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Research Article

Implementation of project-based learning in assessing the creativity abilities of prospective biology teachers

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Abstract: Developing the 21st century abilities is a challenge for educational institutions, especially when it comes to learning that encourages students to be creative. The purpose of this study is to evaluate the creative capacities of prospective biology teacher students by implementing Project-Based Learning (PjBL) in nutrition science subjects. Performance observation sheets and portfolios were employed in this study, which involved 40 students of biology education at a private educational institution in Bandung. This study used an experimental class by first determining the criteria for the percentage of at least 70%. The results of the study show that the percentage with an average value of 51.80% is included in the sufficient category but is still below the specified average standard. The novelty indicator is 50.65% in the sufficient category the useful indicator is 39.53%, the effect on others is 22.30% and the ability to generalize is 31.53% which is still in the less category. Based on this, overall student creativity after the implementation of PjBL learning in the Nutrition Science course still needs to be improved. Findings of learning using PjBL are able to positively correlate with increasing student learning motivation and independence.

Keywords: creativity; creative thinking; project-based learning; science of nutrition

1. Introduction

The development of the 21st century learning skills is a challenge for universities. Furthermore, global competition necessitates vast information as well as the development of critical thinking skills in students (Susetyarini & Fauzi, 2020; Trilling & Fadel, 2009; Wei et al., 2019). They will be expected to be competitive and competent in their field in the future. One of the efforts made by directing pupils to come up with new ideas and solutions to solve the problem (Sumardi et al., 2020; Bayat & Tarmizi, 2012; Suwono et al., 2017).

One of the lessons that lead to the creation of new ideas for students is through Project Base Learning (PjBL) learning. According to research, PjBL can promote creativity, fluent thinking, flexibility, and support innovative thinking habits (Rofieq et al., 2019; Wahyuni & Permana, 2019, Chen et al., 2022). Cultivate critical thinking, problem solving, and metacognitive skills in students, as well as their grasp of the complexities of real-world problems, to boost long-term retention, inspire pupils to learn, and activate prior knowledge (Kilbane & Milman, 2017). The PjBL syntax starts learning with essential questions, works together to plan, and arranges project completion schedules, schedules, and deadlines (Zulyusri et al., 2023). PjBL learning increases creativity and skill in generating books such as designs, schemes, writing, works of art, works of technology, crafts, and others. as well as the collateral effects of teamwork and communication skills, discipline, and time management (Dewi & Sutisna, 2019; Martinich et al., 2006; Sumarni et al., 2021; Sumarni & Kadarwati, 2020).

One of the challenges that teachers and lecturers confront in the subject is determining how direct learning can increase students' creativity, particularly when

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studying science. One approach to instilling creative thinking in science learning can be passed through the science process, science scenarios, and science content, but this approach does not produce a better approach (Nyakito et al., 2021). The science process and science content scenario approaches are easier to begin learning because they are not restricted by rigid content in the syllabus (Khalid et al., 2020). Due to the incorporates intellectual processes, problem-solving is frequently regarded as a higher level of difficulty. A typical problem-solving procedure consists of the following steps: (a) detecting the existence of a problem, (b) determining the nature of the problem, (c) investigating available resources to address the problem, (d) developing a strategy to tackle the problem, (e) brainstorming various solutions, (f) evaluating solutions, and (g) selecting the best solution (Reiter-Palmon & Hunter, 2023).

Nutrition subject is one of the disciplines in the Biology Education Study Program, which is dedicated to the science of food and its relationship to health. The basis of the problem, according to preliminary investigations, was a lack of student attention to nutrition and food consumption, the hazards of rapid food and drinks, fast food, and malnutrition. The world's efforts with the Sustainable Development Goals (SDGs) program, particularly point 3, a healthy and prosperous life, are of particular concern in this course. How students will have an insight into nutrition and health problems in the future so that they can solve them with various innovative solutions? It is thought that by presenting authentic challenges in PjBL, students would be able to develop more creativity. Students will be concerned with their own and their families' health, as well as global health challenges in general (Susetyarini & Fauzi, 2020).

Several nutrition and health research findings show that the level of literacy on food nutrition and healthy behavior among college students (2.8 and 3.07 out of a possible 5) is not optimal, but there is a positive relationship between nutritional literacy and a healthier eating pattern (Al-Tell et al., 2023; Spronk et al., 2014). Tips for promoting nutritional understanding and healthy eating habits among college students (Liao et al., 2019). In Indonesia, especially health and nutrition problems are quite a lot and increasing from year to year, the problem is that people find it difficult to receive health information (Hidayat & Wulandari, 2022). Based on this, the purpose of this study was to evaluate the creativity capacities of biology teacher candidates by implementing PJBL (project-based learning) in nutrition science subjects. The contribution of research on PjBL is to provide a deeper understanding of this learning method and provide empirical evidence about its effectiveness in improving student learning. This research can also provide insight to educational practitioners about how best to implement PjBL in their classrooms, including effective teaching strategies and the support needed for successful implementation. In addition, research on PjBL can also provide input to educational policies to improve innovative and results-oriented learning approaches that are relevant to real world needs. Thus, research on PjBL can contribute significantly to the development of better educational practices and prepare students to face the increasingly complex demands of society and the future work.

2. Materials and Methods

The research was carried out by following the Research and Development flow according to Sugiyono (2017), namely the potential and problem stage, data collection stage, product design stage, design validation stage, design revision stage, product and final product stages (it can be seen at Figure 1). The research was conducted in the Biology Education Study Program, Pasundan University, which is one of the l Private Higher education organizing institutions (LPTK) in Bandung City.

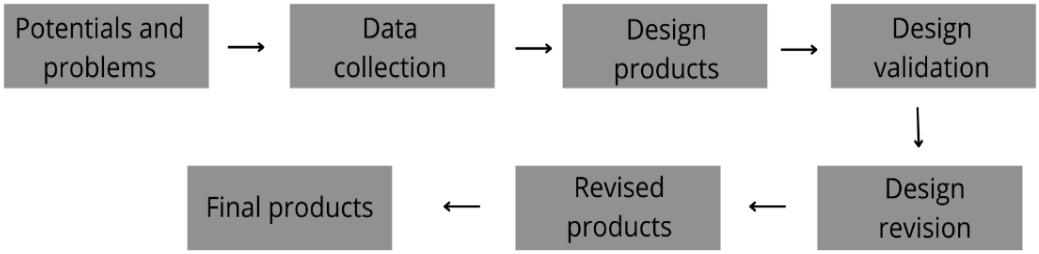

Figure 1. Research and Development flow (Sugiyono, 2019)

Based on the flow of this research, it is at the data collection stage to produce data that suits your needs. This stage is carried out by taking a portfolio from a nutrition science lecture so that student creativity data is produced. Instruments were developed that were measured based on creativity indicators which were then analyzed and interpreted to conclude. The research results at this stage are used to support the next stage, namely product design development.

3. Results

Project-based Learning (PjBL) is implemented by integrating students jointly so that students become more active participants in the nutrition science learning process. The adoption of PjBL aims to develop student creativity through constant training, preparing students to confront the difficulties of the workplace (Anazifa & Djukri, 2017). Based on class observations on Table 1, it appears that PjBL can boost student motivation at each stage of learning. Students must be motivated, and motivation will build as a result of challenges when participating in learning, fostering a sense of responsibility and increasing each student's self-efficacy (Shin, 2018; Luzyawati, 2016).

Table 1. The value of PjBL's activity in the product portfolio of student creativity (Cropley & Cropley, 2007).

Creativity Indicators	Criteria	Compatibility with the rubric	Total (%)	Category
Relevan and Effective	Accurate in solving problems into solutions	Solutions reflect knowledge that is relevant, real and appropriate to the task	80.14	Good
Novelty	Problematization	Solutions reflect the effect of change	42.45	Satisfactory
	Add to existing knowledge	An approach that provides benefits	55.27	Satisfactory
	Develop new knowledge	Construction of new knowledge that is potentially effective and solutive	54.23	Satisfactory
Useful	External uses	The solution used has an effect on other people	39.53	Less
	Internal uses	Solutions can be implemented in everyday life	89.50	High
	Effect on others	Readers find the best solution	22.30	Less
Generalization	Ideas can solve problems	Solutions offer new ways of looking at issues or problems	31.53	Less
Overall Average Percentage of Creativity Rating			51.80	Satisfactory

PjBL implementation consists of six stages: (1) determining the basic questions (start with the most important question); (2) designing a project plan (create a project plan); (3) arranging a schedule (create a schedule); (4) monitoring the progress of the project (monitor the students and the progress of the project); (5) testing the results (assess the outcome); and (6) evaluating the experience (Sholekah, 2020). The first level of PjBL

involves asking students trigger questions about fixing difficulties so that students are driven to find solutions. Students are confronted with issues concerning community and family nutrition, including how to provide nourishment for families with family members of varying ages, activities, and economic circumstances. Based on the difficulties presented to students, effective, efficient, relevant, and actual performance in developing solutions was found. The assessment findings in the innovation category were good, with a score of 80.14%, as evidenced by the solutions presented referencing the literature review and relevant journal articles. Furthermore, the stages of the solutions presented are systematic, logical, and true in the context of daily life.

Students are allowed to gain knowledge in problem-solving by designing an investigation, collecting and analyzing data, and reaching a conclusion (Kokotsaki et al., 2016). The approach involves working in groups to solve problems by gathering information from diverse sources. Furthermore, students can use technology to aid the learning process by searching for literature to help them solve challenges (Winkler et al., 2021).

The second stage involves designing product planning. At this stage, students talk about creating a strategy for a problem-solving activity, which includes work delegation, and the preparation of tools, materials, media, and resources. Product design begins with problems presented at the start of learning, and students collaborate to develop a solution by creating a book on nutritional problems in families and communities. At this point, students must be more imaginative and innovative in coming up with a fresh idea for generating a product. According to the novelty indicator, there is a suitable category with an average proportion of 42.45% where finding a solution can change the thinking process. Based on this, students can collaborate and think openly about learning so that they can practice their respective capacities to respect each other among group members, propose answers to challenges, and demonstrate the active participation of students in learning (Erbil & Kocabaş, 2018).

The third stage is the stage of compiling a project completion schedule by taking into account the time limit that has been determined together. Scheduling must be well designed and structured so that project completion is timely so that students get meaningful learning and acquire skills, knowledge, attitudes and meet the expected learning objectives (Budoya et al., 2019). The fourth stage of learning is by making projects according to a predetermined schedule and discussing any problems that arise during the completion of the project with the lecturer. Product creation is the result of a collection of references from various media both online and offline which are arranged systematically. At this stage, students can take advantage of various learning resources that can help smooth the making of projects so that optimal learning results can be achieved (Luzyawati, 2016).

The product testing stage is the fifth stage. As a result of group collaboration, students create product reports in the form of booklets at this stage. On the novelty indicator, the product assessor stage shows sufficient criteria with an average percentage of 55%, indicating that it does not yet reflect solutions that affect change and provide benefits that are potentially effective and solutive, whereas student performance results are able to present solutions that are still general theory originating from 1 to 2 sources. Increasing student creativity through bookmaking fulfills the very good features of novelty by adopting appealing designs (Ummah et al., 2019). Based on this, critical thinking skills are required in order to solve innovative problems. As indicated in Figure 1, the following product was created by numerous student groups.

4. Discussion

Figure 2 shows several examples of student-created products that highlight dietary challenges in families and communities and are subsequently tested on a small scale to determine product feasibility (Widayanti et al., 2018). It has not been able to provide external use and affects other people who read it, based on creativity indicators seen from the usefulness indicated in the less category with an average percentage of 39%. Creativity is the product of creative thinking in the learning process, which includes creation and cooperation, as well as conscious mental and cognitive processes that culminate in the development of something new (Sumarni et al., 2021; Yustina et al., 2020). However, observations in the field reveal that the solutions supplied are capable of generating internal benefits for students, as seen by the high proportion of 89.50%, offering new knowledge for students that may subsequently be implemented in everyday life.

The book's product in general describes different dietary difficulties encountered in daily life, both in the home and in the community. Based on generalization indicators that offer ideas for solving difficulties in novel ways, the problems presented are in the lower group (31.53%), indicating that the solutions presented by students are still extremely prevalent. The studies in the field demonstrate that critical and creative thinking abilities should be used to see the challenges of the occurrences presented.

Figure 2. Products Made by Students

The evaluation step of the learning process is the sixth and final stage. Learning must be evaluated to determine the positive influence on students, such as the level of student knowledge of the implemented learning, program sustainability, and improving the quality of learning (Al-fraihat et al., 2020). At this point, the process of giving reports for each group was completed with comments from other groups, who then reached a conclusion on the project's results directed by the lecturer. Based on this, student creativity emerges in problem solving through expressing and producing new ideas as a solution. The study's findings indicate that learning with the PjBL model increases student creativity to the point where it needs to be increased again by continuing to practice through an ongoing program, as this can be demonstrated at various levels of learning. PjBL can encourage students to think about how to solve challenges and create a product as a result of their ideas (Soh, 2017).

5. Conclusions

Overall, it shows that the application of PjBL learning can increase student creativity. The results show an increase in creativity of 51.08% which is included in the satisfactory category. PjBL learning can train students to carry out learning collaboratively in solving a problem and completing a project related to nutritional problems in the family and community, so that students can develop new knowledge, provide solutions to problems, and can gain benefits in producing a product that can be used by needy parties. Based on these findings, PjBL learning can boost creativity while also enhancing motivation and learning independence.

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