate. This instructional manual must be created to accommodate lecturers' learning requirements and facilitate the achievement of learning goals. (Lin et al., 2011) (Selvaraj & Azman, 2020;Shakman et al., 2020). The results of this analysis become the basis for formulating relevant and effective objectives for the development of the teaching guide.

The development of new teaching tools referred to is a teaching guide based on project-based learning and case studies oriented towards 21st century skills, including learning devices (Lesson Plans), Student Activity Sheets (LKM), and evaluation instruments, as well as analyzing the feasibility and requirements for the development of these teaching tools. The development of new teaching tools begins with issues related to sources/materials or teaching strategies that have already been implemented. After analyzing the necessity for developing new teaching tools, the researcher also analyzes the feasibility and requirements for the development of these new teaching tools.

Several questions must be addressed as part of the analysis process: (1) Do the current learning challenges get addressed by the teaching tool, which is a teaching guide based on project-based learning and case studies focused on 21st century skills? (2) Can the new teaching tool a teaching guide based on project-based learning and case studies focused on 21st century skills be implemented with sufficient facilities and support? (3) Can instructors use a teaching guide based on project-based learning and case studies focused on 21st century skills as a teaching tool? This analysis aims to ensure that there is no well-designed teaching tool in the form of a teaching guide based on project-based learning and case studies oriented towards 21st century skills that cannot be applied due to certain limitations, such as the absence of tools or support systems, making implementation impossible. To ascertain whether using the new teaching tool a teaching guide based on project-based learning and case studies focused on 21st century skills is feasible, a study of the tool is carried out.

The findings of the analysis demonstrate how the project-based learning and case study-based teaching guide for 21st century skills effectively tackle a number of issues with the current educational process. By using this guidance, common learning problems including low student engagement, inadequate critical thinking skill development, and limited student collaboration and innovation abilities can be lessened (Yuniarti & Muchsini, 2024; Rahmawati & Suriansyah, 2024). Students can actively participate in the learning process through the project-based approach, which promotes inquiry, teamwork, and the application of information in practical contexts (Mulyadi, 2023). Meanwhile, case studies provide an analytical framework that helps students understand the context of problems and relevant solutions (Arantini et al., 2024). Thus,

this guide not only addresses cognitive issues but also supports the development of essential non-cognitive skills in the 21st century.

The facility availability of study points to both opportunities and difficulties in putting this approach into practice. Successful implementation is determined by supportive facilities such technology access, group-oriented classrooms, and tools for project and case study implementation (Brillian, 2024). In institutions with adequate infrastructure, this guide can be optimally applied. However, in environments with limited facilities, adaptation strategies are needed, such as utilizing simple technology or implementing community-based projects that do not require advanced tools.

From the perspective of lecturers' capabilities, the analysis shows that the majority of lecturers have the capacity to implement this guide. Lecturers' readiness to adopt such new approaches heavily depends on their experience with active learning methods, flexibility in classroom management (Sukardi et al., 2023), and a deep understanding of the 21st century skills to be developed. However, mentoring and training programs that teach how to create pertinent projects, create in-depth case studies, and assess skill-based learning outcomes are needed.

This analysis indicates that the teaching guide based on project-based learning and case studies oriented towards 21st century skills have great potential to enhance the quality of learning and address the challenges faced in today's education. To ensure that this guide can be effectively implemented, a holistic effort is needed, including infrastructure improvements, training provision, and the development of adaptation strategies in resource-limited environments. This is crucial so that good innovations in teaching tools do not remain merely as designs without real implementation in the field.

Design

Following the analysis, the teaching guide's framework is created as part of the design step. The material structure, which consists of instructional resources, student worksheets, and assessment tools, is arranged at the start of the design phase. Every element of its design is guaranteed to foster the growth of abilities like creativity, critical thinking, teamwork, and communication. This teaching tool product's design is still conceptual and will serve as the foundation for further development. In order to confer with professionals about the product design, the researchers also work with them during this design phase.

One of the most important stages of creating the teaching guide is the design process. Some of the reasons why designing teaching guides is a very important part are because teaching guides provide a clear structure for the learning process, ensuring that all materials that need to be taught are covered well and consistently. With a good guide, teachers can plan and implement more effective learning, according to the needs and characteristics of students. Teaching guides also help in designing appropriate assessment methods, so that lecturers can evaluate student progress accurately. A well-designed guide allows teachers to adjust teaching methods according to different situations and conditions (Kamid et al., 2020).

Input and suggestions for improvement from experts emphasize the importance of a holistic, inclusive, and contextual approach in designing learning tools in the form of project-based teaching guides and case studies oriented to 21st century skills. Experts encourage every aspect of the design, from learning objectives to evaluation tools, to be designed carefully by considering the diversity of student needs and abilities and relevance to real-world challenges. With the integration of this input, it is hoped that the design of the guide will be more comprehensive and ready to be further developed to the implementation stage.

Development

The development in the ADDIE design consists of activities to realize the product design of teaching tools in the form of a teaching guide based on project-based learning and case studies oriented towards 21st century skills, which includes lesson plans, student activity sheets, and evaluation tools. In design phase, a conceptual framework and construction have been prepared. In development phase, this conceptual framework is realized into a product ready for implementation.

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Several activities are conducted during the development phase, such as searching for and collecting various relevant sources to enrich the content, creating learning scenarios, student worksheets, and evaluation tools that align with the project-based learning and case study experiences oriented towards 21st century skills, including elaboration according to the recommendations from the previous phase. Additionally, in this development phase, activities to validate the draft of the developed product and revisions based on input from experts are carried out, including validators for teaching tools, subject matter experts, and practitioner educators.

The results of revisions based on expert input on several aspects, in line with feedback from the design phase, include simplifications and logical restructuring of the activity flow in the student activity sheets, emphasizing steps that facilitate active learning. Following the recommendations from subject matter experts, the product draft has been revised to include a wider variety of case studies relevant to various fields of knowledge and practical situations. Some of the activity sheet's instructions have been streamlined to make them easier for students to understand in response to feedback from practitioner educators. To help lecturers better explain topics to students, the draft lesson plan has also been updated to incorporate more examples of how the theories taught are applied in the actual world.

In an effort to enhance the effectiveness of evaluating 21st century skills, the evaluation guide has been expanded by adding more detailed assessment criteria and comprehensive assessment rubrics. This revision aims to ensure that lecturers can conduct objective and in-depth evaluations of student skill development.

The quality of the created instructional resources has improved as a result of the product development draft's validation and revision process. This product is now more prepared for implementation with the intention of favorably influencing project-based learning and case studies focused on the development of 21st century skills, thanks to the integration of input from multiple specialists. The changes made guarantee that this product is not only applicable and compliant with requirements, but also useful and adaptable.

Implementation

At this stage, the design of the teaching aids in the form of a teaching guide based on project-based learning and case studies directed towards 21st century skills and the proposed methodologies are applied. At this stage, the results of the development are examined by specialists, including validators for teaching tools, subject matter experts, and practitioner educators and teachers to gather feedback and assess its usefulness in learning. The following is a presentation of the data from the expert validation of the created teaching guide for each evaluated aspect:

1) Content Feasibility

The applicability of instructional materials to the project-based learning and case study approach received a 100% score in terms of content feasibility. A percentage score of 93% was given to the teaching guide component, 88% to the learning stages component, 100% to the material presentation component, 100% to the supporting learning materials component, and 100% to the currency of the material component. According to this data, the elements of teaching materials' relevancy, presentation, supporting learning materials, and currency all obtained the highest score of 100% in terms of content feasibility. Figure 3 illustrates that the average score for the content feasibility elements is classified as very feasible.

The appropriateness of the content in compiling teaching guides is very important because the material presented must be accurate and relevant to the curriculum and the needs of students. This ensures that students get the right and useful information. In addition, teaching guides must be in accordance with the learning objectives to be achieved, the goal is to help ensure that every activity and material presented supports the achievement of these objectives (Bedin et al., 2023).

Additionally, the teaching guide's materials must be adapted to the students' developmental

stage and skill level. Both teachers and students should find the information easy to follow and comprehend if it is arranged methodically and coherently. This facilitates the development of a rational and efficient learning flow (Ahmadi, 2019).

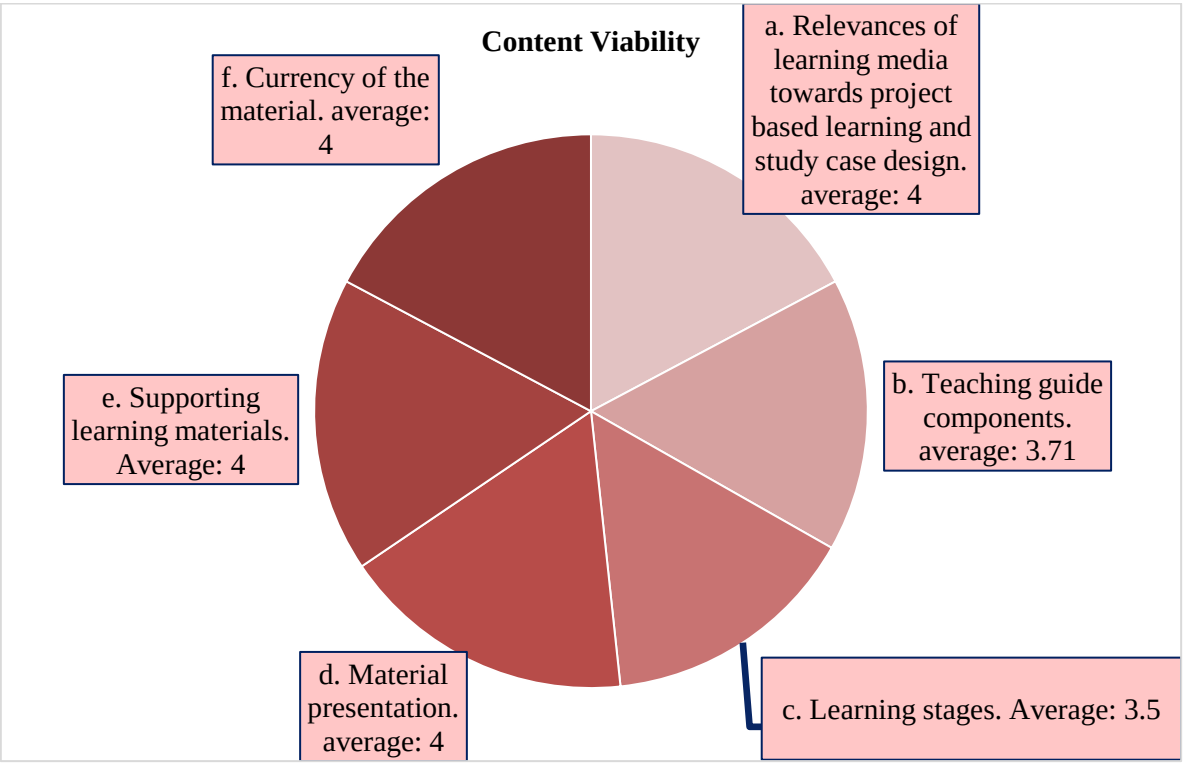

Figure 3. Content Viability

2) Presentation Feasibility

In terms of presentation feasibility, there are four aspects measured in the presentation feasibility assessment, in the presentation completeness aspect for the presentation technique sub-aspect, presentation support aspect, learning presentation aspect, and presentation completeness aspect. The percentage for each presentation feasibility aspect above is 100%, 78%, 100%, and 100%. From these figures, it can be seen that the highest value for each aspect is in the presentation technique aspect, learning presentation and presentation completeness with a value of 100% and the lowest value is in the presentation support aspect with a value of 78%, all aspects in the presentation feasibility criteria are in the very feasible criteria, can be seen in Figure 4.

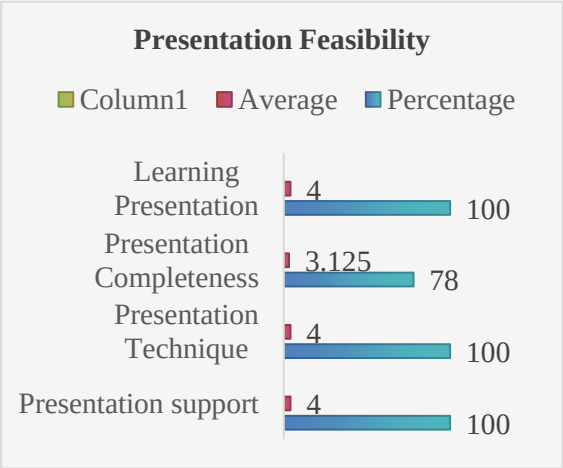

Figure 4. Presentation Feasibility

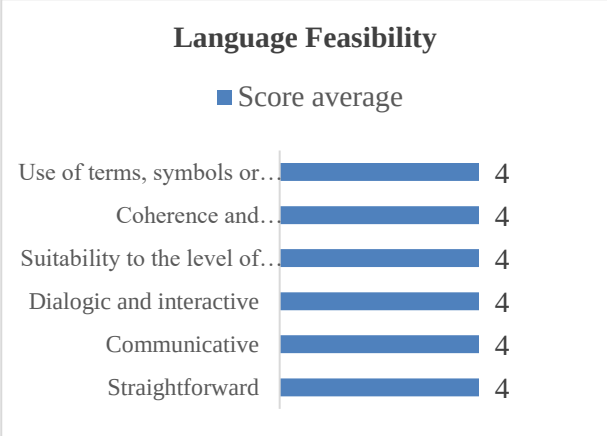

Figure 5. Language Feasibility

3) Language Feasibility of Presentation

In terms of language feasibility of presentation, the assessed aspects are: 1) clear language, 2) communicative, 3) dialogic and interactive, 4) appropriateness to the developmental level of the learners, 5) coherence and integration of thought flow, and 6) use of terms, symbols, or icons. All All aspects received the highest percentage score of 100% with a score of 4 in the very appropriate category can be seen in Figure 5.

The appropriateness of the language and presentation in the teaching guide is very important to ensure whether the teaching guide used is effective. The language appropriateness test evaluates whether the language used in the teaching material is appropriate for the target audience. The language used must be clear, easy to understand, and appropriate to the level of understanding of students (Suhaika et al., 2022; Zulkarnaen et al., 2023). The teaching guide's presentation needs to be well-structured and logical. By offering a logical flow of information, a well-structured guide improves the learning process and is simpler for teachers and students to follow (Hasanah et al., 2019).

When creating instructional manuals, the viability of the language and presentation is crucial. This element guarantees that the teaching guide's contents are not only educational but also interesting and easily accessible, which eventually improves the learning environment. Table 1 summarizes the percentage scores from the evaluated elements of the project-based teaching guide's viability and case studies focused on 21st-century abilities.

Table 1. Average Score by Indicator Percentage

Indicator	Aspect	Average	%	Notes
Content Feasibility	Feasibility of teaching materials with project-based learning models and case studies	4	100	Very feasibly
	teaching guide	3.71	93	Very feasibly
	learning stages	3.5	88	Very feasibly
	material presentation	4	100	Very feasibly
	supporting learning materials	4	100	Very feasibly
	currency of the material	4	100	Very feasibly
	Mean Score	**4**	**97**	**Very feasibly**
Presentation feasibility	Presentation Techniques	4	100	Very feasibly
	Presentation Support	3.125	78	Very feasibly
	Learning Presentation	4	100	Very feasibly
	Presentation Completeness	4	100	Very feasibly
	Mean Score	**3.78**	**95**	**Very feasibly**
Language Feasibility	Straightforward	4	100	Very feasibly
	Communicative	4	100	Very feasibly
	Dialogical and interactive	4	100	Very feasibly
	Suitability to the level of student development	4	100	Very feasibly
	Coherence and integration of thought flow	4	100	Very feasibly
	Use of terms, symbols, or icons	4	100	Very feasibly
	Mean Score	**4**	**100**	**Very feasibly**

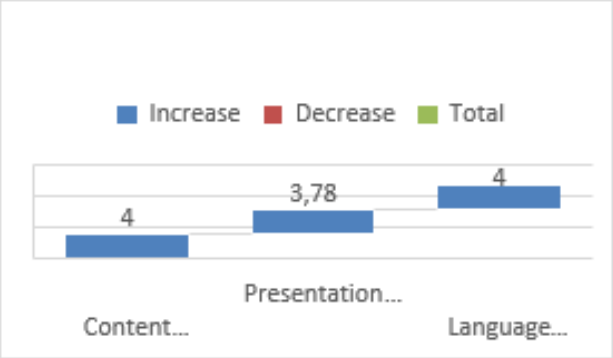

Figure 6. Indicators' Average Score

The three assessment components of the viability of the project-based teaching guide and case studies focused on 21st-century abilities are shown in detail in Table 1 and Figure 6 as follows: Content feasibility received an average score of 4.00, placing it in the very feasible category; presentation feasibility received an average score of 3.78, placing it in the same category as content feasibility; and language feasibility received an average score of 4.00, placing it in the very feasible category once more.

Evaluation

Since this kind of evaluation is related to the development research phase that aims to improve the established learning device goods, just an initial evaluation was carried out in this study. The ADDIE approach to evaluation in the development research design is used step-by-step to gather data at each stage. This data is then used for refinement to assess the quality of the new learning product, specifically the case studies focused on 21st-century skills and the project-based teaching guide.

During the evaluation phase, input from the project-based teaching guide's implementation and case studies focused on 21st-century skills are analyzed. In order to ascertain the overall quality of the product, the evaluation stage's final conclusions include an analysis of 1) content feasibility components and 2) design feasibility, which includes a) validation aspects and b) the product's practicality and effectiveness.

The project-based teaching guide and case studies focused on 21st-century abilities are very viable to employ, according to the study of user answers on both content feasibility and design feasibility components. The teaching guide can help students build 21st-century abilities because it includes case studies and project-based learning activities.

Through project-based learning, students are encouraged to take on real-world issues that call for critical thinking and creative problem-solving. Teachers are instructed to support students in the inquiry, investigation, and problem-solving processes through the teaching guide, which improves students' critical thinking abilities (Bell, 2010). Case studies and project-based learning frequently call for originality and innovative thinking. Teachers help students create projects that inspire them to think creatively and come up with original ideas by using a teaching guide that includes worksheets. This helps students develop a creative attitude (Martinez, 2022).

Current project-based learning and case studies often involve the use of technology, helping students become proficient with digital devices. Lecturers can integrate technology into projects outlined in teaching guides, thus preparing students for the demands of technology in the modern workplace (Ammenheuser, S, 2022).

The results of user responses to project-based learning and case study-oriented 21st century skills teaching guide products are presented in Figure 7.

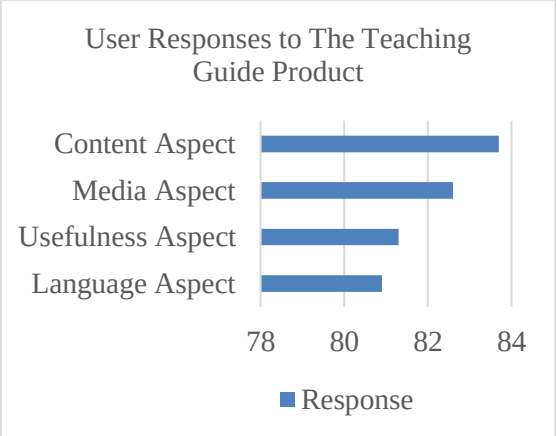

Figure 7. The results of user responses to the project-based teaching guide and 21st-century skills-oriented case studies

At least four factors must be directly considered when creating instructional materials: the curriculum, participant characteristics, infrastructure and facility availability, and

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expenditures. According to Araina et al (2023), materials that are often used in the educational process occasionally do not go through a systematic development procedure. Often scientific steps are not considered, especially when pressed by the deadline for preparation. There are ten stages in developing learning materials, namely: 1) Identification of needs and problems; 2) Problem analysis: especially related to resistance patterns; 3) Problem analysis: identification of needs and motivation factors, and persuasion tactics; 4) Formulating and setting goals; 5) Selecting topics; 6) Selecting the form (format); 7) Compiling content: visual script; 8) Editing; 9) Testing; 10) Revision.

Teaching materials are generally divided into 4 types based on the sophistication of the technology used. These teaching materials include: printed teaching materials, audio, audio-visual, interactive multimedia, and web-based teaching materials (Suherja et al., 2022). Printed teaching materials include teaching materials printed on sheets such as textbooks/teaching books, modules, handouts, worksheets, brochures, leaflets, etc. Vinyl records, radios, cassettes, and audio compact discs are examples of audio materials. Films and video compact disks are examples of audiovisual materials. Computer Assisted Instruction (CAI), CDs, interactive multimedia learning, and web-based learning resources are examples of interactive multimedia materials (Wachidah, 2023)(Ramadhani et al., 2023). The project-based teaching guide and case studies focused on 21st-century skills are included in the print or written resources, according to the categories of materials previously indicated.

Learning Materials are components of the message content in the curriculum that must be conveyed to students (Rusnawati, 2022). This component has various forms of messages, some are in the form of facts, concepts, principles/rules, procedures, problems, and so on. This component acts as content or material that must be mastered by students in learning activities. The scope of learning materials has been systematically arranged in the organizational structure of the curriculum in this case is the content standard (Ariani, 2024).

The nature of the material arranged in the content standards is only the main points of the material, so for the smooth implementation of learning, learning materials need to be developed first by completing them in the form of complete learning materials (Dewi, 2023). When learning is to be carried out, a professional educator must understand the characteristics of the content of the learning message to be conveyed, so as not to make a mistake in choosing the learning materials to be used (Afifah et al., 2023). Therefore, we get that the selection of learning materials needs to be considered in accordance with the content standards and especially the selection of learning materials that are in accordance with the characteristics of students.

CONCLUSION

Based on the review and analysis of the research data, it can be concluded that the development of the project-based teaching guide and case studies oriented towards 21st-century skills at Kuningan University is considered very feasible. Furthermore, it can be tested and/or implemented on a limited and wider scale for use in the learning process.

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