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Development of Team-Based Project Biochemistry Practicum Manual to Create Practicum Product

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Abstract: Team-based learning is learning that is imposed on students to improve students' critical thinking, problem solving, solution finding, and communication skills. This learning is also useful for lecturers as teaching staff to improve higher abilities and skills. Researchers will combine practicum instructions with a team-based learning model. Team-based project practicum instructions will be able to make students together do practicum utilizing the surrounding environment to produce practicum products. This research is a research development with ADDIE development model and Tessmer formative evaluation. The research stages consist of self evaluation, expert reviews, one to one, small group. The innovation and originality of this research is the valid and practical team-based project practicum instructions used in Biochemistry practicum lectures. The results of the research were tested and used in Biochemistry team-based project practicum lectures. The results of laboratory development validation show the Aiken coefficient of 0.86 for material experts and 0.90 for design experts. The results of the implementation show the practicality of 96.45%. It can be concluded that the biochemistry lab instructions on team based project developed in the Biochemistry practicum is valid and practical.

Keywords: Biochemistry practicum; Team based project

Introduction

The environment around students can be utilized as a means of lecture. Biochemistry practicum lectures have used local materials as materials and reagents that affect students' creativity and creative thinking skills (Sari et al., 2018, 2019, 2021). Some topics of Biochemistry practicum activities so far often use betel leaves, kenanga leaves or sambiloto leaves which are difficult to find by students. This is an obstacle as well as an opportunity for the research team to find materials that are easy to find and not rare. The results of research in 2023 show that practicum materials can use materials that are considered waste around students (Sari et al., 2023).

The use of materials that are considered waste becomes potential as Biochemistry practicum materials (Mulyani et al., 2018). This can be accommodated with practicum instructions that support it. One model that can be used as an innovation to overcome the above problems is the Team Based Project learning model. Why team based project learning model? The Ministry of Education and Culture through decree No. 3/M/2021 concerning the Main Performance Indicators of State Universities and Higher Education Service Institutions emphasizes collaborative learning and real experience to students. This learning aims to improve the quality of learning and the relevance of higher education in the university environment, which requires universities to be able to design and implement learning innovatively, so that students can achieve learning including attitudes,

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knowledge, and skills optimally (Chistyakov et al., 2023; Hodijah et al., 2022; Almulla, 2020; Sumarni, 2015). Learning in higher education should be able to engage students to engage in higher order thinking activities.

Team-based project learning is one of the Key Performance Indicators (KPI) implemented by the Ministry of Education and Culture of the Republic of Indonesia number 3/M/2021. Team-based project learning is learning that is charged to students to improve students' critical thinking skills, solve problems, find solutions, and foster communication skills (Sweet & Michaelsen, 2023; Hussein, 2021; Lee et al., 2017; Lightner et al., 2007). This learning is also useful for lecturers as teaching staff to improve their abilities and higher skills (Rohm et al., 2021; Ngereja et al., 2020; Kokotsaki et al., 2016).

In this study, the team-based project model will be combined with practicum instructions because it can be a challenge for students to participate directly in constructing the concept of Biochemistry practicum. As stated by Fairbrother et al. (2022), Cortázar et al. (2021), and Ouellette et al. (2015) that team-based projects offer an alternative to traditional learning and cause new innovations to facilitate students in critical thinking and cooperation.

Some waste materials that can be used as practicum materials are banana peels (*Musa paradisiaca*) and avocado peels (*Persea americana* Mill) which contain compounds with hydroxy groups that play a role in antioxidant activity. Essential oils derived from banana peels and avocado skins will have potential as a forerunner to the downstream practicum lecture products (Hodijah et al., 2022; Cissy, 2008). One of the team-based project practicum instructions can encourage students to participate by looking for potential practicum materials in their respective environments which may have been considered waste.

From this background, the researcher is interested in conducting research on the Development of Biochemistry Practicum Instructions for Team-based projects as a First Step in Creating Practicum Product Downstreaming.

Method

This research is Development Research. This research aims to produce practical instructions for Biochemistry team-based projects that meet valid and practical criteria. The research was conducted in April-November 2024 at the PSB Chemistry Laboratory, Sriwijaya University. The research procedure refers to the ADDIE (Analysis, Design, Development) development model (Dick et al., 2014) and Tessmer's formative evaluation which consists of several stages, namely self (Tessmer, 2013). This research is Devlopment Research. The research procedure can be seen in Figure 1. The instruments used in this study are (Riduwan, 2008):

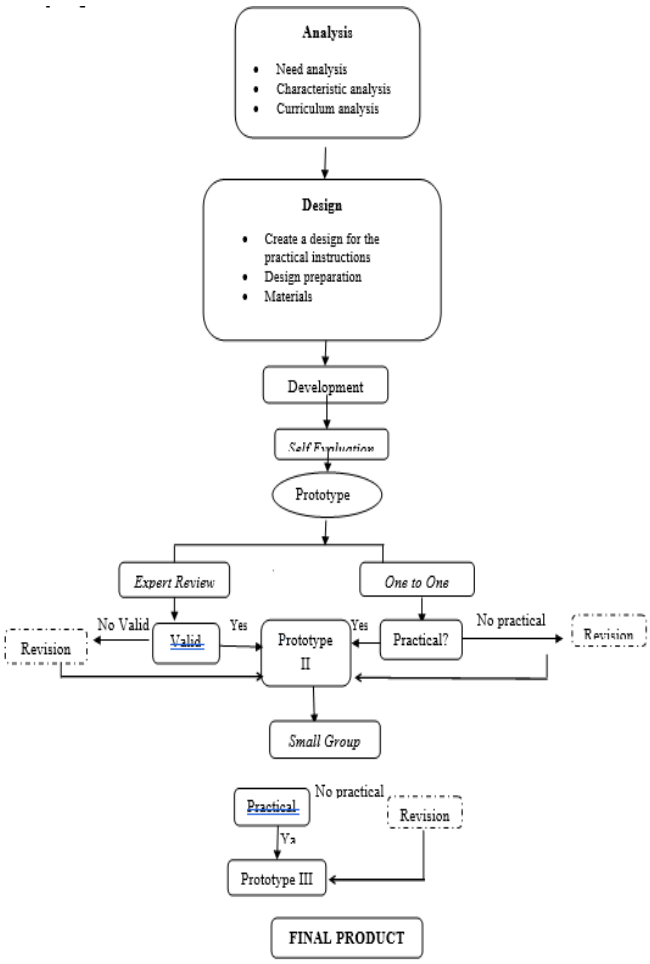

Figure 1. Development research procedure with ADDIE model

Interview

To gain a deeper understanding of the effectiveness of current biochemistry laboratory manuals for team-based projects, this study conducted in-depth interviews with a number of students. The interviews aimed to explore students' perceptions of the existing laboratory manuals, identify challenges they faced, and gather feedback on necessary improvements (Creswell & Creswell, 2017). By employing qualitative research methods, particularly in-depth interviews, this study sought to obtain rich data on students' experiences and challenges in meeting the learning outcomes specified in the biochemistry curriculum (Braun & Clarke, 2006; Kvale, 1996). The findings from these interviews will serve as a foundation for developing more relevant and effective laboratory manuals, thereby enhancing the quality of student learning in biochemistry (Prince, 2004; Michaelsen & Knight, 2004).

Expert Test

A stringent validation process was executed by a panel of three experts—a subject matter expert, a pedagogical expert, and a design expert—to ascertain the quality and efficacy of the developed team-based biochemistry practicum instructions. The validation process aimed to assess the content validity, instructional design, and overall quality of the developed materials. Expert validation is a widely recognized method for evaluating the quality of instructional materials (Gall et al., 2007). The feedback and suggestions provided by the experts were carefully considered and incorporated into the final version of the practicum instructions, ultimately enhancing their suitability for student learning and engagement.

Questionnaire

A questionnaire was provided to a sample of students to collect quantitative data on the efficacy of the generated instructional materials. This questionnaire employed a checklist format, presenting students with a series of statements related to the materials' clarity, relevance, and effectiveness (Babbie, 2020). By utilizing a standardized instrument, the study aimed to collect reliable and valid data on students' perceptions (Fraenkel & Wallen, 2009). Data analysis involved calculating the mean and standard deviation of the responses, followed by a detailed interpretation of the results (Pallant, 2011).

Result and Discussion

The following presents the data obtained in accordance with the development research procedures that have been carried out.

Analysis

At the analysis stage, the researchers obtained the results: Overall, students have difficulty doing Biochemistry practicum; there is no biochemistry lab instructions on team based project for Biochemistry practicum in the Unsri Chemistry Education study program.

Design

At this stage, the researcher obtained a design for biochemistry lab instructions on team based project that would be developed in the form of practicum procedures.

Development

Biochemistry lab instructions on team based project Creation. At this stage, a biochemistry lab instructions on team based project is generated that is in accordance with the researcher's design.

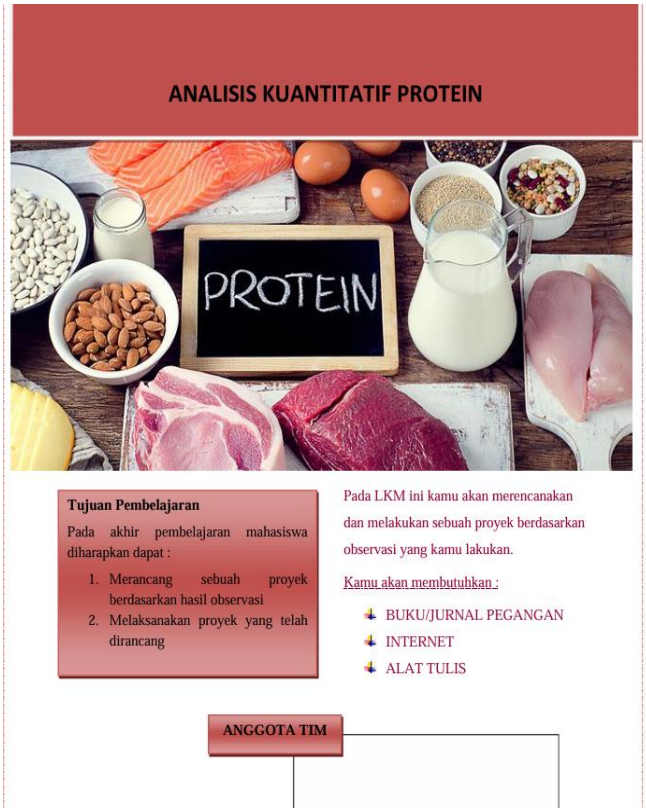

Figure 2. Prototype biochemistry lab instructions on team based project

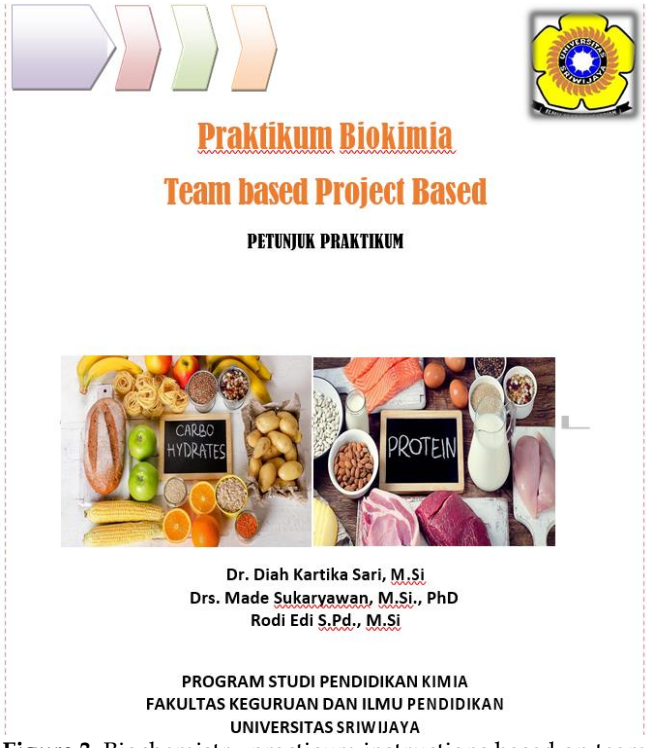

Figure 3. Biochemistry practicum instructions based on team-based project

Testing

The results of the testing can be seen in Table 1.

Table 1. The Result of Testing

Items	Before revision	After revision
1	Explanatory material is too short and not sourced	Has been added
2	There is no reaction mechanism every practicum	Has been added

Expert Test

Material Validation

The results obtained from material validation can be seen in Table 2 below.

Table 2. Comments and Suggestions from Material Validators

Before revision	After revision
There is no explanation that supports the results of the practicum	Has been added

The results of material validation using the V Aiken formula can be seen n the Table 3 below.

Table 3. The Results of Material Validation

Validator	Score	Average	Category
Expert 1	0.81	0.86	high
Expert 2	0.91		

Improvements to the material contained in the biochemistry lab instructions on team based project have been improved according to comments and suggestions from material experts. The biochemistry lab instructions on team based project validity assessment questionnaire that has been filled out by a material expert consisting of two aspects assessed with 13 descriptors is then analyzed using the V Aiken formula to determine whether the material contained in the biochemistry lab instructions on team based project is valid and the final score is 0.86 with a high category so that it can biochemistry lab instructions on team based project is valid and in accordance with the introduction of chemical laboratory equipment, and the biochemistry lab instructions on team based project is feasible to proceed to the next stage, namely testing.

Design Validation

The results obtained from media validation can be seen in Table 4 below.

Table 4. Comments and Suggestions from Media Validators

Before revision	After revision
The cover just plain colors.	Tried to fix

The results of design validation using the V Aiken formula can be seen in the Table 5.

Table 5. The Results of Design Validation

Validator	score	Average	Category
Expert 1	0.91	0.90	High
Expert 2	0.89		

Design assessment in biochemistry lab instructions on team based project for cover, text, images. The results of the assessment with media experts contained suggestions and comments, namely the appearance of the cover because it only displays plain colors and it would be better if all laboratory equipment was equipped with figure on how to use it. Improvements to the text contained in the biochemistry lab instructions on team based project have been improved according to suggestions and comments from design experts. The biochemistry lab instructions on team based project validity assessment questionnaire which consists of two aspects with 12 descriptors to be assessed has been filled in by design experts, the results of the assessment are then analyzed by researchers using the V Aiken formula to determine whether or not the biochemistry lab instructions on team based project is valid and the final score obtained which is 0.90 with a high category so that it can be said that the biochemistry lab instructions on team based project developed is valid and feasible to proceed to the next stage, namely testing.

Implementation

The implementation stage is carried out to determine the level of practicality of the biochemistry lab instructions on team based project which has previously been validated by material experts and design experts. The results of expert validation obtained prototype II which will be tested in small groups involving nine students. The nine students consisted of two high-ability students, five medium-ability students, and low-ability students. The nine students were then given a biochemistry lab instructions on team based project. The results of the implementation using the Guttman scale can be seen in Table 6.

Based on the results of the assessment obtained from the implementation stage, the percentage results obtained with an average score of 96.45% with a very practical category which means the biochemistry lab instructions on team based project is significantly practical. It can be concluded that this biochemistry lab instructions on team based project is very practical and can be used in learning Biochemistry Practicum. With comments and suggestions that the biochemistry lab instructions on team based project is very interesting in delivering material so that it stimulates students to increase their enthusiasm for learning and add insight into the Biochemistry Practicum. Comments and suggestions at the implementation stage can be seen in Table 7.

Table 6. Results of the Percentage of Practicality Using the Guttman Scale

Questionnaire Statement	Amount		Percentage (%)	
	Yes	No	Yes	No
1	9	0	100	0
2	8	1	88.9	11.1
3	9	0	100	0
4	9	0	100	0
5	9	0	100	0
6	9	0	100	0
7	8	1	88.9	11.1
8	9	0	100	0
9	8	1	88.9	11.1
10	6	3	66.7	33.3
11	9	0	100	0
12	9	0	100	0
Average				96.45

Table 7. Comments and Suggestions from Students at the Implementation Stage

Student	Comments and Suggestions
Student 1	The team-based project biochemistry practicum guide is good and very interesting.
Student 2	The use of the biochemistry lab instructions on team based project is good, both in delivering material and understandable.
Student 3	The use of the biochemistry lab instructions on team based project is good,
Student 4	This team-based project-based biochemistry practicum guide is interesting enough to increase the desire to do the practicum.
Student 5	The biochemistry lab instructions based on team based project is good, it can be used as learning media.
Student 6	Biochemistry lab instructions on team based project can help with practical activities that are difficult to carry out online. Suggestion material can be reproduced even more.
Student 7	Biochemistry lab instructions based on team based project berbasis team based project is good to use
Student 8	Biochemistry lab instructions based on team based project is good and can help in understanding the material for the Biochemistry Practicum
Student 9	With the team-based project-based biochemistry practicum guide, you can immediately see the biochemistry practicum.The suggestion is to be further improved and the material is reproduced again.

Evaluation

Evaluation is carried out by researchers at each stage of research development to improve the resulting product development. The development of a biochemistry lab instructions on team based project in the Biochemistry practicum can help practicum activities. In line with previous research, biochemistry lab instructions on team based project can build students' understanding, thinking skills and convey important concepts (Darby-White et al., 2019; Widowati et al., 2017; Quesada, 2020; Gambari et al., 2018). This biochemistry lab instructions on team based project will be more effective if it is associated with the environment (Li et al., 2020; Dwiningsih et al., 2018) and learning model (Masril et al., 2018; Shin, 2018).

Conclusion

A study has been conducted to develop biochemistry lab instructions based on team based project. Based on the findings and discussion, it can be concluded that the biochemistry lab instructions on team based project was proven by Aiken value obtained was material expert and design expert of +0.86 and +0.90 which means that it can be considered as valid for all validated components. The results of the implementation show that the practicality reaches 96.45%. This means that the biochemistry lab instructions on team based project is very practical and can be used in learning Biochemistry Practicum.

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Conflicts of Interest
All author declares that there is no conflict of interest.

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