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Prospective teachers' creativity in constructing learning media in project brain-based learning (PjBBL) model

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Abstract: Creativity is an essential competency for prospective teachers, especially in learning preparation. In learning, teachers' creativity establishes an innovative learning process. However, the studies on prospective teachers' creativity in developing learning media have not been carried out comprehensively. Therefore, this study investigates the prospective teachers' creativity in constructing learning media using a descriptive qualitative approach. As many as 131 students from Universitas PGRI Madiun, Indonesia, participated in this study. The participants were asked to compose learning media at the end of the course. Besides they were also given 10 question items. Our results suggested the different levels of creativity among the prospective teachers attending learnings with PjBBL, PjBL, BBL, and conventional learning methods.

Keywords: Creativity; thinking; intelligence; prospective teacher; learning model.

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INTRODUCTION

Teacher's competencies consist of (1) pedagogical, (2) personality, (3) social, and (4) professional competencies, which are acquired through the professional education (Oktaviani & Fitri, 2020). Pedagogical competency represents teachers' skills in regulating learning, while professional competency correlates with the mastery of scientific knowledge, technology, art, and culture relevant to their teaching materials. In general, these four competencies are crucial, with the professional and pedagogical competencies carrying the most significant role in the learning process. These two skills correspond with the ability to teach the materials to students effectively (Mardhiyah et al., 2021). Besides, pedagogical competency is the central requirement for learning efficiency that facilitates students in achieving educational purposes. Additionally, this competency also represents the skills to use and develop learning media.

Students' skills can be improved using innovative learning than conventional learning (Hutasuhut, 2010; Loima, 2022; Saputra, Kurniawan, Rintayati, Midrati, 2021). The results of observation on the semester study plan showed that the learning material had been presented through presentation and discussion using active knowledge sharing without a specific learning strategy or model. A learning model guides learning and improves the students' skills. In this study, we examined a number of learning models, namely Project Brain-Based Learning (PjBBL), Project-Based Learning (PjBL), and Brain-Based Learning (BBL). Learning in the 21st century should focus on students' learning experience in completing projects, as well as the progression of their critical thinking, problem-solving, creativity, and collaborative skills.

Previous studies have generally focused on the implementation of PjBL in a broad sense, without specifically linking it to the BBL approach. Furthermore, although the creativity of prospective teachers is often mentioned as a crucial factor in education, few studies have specifically explored how this creativity develops within the context of constructing learning media based on project work and BBL principles. What has not yet become a central focus of previous research is the integration of neuroscience principles (which form the foundation of BBL) with the development of prospective teachers' creativity through concrete activities such as designing learning media. There is also a lack of studies highlighting how hands-on experiences in designing learning media through the PjBBL model can stimulate brain functions involved in the creative process, such as imagination, association, and reflection. This research contributes to a deeper understanding of how creativity can be fostered through a learning approach that aligns with the way the brain works.

Creativity is an essential 21st-century skill and a crucial competency in the learning process (Wicaksana & Sanjaya, 2022). Creativity is defined as the multidimensional construction carried out by every individual until a specific level. It also represents the individual's ability to create novel and irregular products to solve a problem. This skill has a connection with the ability to develop, organize, and identify new forms, as well as produce a product from imaginative skills. Meanwhile, Yulimarni, Baharudin, Widdiyanti, Prastawa, and Akbar (2021) described creativity as the interaction between relevant skills in science learning, as well as motivation, interest, concentration, and search for knowledge. The creative process is similar to the scientific process, which involves observation, hypothesis, experiment, and verification (Hidayat, 2017). Each of the stages of the scientific process also requires creativity.

A teacher has to be creative in continuously establishing an enjoyable learning environment so students do not get bored easily and face no learning difficulties. Excellent management of the learning process with students' creativity can facilitate the attainment of learning purposes (Farida, 2021). As students have a great responsibility, their creativity should be expanded. Various programs for creativity and innovative

development can be associated with the learning assignments and the roles of students. Accordingly, the planning and implementation of learning activities should be empowered, such as the learning material, method and approach, facility and infrastructure, and assessment (Puspitasari et al., 2020). The learning process can be refined using learning facilities or media. In planning the learning, the prospective teachers should provide clear illustrations for the abstract concept. Rohaeti et al. (2019) discovered the correlation between the central functions of learning media. The learning media can be modified using the factory instruments or the available second-hand materials (styrofoam, used bottle glass, rubber flip-flops). Transforming secondary goods into new ones also indicates creativity and innovation skills.

In addition, creativity skills can be enhanced through the scientific learning process and unusual thinking, such as problem-solving activities (Basam et al., 2018). The creativity-centered science learning has been reported to facilitate students to understand science concepts and develop their creativity (Hikmawati & Ayub, 2021; Mardhiyah et al., 2021). The research on science education has confirmed that learners greatly influence science teaching and the adoption of alternative forms of science activities. Commonly, science teaching and learning emphasize understanding natural phenomena, so science teaching involves creative elements and thinking skills for the problem-solving process (Iskandar, 2014; Karina et al., 2014; Nahdi, 2015).

Besides, science learning greatly emphasizes the visualization or production of images; novel combination of objects and ideas; creation of alternative usages of objects; solvency for problems and puzzles; fantasy; design of devices and tools; as well as the establishment of unconventional ideas. Additionally, creativity is one of the five domains of science education problems. Previous research reported that learning focusing on the process is more effective for increasing students' creative skills (Chamidiyah, 2015; Inayah et al., 2018). Examples of learning activities for expanding students' creativity are (1) giving assignments with alternative answers; (2) being open to students' answers which are different from the original concept; (3) focusing on the process rather than the results; (4) allowing students to try, examine the unclear information, and understand a concept relevant to a particular event; and (5) providing balanced structure and spontaneous activities (Titu, 2015). Creativity evolves during learning, focusing on creating a product with original, flexible, and integrative means through various hypotheses and perspectives (Mapeala & Siew, 2015). In this study, we analyzed the average ± standard deviation (SD) of the prospective teachers' creativity who have attended PjBBL, PjBL, BBL, and conventional models.

Creativity

Creativity is an individual's skills in creating unique meaningful new ideas and particular knowledge (Saleh *et al.,* 2019). It is the result of a creative thinking process that is directed to encourage students' ingenuity. Dewi *et al.* (2015) described creativity as the consequence of cognitive activities which develop new perspectives to solve problems unlimited to the pragmatic results.

In addition, the creative process demands the harmonious application of three essential aspects, namely analytical, creative, and practical skills (Erlina *et al.,* 2022; Hotimah, 2020). A balanced combination of the aspects of creativity generates an individual's intelligence and success. Creativity also correlates with involvement in the creative process and environmental support (Hotimah, 2020). Creativity can be enhanced through problem-solving exercises using an authentic learning environment *(The Fourth* Strategi IT in Pendidikan, 2014). Listiani (2020) contend that by focusing on the process, we can help students develop their creativity effectively. In improving creativity, students have to be provided with the chance to ask questions, conduct discussions, and solve problems through exploration guided by the lecturers (Khodabakhshzadeh, Hosseinnia, & Rahimian, 2017).

The original, flexible, and integrative procedures to answer a hypothesis using a number of different perspectives also improve students' Creativity (Zayyinah et al., 2022). Further, the integration of creativity development into courses also habituates students to implement their skills and learning results into daily life. The lecturers also have to establish an effective learning environment to facilitate active and creative students' involvement in the learning process while also increasing their creativity, responsibility, questioning, and decision-making skills (Ginanjar & Mukti, 2013; Yuliati, 2017).

Teaching

Although teaching has been approached from multiple perspectives and consequently has become the responsibility of the learner, the learning instruction directs learners to necessary information and challenges to engage in thinking about concepts they created in their minds. The teacher is someone who teaches, while the learner is someone who is learning. Both of these components must be included in a teaching process. Teaching should be carried out through specific procedures for students' practical thinking. According to Harianja & Sapri (2022), teaching is a process that reinforces students to reconstruct or re-regulate their experience by comprehending their meaning and constructing further experience. Meanwhile, Dewey reported that obtaining knowledge aids students in earning new information and expanding their skills to regulate the knowledge, which further increases their capacity to face future life problems. Thus, learners carry a central role in the learning process (Dewi *et al.,* 2021).

Burner describes teaching as the process of guiding learners through a series of statements and presentations of problems to boost their skills in understanding, changing, and implementing what they have learned (Harris & de Bruin, 2018). Therefore, the teachers' skills highly impact students' transformation of activities, mental involvement, and order of knowledge. However, learning may occur with no teachers through specific instructions for the students. In other words, learning requires instructions that can be facilitated by computers or other man-made devices. This individual learning is highly recommended in the 21st century.

Learning

In a learning process, students should actively participate, so learning will never occur with no students. Thus, the active participation of students facilitates the learning process. Besides, students' purposes, values, and aspirations affect their learning skills (Septikasari & Frasandy, 2018). In general, learning develops permanent changes in behavior from the individual's experiences which are unrelated to a momentary physical condition (Junaidi, 2020). The behaviorism theory explains that learning is manifested into behavior. Accordingly, the results of learning are demonstrated through the individuals' skills after the learning process.

In addition, learning is perceived as an active cognitive process to form or reconstruct a specific meaning. The cognitivist interprets meaning as the product of learning experience, specifically from the interaction with authentic worlds and their personal ideas (Indarini *et al.,* 2013). Further, learning experiences contain modifications, leading to learning from within rather than from the outside.

Meanwhile, in the cognitivist approach, learning is construed as gaining new knowledge, observation, and cognitive operation, while the behaviorist correlates learning with response to stimulus (Kim, 2006). Previous knowledge and experience, along with cognitive talent, are the crucial components of learning. Besides, the student's ability to interact with their environment and their cognitive structure enables learning (Tohir, 2020). Thus, the learning environment holds an essential role in improving students' knowledge, skills, and conceptual understanding.

Learning Model

Project Brain-Based Learning (PjBBL) has been established based on the superiorities offered by *Project-Based Learning* (PjBL) and *Brain-Based Learning* (BBL). It was developed following the examination of the syntax, principle reaction, social system, supporting system, instructional influences, and accompaniment influences (Joyce, Weil, Calhoun, 2016). The syntax of PjBBL consists of (1) providing the essential questions, material presentation, preparation, initiation, and acquisition; (2) designing a plan for the project and elaboration activities; (3) arranging the schedule of activities; (4) monitoring the activities and incubation, while also entering the memory; (5) evaluating the success, verify, and checking the confidence; as well as (6) evaluating students' experience, celebrating, and integrating. In the PjBBL, the reaction system includes administering essential questions, discussing the project plan, monitoring the activity, and evaluating the students' success, confidence, and experience. The social system of the PjBBL model is shown from the students' and lecturers' roles within the learning model. For the supporting system, the PjBBL model requires the learning material, students' worksheets, and learning media. The instructional model represents the attained learning results, while the accompaniment influence is the students' creativity.

Learning Media

The increasing availability of information and communication device of various sizes and costs greatly correlates with the potential usage of technology devices in critical thinking and problem-solving learning. With this technology, learners and teachers have more extensive opportunities to improve their required skills in the recent century (Sari *et al.,* 2022). Recently, the available technology has focused more on the learners' experience. Accordingly, investigation-based learning can be carried out using media, instruments, strategy, and application to facilitate learning with exploration, thinking, writing, reading, researching, problem-solving, and identification activities.

Learning media is defined as every instrument that facilitates the dissemination of learning material as well as provokes students' emotion, thought, willingness, and learning (Erlina *et al.,* 2022; Marzuki, Zuchdi, Hajaroh, Imtihan, 2017). Further, it can be understood as the tools that facilitate effective and efficient learning, physically or virtually (Sari *et al.,* 2022). Learning media is predicted to accelerate material comprehension and students' active learning participation. Technology-based multimedia can be used as an alternative to learning media. Wang (2014) uncovered that multimedia carries significant effects on the improvement of learning results.

Marzuki, Zuchdi, Hajaroh, and Imtihan (2017) divide three primary principles for the implementation of learning media. First, the efficacy and efficiency principle represents the attainment of the learning process to achieve the learning purposes effectively, as well as the maximum usage of time, cost, infrastructure, and other resources. The second principle is relevance. This principle obligates learners to select media based on the learning goals, content, methodology, and evaluation. The third principle is productivity which represents the optimum usage of the available human and natural sources during the learning process.

METHODS

This descriptive qualitative study aims to identify the prospective teachers' creativity in constructing a learning media. The descriptive analysis was conducted since it accurately illustrates an individual, event, or group of people (Sueb et al., 2022).

Participant

Our population was 287 students from the elementary school teacher program, which were divided into ten classes. The research subjects were selected based on students' learning outcomes. A total of 131 students were then chosen, consisting of 43 with high

ability levels, 45 with moderate ability levels, and 43 with low ability levels. This study was conducted from March to June 2024.

Material

For the research instrument, we used a test and scoring sheet. The validity test was conducted to determine the extent to which each item in the instrument accurately measures aspects of creativity. Validity was tested using the Pearson Product Moment correlatioan between individual item scores and the total score. The reliability test was conducted to measure the consistency of the instrument. This test used the Cronbach's Alpha formula. The participants' creativity in developing learning media was assessed using the indicators of creativity summarized in Table 1.

Prosedure

The data collection instruments underwent a validity test involving the experts. Before the data collection process, the participants were divided into five different classes using different learning models. The first (A) to the fourth (D) classes learned using Project Brain-Based Learning (PjBBL), Project Based Learning (PjBL), Brain-Based Learning (BBL), and conventional learning models.

In this study, we conducted two types of validity tests, namely the content and construct validity tests. The content validity test was completed through the judgment of relevant experts. The test was conducted over the course of one semester, and the validity testing was carried out prior to the implementation of the research activities. Meanwhile, the assessment instrument was constructed based on the five aspects of learning media development enacted by the Indonesia National Education Department in 2006.

Data Analysis

The obtained data were analyzed using descriptive statistic analysis to get the average and standard deviation from the data. The descriptive analysis results illustrated the prospective teachers' creativity in every class. Astriani (2020) described the categorization of creativity scores, ranging from 81–100 (very high), 61–80 (high), 41–60 (moderate), 21–40 (low), and 1–20 (very low).

TABLE 1. *Indicators of creativity*

Sub-variable	Indicators
Organization of general material presentation	1) Materials are presented systematically and logically 2) Support the learner's active participation in expressing and sharing ideas
Material presentation from the significance and usefulness	3) Correlating various concepts in explaining a phenomenon 4) Connecting concepts with real-life events
Active participation of the learners	5) The learning material should be applicable to collaborative learning
General display	6) Figure or illustration suitable to the concept 7) Suitable title or description of figure 8)Clear and colorful authentic figures, animation, graphics, and other depictions 9) Enhance the reading interest of the teachers and learners
Variations of information transfer	10) Apparent and accurate information that grows students' comprehension

(Source: Department of National Education, 2006).

TABLE 2. *Creativity of research participants*

Indicator	Class				Average Score	Category
	PjBBL	PjBL	BBL	Conventional		
1	80	72	76	74	75.5	High
2	78	65	62	68	68.25	High
3	85	76	76	74	77.75	High
4	68	58	54	54	58.5	Moderate
5	82	74	76	76	77	High
6	87	78	82	80	81.75	Very high
7	85	82	80	82	82.25	Very high
8	87	74	78	74	78.25	High
9	85	76	72	74	76.75	High
10	90	82	78	82	83	Very high
Total Average Score					**75.9**	**High**

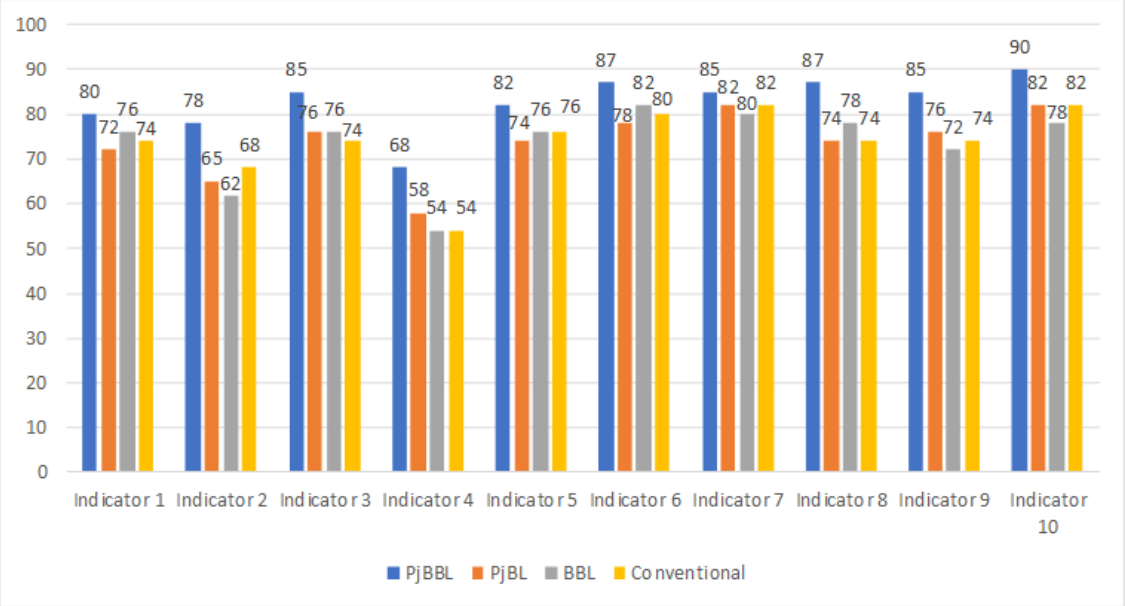

FIGURE 1. *The creativity of participants*

In addition, we also used inferential statistics to identify different creativity scores from different classes. For this analysis, we used one-way ANOVA analysis, which was preceded by the prerequisite tests consisting of normality, homogeneity, and linearity tests. For the normality test, we conducted Kolmogorov-Smirnov, while the Levene test was used as the homogeneity test, and ANOVA was used as the linearity test. The requirement for the decision-making was a significant score greater than (α = 0,05). All of the inferential statistics were carried out using the statistic software. If the results showed differences, then we conducted a further analysis using the Bonferroni test.

RESULTS

Our results suggested that the prospective teachers attending the PjBBL learning model have produced products following the standards. These products were evaluated using the criteria proposed by Astriani (2020). The details of our results are described in the following.

Creativity during the Learning Process

The participants' creativity was assessed through observation and tests. Creativity indicators can be seen in Table 1. The creativity of participants is summarized in Table 2.

TABLE 3. *Participant percentage score from every class*

Class	Scores Percentage in Each Category				
	Very low	Low	Moderate	High	Very High
PjBBL	5.88	14.71	11.76	29.41	38.24
PjBL	18.75	25.00	3.13	53.13	0
BBL	9.38	6.25	9.38	71.88	3.13
Conventional	15.15	18.18	9.09	57.58	0

TABLE 4. *Summary of descriptive statistics results based on the classes*

Class	N	Minimum	Maximum	Mean	Std. Deviation
PjBBL	34	70.60	89.70	80.77	5.19
PjBL	32	63.20	84.30	75.46	6.15
BBL	32	67.60	85.60	78.91	5.54
Conventional	33	60.80	76.10	68.38	4.34
Total	131			75.89	7.12

TABLE 5. *Results of the oneway ANOVA test*

	Sum of Squares	*df*	Mean Square	*F*	*Sig.*
Between groups	2970,486	3	990,162	34,774	.000
Within groups	3616,224	127	28,474		
Total	6586,710	130			

TABLE 6. *Results of the bonferroni test*

	Average Difference	Std. Error	Confidence Intervals 95%		P-value
			Minimum	Maximum	
PjBBL vs. PjBL	5,320	1,314	1,80	8,84	.001
PjBBL vs. BBL	1,864	1,314	-1,66	5,39	.951
PjBBL vs. Conventional	12,395	1,304	8,90	15,89	.000
PjBL vs. BBL	-3,456	1,334	-7,03	0,12	.064
PjBL vs. Conventional	7,074	1,324	3,53	10,62	.000
BBL vs. Conventional	10,531	1,324	6,98	14,08	.000

As shown in Table 2, in general, the participants have relatively high scores, even though some of their scores are in the moderate and very high categories. For instance, the average score in indicator 4 is classified as moderate, while the scores in indicators 1, 2, 3, 5, 8, and 9 are categorized as high, and the scores in indicators 6, 7, and 10 are categorized as very high, as illustrated in Figure 1.

The analysis results showed that conventional classes do not always have low scores, as presented in their average scores in indicators 2, 5, 6, 7, and 10. Even in some indicators, the participants from the conventional class have more excellent scores than those from PjBL and BBL classes. The detailed total creativity scores from the participants in each class are listed in Table 3.

Table 3 presented the total participants' score percentage in every category, with the highest score attained by participants from PjBBL, followed by those attending the BBL, PjBL, and conventional classes. The summary of descriptive statistic results of participants' creativity is presented in Table 4.

As presented in Table 4, the average score and standard deviation for the PjBBL, PjBL, BBL, and conventional are 80.77 ± 5.19, 75.46 ± 6.15, 78.91 ± 5.54, and 68.38 ± 4.34, respectively. The average of those scores is 75.89, with a 7.12 standard deviation. These scores indicate similar average creativity scores from participants in different classes.

Different Creativity Skills of Participants from Different Classes

Prior to the ANOVA test, we carried out the normality, homogeneity, and linearity test. The normality test was completed using the Kolmogorov-Smirnov, showing p-values of .134, .127, .090, and .113 > .05 for the participants attending the PjBBL, PjBL, BBL, and conventional classes, respectively. These scores showed the samples originated from a

population with normal distribution. The Lavene test results show a p-value of 0.933 > .05, indicating a variation in creativity level between the participants. The third test was the ANOVA test. The results of the ANOVA test suggested 0.576 > 0.05 deviation from the linearity value, demonstrating a linear and significant correlation between the class and score variables. Following the results of prerequisite tests, the hypothesis test was carried out using the Oneway ANOVA test. The summary of the hypothesis test results is presented in Table 5.

According to Table 5, we obtained a p-value of 0.000 < 0.05. The formulated hypothesis in this study is H_0 (there are no differences in creativity skills among participants attending PjBBL, PjBL, BBL, and conventional classes) and H_1 (there are differences in creativity skills among participants attending PjBBL, PjBL, BBL, and conventional classes). The obtained p-value indicated that the H_0 was rejected while the H_1 was accepted. Therefore, we concluded that there had been significant differences in creativity skills between students attending PjBBL, PjBL, BBL, and conventional learning models. Consequently, we conducted a further analysis using the Bonferroni test.

The Bonferroni test results presented in Table 6 showed p < .005 from participants attending PjBBL with PjBL, PjBBL with conventional, PjBL with conventional, and BBL with conventional. This finding suggested different creativity in participants from PjBBL with PjBL, PjBBL with conventional, PjBL with conventional, and BBL with conventional classes.

The results indicate significant differences in students' creativity based on the learning model applied. A significant difference (p = 0.001) was found between students in the PjBBL and PjBL groups, with a mean difference of 5.320. This suggests that integrating brain-based principles into project learning offers a greater enhancement in creativity than project learning alone. No significant difference (p = 0.951) was found between PjBBL and BBL, indicating that both models are similarly effective in enhancing creativity. This may imply that brain-based principles are the key factor contributing to creativity development, regardless of whether they are implemented with project-based components. A highly significant difference (p = 0.000) was observed between the PjBBL and conventional groups, with a mean difference of 12.395. This highlights the substantial impact of PjBBL in fostering creativity compared to traditional methods that often lack student engagement and creative stimulation. Although the difference between PjBL and BBL was not statistically significant (p = 0.064), it approached significance. The result indicates a slight tendency for BBL to be more effective in fostering creativity than PjBL, though the evidence is not strong enough to confirm a clear distinction. A significant difference (p = 0.000) with a mean difference of 7.074 was found, demonstrating that PjBL is more effective than conventional learning in promoting creative thinking, likely due to the active and student-centered nature of project work. BBL also showed a significant advantage (p = 0.000) over conventional methods, with a mean difference of 10.531. This confirms that brain-compatible learning environments are effective in stimulating students' creative potential.

These findings reinforce the importance of innovative instructional models such as PjBBL and BBL in education, particularly for enhancing students' creativity. PjBBL, in particular, successfully combines the strengths of project-based learning with neuroscience-informed strategies to produce significantly higher levels of creativity. Therefore, educators and institutions are encouraged to adopt and integrate such models, especially in teacher education and 21st-century learning contexts.

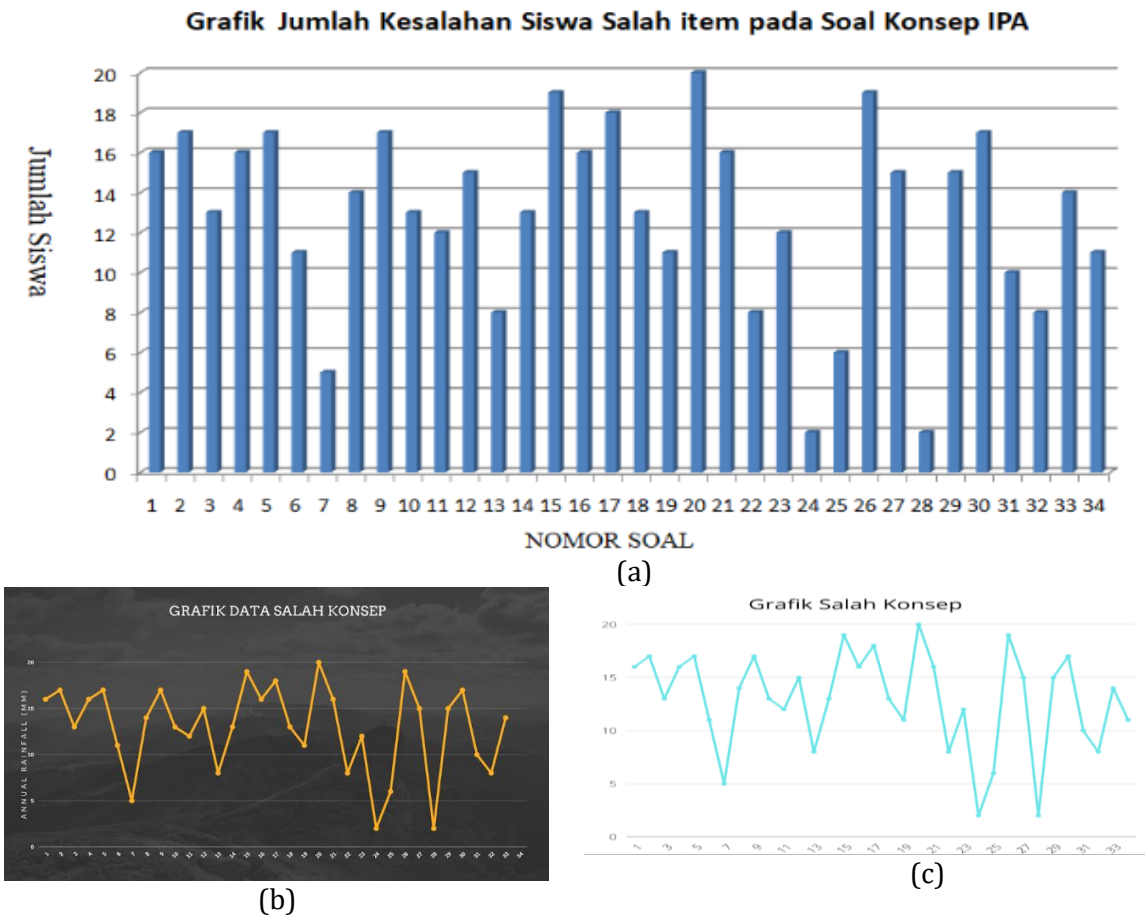

FIGURE 2. *(A) The correct graphic; (b) and (c) incorrect graphic*

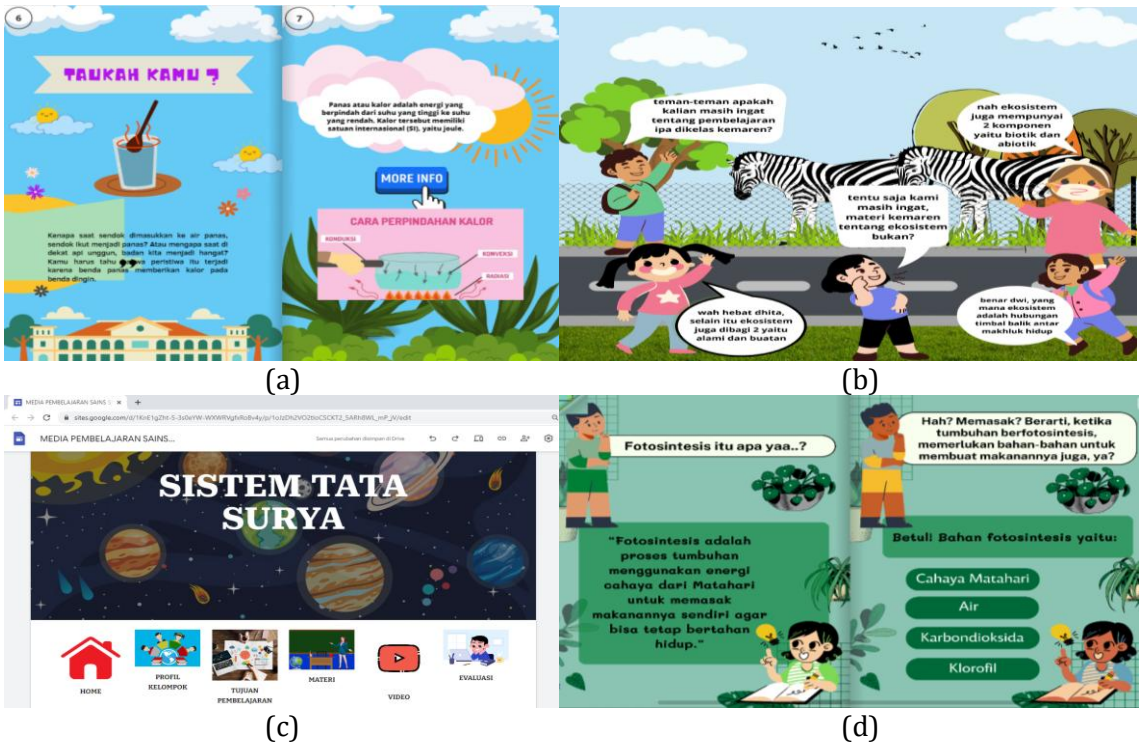

FIGURE 3. *Learning media developed by participants attending PjBBL (a) developed using canvas, (b) comic media, (c) Google Site, (d) FlipBook*

DISCUSSION

Creativity during the Learning Process

In this session, the participants' creativity is discussed based on the obtained three groups of score classification, namely moderate (indicator 4), high (indicators 1, 2, 3, 5, 8, and 9), as well as very high (indicator 6, 7, and 10). First, the participants obtained an average moderate score only in indicator 4. This indicator illustrates the participants' ability to correlate the concepts they have learned with their real life. Our analysis results disclose the prospective teachers' difficulties in connecting their learned materials with real-life experience. They encounter challenges in discussing the materials using their authentic experience. They also face issues in describing phenomena during the Science Learning Development (SLD) course. Similarly, previous research also reported students' inability to expand their scientific behavior, especially in correlating the knowledge obtained from the SLD courses (Wicaksana & Sanjaya, 2022). Meanwhile, the connection between the concepts and real-life experience is essential to grow students' problem-solving skills and ability to create creative products (Dewi et al., 2021).

In indicator 1, the participants secured the highest average scores. In this indicator, the participants were asked to submit issues using systematical and logical graphics or diagrams. The examples of participants' work in indicator 1 are shown in Figure 2. Figure 2 (a) shows the correct participants' diagram with a suitable title and description, and in Figure 2 (2), the participants give incomplete descriptions. Meanwhile, the participants' answer shown in Figure 2 (c) is also incorrect due to the inaccurate information, from the supposedly 34, the participant only report 33. Further, Figure 2 also illustrates the participants' high average score in indicator 8 since their drawings are authentic, clear, and colorful. In addition, the participants also obtained high average scores in indicators 1 and 2 due to the participants were given the student-centered learning model. The participants also show great ability in analyzing the connections between concepts, so they have a high average score in indicator 3. Indicators 5 and 9 describe the prospective teachers' skills in developing a learning media with topics applicable to collaborative learning that can enhance students' and teachers' reading interests. The participants have constructed the media systematically, effectively, and interestingly, with great variations. The examples of media developed by the participants are shown in Figure 3. In detail, Figure 3a is a module for the shape transformation developed using the Canva application, Figure 3b is a comic for ecosystem material developed using the Canva application, Figure 3c is the module for solar system material made using GoogleSite platform, and Figure 3d is a photosynthesis module made using flipbook application.

In indicators 6, 7, and 10, the participants attained very high scores. Indicator 6 illustrates the participants' skills in creating figures or illustrations according to the concept. The participants have constructed media following the material being discussed, as shown in Figures 3 (a-d). The participants also obtained very high average scores in indicators 6 and 7 due to the suitable titles and descriptions for their figures. The apparent and accurate information and material within the learning media are essential to avoid misconceptions.

Different Creativity Skills of Participants from Different Classes

The obtained Oneway ANOVA results indicated significant differences in creativity levels among participants attending the PjBBL, PjBL, BBL, and conventional learning models (p-value= .000< .05). creativity correlates with someone's thinking process (Hidayat, 2017). The management of creativity can be enhanced through continuous and intensive intelligence coaching, which results in new and authentic ideas. Mayasari et al. (2016) contend that individual thinking can optimize the process of information in the brain. Accordingly, individuals can find solutions, solve problems, and generate novel ideas.

Further, the connection between thinking, brain, and intelligent potential serve as the determinant factors for stimulating creativity.

Following the constant transformation of education, students are expected to be more creative. In expanding students' creativity, teachers have to adopt an innovative approach to arrange effective learning (Sholahuddin et al., 2021). Meanwhile, Khodabakhshzadeh, Hosseinnia, Moghadam, & Ahmadi (2019) added that ideal teachers should be friendly, highly motivated, not anxious, objective, non-authoritative, smart and sensitive in preparing the materials, managing the class, and others. Accordingly, those criteria are crucial for teachers to facilitate effective learning for students (Ferry & Kamil, 2019).

During learning, teachers act as collaborators that aid students in identifying various learning sources. Essentially, teachers have to provide authentic material to support and enhance learners' motivation, fulfilling the needs of learners and integrating science into learning (Gamanik et al., 2019; Wicaksana & Sanjaya, 2022). Additionally, learners should be facilitated by more extensive chances for sharing and discussing ideas since their communication can be done in multiple ways of communication (Yulimarni, Baharudin, Widdiyanti, Prastawa, Akbar, 2021). Through those activities, learners are given the opportunity to garner ideas and knowledge. Linearly, Mardhiyah et al. (2021), and Sanaiey et al. (2016) described that student-centered learning enhances learners' analytical, problem-solving, learning, and motivation, as well as their life-long, independent, and reflective learning. Consequently, the teacher's creativity is substantial to accommodate learners' ideas.

The teacher's creativity also impacts the learner's learning results. It is useful for modifying the learning strategy based on the learner's characteristics and the learning materials (Sobron et al., 2020). Learning strategy influences students' learning comprehension. Thus, the teacher's creativity should be optimized during learning (Lisliana et al., 2016). For optimum learning activities, teachers have to improve their creativity to achieve the central purposes of education. Besides, creativity also serves as a vital instrument for the problem-solving process and for overcoming future challenges (Al-Qahtani, 2016).

Meanwhile, scientific creativity is an intellectual skill that enables someone to generate meaningful and original products using the available information (Erlina et al., 2022). This scientific creativity is also correlated with the feedback among several cognitive factors, such as intelligence, concentration, skills, and permutations of mental elements, as well as several non-cognitive factors, such as motivation, personality, and interest (Hikmawati & Ayub, 2021; Li et al., 2009). Individuals with excellent scientific creativity present unique problem-solving and are capable of recognizing the best problem-solving for particular scientific issues (Wardani &Yustitia, 2017).

CONCLUSION

From our analysis results, we concluded that the prospective teachers have relatively high relatively. Creativity is affected by an individual's thinking skills while thinking skill is influenced by intensive and continuous training. Through intensive and continuous training with students' centered learning, the prospective teachers are facilitated to regulate and increase their thinking from the elementary to the university level. Further, their experience from these activities can be the initial modal to enhance their creativity. Research shows the empowerment of creativity through the implementation of comprehensive learning models on different subjects. It is hoped that this research can provide new knowledge for the creativity of prospective elementary school teachers, based on the implemented learning model.

Practical research applications lie in project activities that emphasize brain activity and group collaboration. Learning with the pressure of how the brain works is considered optimal in developing the capacity and abilities possessed by someone so that they are able to find solutions and the right way to prohibit learning materials for elementary

school students. Teaching should be carried out through specific procedures for students' practical thinking but, teaching is a process that reinforces students to reconstruct or re-regulate their experience by comprehending their meaning and constructing further experience. Students in earning new information and expanding their skills to regulate the knowledge, which further increases their capacity to face future life problems.

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