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Community-Based Project Learning: Empowering Students' Self-Regulated Learning and Creativity

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Abstract: Changes and challenges in the highly dynamic world of education require postgraduate students to manage their learning well and create something from their creative thinking according to the needs of the field. One of them is the activity of students in developing integrated natural science teaching materials is very necessary because learning at the primary level still uses integrated or thematic learning. Furthermore, students also need to be encouraged to be adaptive to these challenges by empowering their independence in learning. The ability to manage learning and creativity to create something new is highly prioritized for college graduates to contribute generously to their environment. This study aims to describe the empowerment of self-regulated learning and student creativity in developing natural science teaching materials in collaboration through community-based project learning. This study used a quasi-experimental design with a single-subject design type. The instruments used to retrieve data are creativity assessment rubrics and self-regulated learning questionnaires. The conclusion is that students are intrinsically and extrinsically motivated to fulfill the given tasks. Learning is essential for increasing competence, and learning strategies have been adjusted to the material's complexity or the difficulty level of the studied content. The aspect of student creativity in developing Integrated Science teaching materials shows the existence of change from stage one to the next and good categories.

Keywords: *Community, creativity, project, self-regulated learning.*

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Introduction

Self-regulated learning is essential for encouraging students to take responsibility for their achievements and learning progress (Dent & Koenka, 2016). Students must be actively and independently involved through project-based learning during the learning process. Lecturers only monitor student activities and provide assistance if needed (Gurung & Rutledge, 2014). Ongoing assessments and helpful feedback to measure student learning progress (Reigeluth et al., 2016). Learning scenarios and environments need to be designed to familiarize students with learning independently and be able to develop their creativity in addition to cognitive aspects (Artino & Jones, 2012). Efforts must be made to create systematic learning so that it is easy for students to follow and provide clear information about what will be achieved and how to achieve these targets or goals (Vrieling et al., 2018).

A preliminary study conducted by researchers through a survey of 97 prospective elementary school teachers shows that 45% of students are motivated to complete assignments to get good grades at the end of lectures. The orientation to achieving the maximum score at the end of the course is not to blame, but students need to also focus on rewarding a task to develop skills and interpret the process. Often, students expect maximum grades without maximal effort or strategies.

In addition, students are also less persistent in managing their learning strategies to interpret the ongoing learning process, as the survey results show that only 25% of students never give up on problems that are not familiar during learning. As many as 80.4% of students do not focus during education and do things outside the learning context. Students learn when the exam is held by 61%, and students are almost entirely passive in fulfilling tasks in learning, as evidenced by as many as 91% of students waiting for instructions and directions from lecturers regarding assignments.

According to constructivist learning theory, learning must be able to facilitate students to be actively involved in learning to build knowledge through the presentation of authentic education and a learning environment that supports

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collaboration in solving a problem in a learning topic (Reigeluth et al., 2016). Students need to be accustomed to experiencing meaningful learning in social interaction to build knowledge (Hung et al., 2007), for example, problem-based learning, projects, questions, or emerging issues.

The problems used in learning need to prioritize problems called ill-structured problems. This problem has an unclear purpose, a variety of solutions, and ways of solving it, and it requires students to be active as decision-makers (Jonassen, 1997). Collaborations between students and their environment can give rise to various perspectives on a problem phenomenon. Interaction between multiple cultures and backgrounds in a community becomes a medium for sharing ideas according to the context (Hung et al., 2007).

As the theory of learning humanism explains, students must be given independence or freedom in developing themselves, finding problems that they think are important to study and solve with their ideas and strategies (Rogers, 1970). Based on this background, learning needs to facilitate students to be empowered with themselves, to become independent students, creative through contextual problem-based learning, and empowered through collaboration with parties outside the campus.

Based on the results of two instructors' observations of learning in the integrated science course last year, many postgraduate students still have difficulty developing teaching materials, especially those presented in an integrated way between several pieces of content. This problem is also a common problem experienced by practitioners in elementary schools. This finding was obtained when researchers explored through interviews the insights of students who had worked as teachers and taken courses in developing integrated teaching materials in the previous year. Almost all students think integrated learning is a container that wraps several subjects with themes. However, in practice, the learning conditions given to students are still separate for one subject. For example, the concept of building space in mathematics is not integrated with other subjects in its presentation. Furthermore, it has a tangible impact on the learning achievement of students who have not understood the concept holistically, its application, and its relationship with daily life.

The demand of learning today is that students can master higher-order thinking skills, and teachers must also continue to innovate to produce teaching materials that suit the needs of their students as well as the demands of current educational progress. Thus, it is clear that students must improve their ability to develop teaching materials that are integrated between lesson content and manage their learning independently to understand basic concepts or complete complex tasks. Community-based project learning is required to empower self-regulated learning and student creativity in developing Integrated Science teaching materials.

In the project-based learning model, what is usually done is that fellow students collaborate to solve problems. However, in this study, postgraduate students collaborate with science teachers in an elementary school and build a community that synergizes with each other to solve problems in integrated science learning in elementary schools.

This research aims to empower self-regulated learning and student creativity in developing integrated science teaching materials. The study investigates how self-regulated learning students are during community-based project learning and how students' creativity in developing Integrated Science teaching materials while participating in community-based project learning. In this independent and life-based learning, it is necessary to provide opportunities for students to create and be empowered to become independent and creative learners through collaboration with academics outside the campus to overcome the problems of the learning process in elementary schools.

Literature Review

Self-Regulated Learning

Self-directed learning is appropriate for adult learners as long as they have a level of maturity in knowledge of the subject matter, interest or motivation to acquire knowledge, responsibility for learning, and learning skills (Aslanian, 1983). Past learning experiences, expectations and attitudes about future learning, and prior knowledge characterize a learner's maturity. A study by Knowles (1980) shows that adult learning is characterized by new experiences that affect concept change, freedom and responsibility in decision-making, increased self-motivation, knowledge use in practical problems, and priority in solving practical problems. Self-regulated learning has been studied extensively in primary and secondary education but rarely in higher education (Sitzmann & Ely, 2011). The greater the autonomy of students in higher education concerning the learning process, the more excellent the opportunity for students to direct their learning activities according to their interests, such as expanding their knowledge through learning outside the classroom by monitoring their learning progress (Beishuizen & Steffens, 2011; Wang et al., 2013). Self-regulated learning activities only partially mediate the increase in achievement after the self-regulated learning treatment, so further testing of the impact of SRL interventions on SRL activities and achievement is still needed (Jansen et al., 2019).

Self-regulated learning (SRL) includes five indicators: intrinsic goal orientation, confidence in learning, assessment of tasks, control of learning beliefs, and effort regulation (Pintrich et al., 1993). Planning activities involve determining learning goals, reading the material, writing down questions, and analyzing tasks from a given problem. This activity makes it easier for individuals to assess cognitive strategies and accumulate the initial knowledge they already have.

Learners need to be involved in planning tasks, controlling the progression of studies or their difficulties, and evaluating the achievement of their learning goals. This method motivates students to achieve goals and actively make learning strategies (Abar & Loken, 2010; Zimmerman, 2008). Monitor activities include paying attention to essential parts when reading or listening and answering questions to check comprehension. The regulatory strategy is carried out by re-reading the material related to the question (Pintrich, 1999). Learners monitor, reflect, and adjust their learning methods to master the content or task and overcome failures (Pintrich, 2004; Zimmerman, 2008). Sierens et al. (2009) explained that teachers are encouraged to provide support, guidance, and expectations that support students' autonomy in assessing themselves, planning learning activities, and reflecting on themselves as learners.

Self-confidence in learning is built through good learning management by the instructor. The strategy is to provide guidance when learners have difficulties, provide a discussion forum and provide feedback as soon as possible (Van Merriënboer & Sluijsmans, 2009). Guidance is provided through individual monitors, interactions in discussion groups, and study group activities. Thus, various strategies need to be carried out by the instructor to encourage learners to improve intrinsic goal orientation, confidence, and ability to manage to learn (Cho & Jonassen, 2009).

Self-regulated learning skills are widely studied in online learning. Bol and Garner (2011), Broadbent and Poon (2015), Cho and Heron (2015), and Kuo et al. (2013) explained that independent management of the learning process determines a student's success in achieving the goals or objectives they set for themselves in online learning. Lee et al. (2020) have also explained in their research that a student who is confident in his learning can direct his learning independently well. Jansen et al. (2020) showed that SRL interventions during the MOOC could improve course completion and SRL activities on pre-learning metacognitive activities, seeking help or using resources, and enthusiasm to complete the material taken in the MOOC. However, these studies only emphasize how students demonstrate self-regulated learning skills while interacting with online learning content and are individualized. Online learning and distance education mainly emphasize the interaction between students and learning content; for example, a study conducted by Wong et al. (2021) found that an online learning video-based learning environment helps students set learning goals and action plans to complete tasks.

Meanwhile, according to Joyce et al. (2017), learning also requires a social system so that students' insights and skills develop in heterogeneous conditions. Therefore, it is necessary to study how students' social interaction with their environment can develop self-regulated learning skills. Research on self-regulated learning skills in face-to-face learning is rare, so the researchers want to investigate how community-based project learning conducted face-to-face can strengthen these skills. In addition, considering that graduate students are already mature learners, this study aims to determine whether the intervention, namely community-based project learning, can strengthen self-regulated learning in postgraduate students.

Creativity

Creativity is shown by something new in the results of thoughts/actions and physical objects (Wong et al., 2021). Potential, activity, and creative thinking can develop in uncertain situations. For example, technological developments, cognitive complexity, and uncertainty of social change urge us to respond to these conditions creatively to produce creative solutions, even if they are valid in the short term and not permanently (Beghetto, 2021). Real-life problems provide a context to encourage students to consider multiple alternative solutions and become adept at active communication (Meijerman et al., 2016; Yuan et al., 2008). Given the uncertainty of integrated learning problems in elementary schools, this study aims to determine whether community-based project learning can enhance students' creativity, especially in developing integrated science teaching materials that meet the needs of elementary school students.

Creativity consists of four categories: creative self-perception, creative ability, creative activity, and creative achievement (Lebuda et al., 2021). Generative and evaluative thinking becomes the determinant of creative action. Seeing the novelty of various alternatives allows a person to create something and produce creative achievements (Montag-Smit & Maertz, 2017). However, it is necessary to have the ability to evaluate, assess and reflect on the ideas or strategies used to get the expected results through several criticisms and considerations (Runco & Jaeger, 2012).

Creative skills can be developed and improved through experience or practice. Lecturers and teachers need to facilitate by creating a supportive learning environment to change the mindset of students so that they can become creative learners (Beghetto & Kaufman, 2014). First, lecturers must consider every student's opinion or idea (Beghetto, 2009). Second, appreciate every process students use to find ideas and even novelty. Third, invite students to motivate themselves when assessing a person's creativity by integrating intrapersonal and interpersonal criteria (Peng et al., 2013). It shows a positive relationship between the creative mindset, the creative process, and creative achievements (Puente-Díaz & Cavazos-arroyo, 2017).

The stimulus questions can lead students to capture real problems (Krajcik & Blumenfeld, 2005; Meijerman et al., 2016; Thompson & Beak, 2007). It is related to thematic learning in schools. The problem faced during thematic education found by postgraduate students, in general, is that elementary school students have not been able to think holistically, relating concepts to one another, especially concerning daily life. With this community-based project learning, postgraduate students are expected to apply their knowledge to solve these problems and learn more meaningfully because it is based on real experiences, and working with practitioners in the community encourages students to develop more diverse ideas.

Community-Based Project Learning

Project-based learning is a learning method that exposes students to problems that are not familiar or complicated with stages of orientation to problems, setting learning goals, conducting a series of scientific investigations, collaborating, utilizing learning technology, and creating a product (Krajcik & Shin, 2014). This method involves students in solving problems that exist in real life and producing the end product which is relevant to the cases. In other words, students are encouraged to have authentic experiences (Gülbahar & Tinmaz, 2006; Merrill, 2015). In that case, students can develop their abilities in addition to having a deep understanding of a problem through a series of stages of finding solutions.

Project-based learning is one of the methods to encourage effective learning. First, students are encouraged to actively build ideas and knowledge from a series of meaningful processes, namely combining initial knowledge and extracting information from various sources about a problem. Working with people from different backgrounds can lead to innovative ideas (Barak & Yuan, 2021; Splichal et al., 2018). Second, this learning method allows students to conduct investigations to solve problems and capture the relationship between multiple ideas (Gomez-del Rio & Rodriguez, 2022). Third, a collaboration between students, lecturers, and parties outside the campus can enrich information, connect various views, and deepen understanding (Krajcik & Blumenfeld, 2005; Krajcik & Shin, 2014; Thompson & Beak, 2007). Fourth, communication makes it easier for students to get reinforcement in completing a project. Different insights from practitioners and students complement each other to create new ideas for a project (Usher & Barak, 2020).

In the project-based learning model, students interact and collaborate to solve problems. However, in community-based project learning, students collaborate with science teachers in an elementary school. Thus, elementary school science teachers and postgraduate students can build a community that synergizes with each other to solve problems in integrated science learning in elementary schools. Therefore, this study aims to determine whether community-based project learning can empower students' self-regulated learning and creativity while solving integrated science learning problems in elementary schools.

Here are the stages in community-based project learning. First, students explore the content of integrated science. Second, students review the problem of integrated science. Third, students collaborate and build communities with elementary school science teachers to analyze the issues in the field. Fourth, students and teachers plan solutions following the problems found in integrated science learning. Fifth, students present projects produced by their community. The lecturer facilitates project planning and completion and encourages students to think critically and creatively while collaborating within the community. A community-based project learning model is shown in Figure 1.

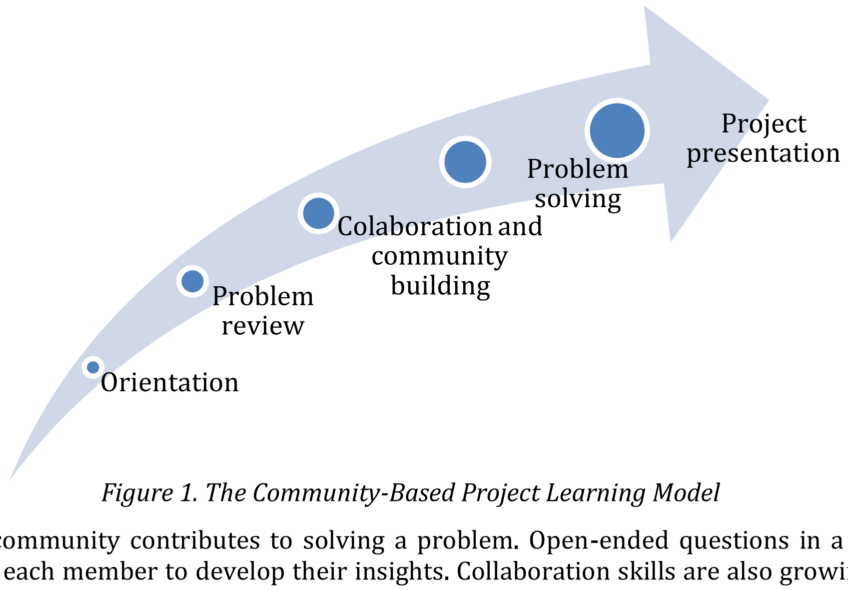

Figure 1. The Community-Based Project Learning Model

Every member of the community contributes to solving a problem. Open-ended questions in a discussion can build comfort and encourage each member to develop their insights. Collaboration skills are also growing with the existence of a community; even this has a positive impact on student career development in the future. Students will be accustomed to building learning strategies and sharing with fellow community members to evaluate and produce strategic improvements that are arranged in such a way based on the agreement during social interactions within the community (Lobczowski et al., 2021). Learning in a community can develop emotional intelligence (Peña-Sarrionandia et al., 2015). In addition, through this collaboration, students can develop creative ideas to overcome a problem (Barak et al., 2020).

Table 1 describes the five components of a community-based project learning model.

Table 1. Five Components in A Community-Based Project Learning Model

Syntax	Social System	Reaction Principle	Support System	Instructional Impact
1. Orientation	Students exchange insights and information related to Integrated Science Learning.	The lecturer presents a case, and students respond	Modules are provided, and students are free to access other literature in the form of books or articles	Students can analyze the nature and principles of Integrated Science Learning
2. Review the problem	Students exchange information about integrated science learning problems	The lecturer asked students to find integrated science learning problems from various literature, and students responded	Varied coverage in print media or articles that students can access	Students can find current issues related to integrated science learning problems
3. Collaboration and community building	Students collaborate with science teachers in elementary schools to explore problems in the field.	Lecturers provide opportunities for students to explore problems through collaboration and act as facilitators.	Information on integrated science learning in elementary schools is extracted through observation and *need assessment.*	Students can work together and find the subject matter of integrated science learning.
4. Problem-solving	Students work with teachers to find relevant solutions	Lecturers encourage students to persevere in critical thinking and collaboration	Students can access relevant articles, books, and online media	Students can solve problems through collaboration
5. Project presentation	Students exchange information about projects with their respective communities and respond to each other.	Lecturers provide feedback, and students respond.	Project results	Students can communicate the results of their projects with their communities.

Self-regulated learning begins to be empowered in the second stage of learning, which is to review the problem. Students need to share information to solve the problem. Problem identification is undoubtedly the first stage required, and students are encouraged to explore insights or prior knowledge related to the problem. The first problem identification process is carried out by reflecting on the learning in primary schools that students, especially in integrated learning, have carried out. The main thing that students need to explore concerning the theory of integrated learning studied at the beginning of the lecture is the fit between learning objectives, learning processes, and learning outcomes. After students understand the mismatch between the objectives and the outcomes, they are involved in planning an action. Action planning is the initial stage of someone being interested, responsive, and appreciative of a task to be completed in self-regulated learning. Forms of action planning include determining the goals that must be achieved to guide the actions to be taken and identifying the information needed. Information used to complete a task can come from the internal environment, namely the knowledge possessed by students during lectures, and from the external environment to enrich insights, namely teachers in elementary schools with varying levels of ability to teach integrated learning.

In the third stage of learning, collaboration, and community building, students share information with elementary school teachers related to issues identified from multiple literature reviews and students' personal experiences during integrated science learning lectures. In this case, students explore information, especially things that need to be improved during the integrated learning process. The data obtained in the field became material for discussion with elementary school teachers.

In the fourth stage, after the students have found real problems in the field, they are encouraged to be able to overcome these problems by working with teachers in elementary schools. To solve a problem, students must identify the relevant knowledge, what strategies must be implemented if there are obstacles in overcoming the problem, and evaluate the extent to which the plans and actions achieved the specified goals.

Strong collaboration between students and elementary school teachers is necessary to achieve shared objectives. Students who once required the lecturer's assistance in problem-solving can now control their learning techniques, notably in integrated learning difficulties. Problem-solving must adhere to the integrated learning paradigm as a whole. Additionally, the practical experience that students gain from working with others and resolving issues in the community can spur the growth of ideas, implying in the creative process to provide innovative solutions. Students can apply the knowledge acquired during the course to new circumstances. The complexity of the problems in the field leads one to dig out more information and increase efforts or develop more complex ideas so that it is not too early to decide.

Autonomy support may provide the necessary fuel for learners to be motivated to apply these self-regulation techniques. Furthermore, students can engage in their studies more voluntarily. Autonomy support fosters students' interest and intrinsic motivation and supports the endorsement of their classroom activities. The strategy improved volitional functioning, or a sense of autonomy, making self-regulating learning processes more readily used (Sierens et al., 2009).

In other words, learning structure and autonomy support are expected to interact as autonomy support primarily gives the motivation (autonomy) to launch these automated methods. In contrast, structure primarily provides SRL requisite know-how (competence). Therefore, under autonomy-supportive circumstances, we anticipate that structure will be particularly associated with SRL (Sierens et al., 2009).

Methodology

Research Design

The research design used a quasi-experiment with a single-subject design (Creswell, 2012). This design focuses on observing individuals during the intervention to determine if the intervention has any impact.

Sample and Data Collection

The participant in this study was a postgraduate student of Master of Elementary Education who took a concentration course in science, namely integrated natural science. A total of four students agreed to participate in the research. The participants have experience in teaching science learning in elementary schools. The participants comprised three women (W1, W2, W3) and one man (G1). Student self-regulated learning is collected after students develop integrated natural science teaching materials through community-based project learning. Eger et al. (2018) developed the framework of the empowerment model that empowerment or building a person's capacity is seen in the process and results. The first step is to identify problems arising in elementary school integrated learning. In this case, the elementary school teacher acts as a resource person and a colleague of the students in solving the problem. Second, the students will design teaching materials based on the integrated learning concepts learned in the lectures. Third, the students discuss the design with the teachers. Students and teachers exchange information to improve the design of teaching materials. Fourth, students communicate their learning progress to the instructor while collaborating with their community. Self-regulated learning is measured by filling out the questionnaires designed by Mashfufah and Novenda (2022) by adapting the name of the course. Based on the instrument test results analyzed by confirmatory factor analysis, the construct validity based on the standardized solution shows a loading factor value of more than .70. The construct validity based on the t-value shows that each statement has a significant relationship with the indicator marked by a t-value of more than 1.96. The goodness of fit criteria for the RMSEA is .059 < .08 and $p > .05$.

Table 2. Indicator and Statement of Self-Regulated Learning Skills

Indicator	Statement
Respect for task	Completing assignments in this course aims to obtain a good grade at the end of the semester. (T1) I think the task in Integrated Science is that it is the material that is important for me to master. (T2) I find the assignments in Integrated Science useful for improving my competence. (T3)
Self-confidence in learning	I am confident that I can understand any content presented in the Integrated Science course. (S1) I could understand the most complex material presented in Integrated Science. (S2) I am confident that I can master the knowledge taught in this course. (S3)
Search and learn the information.	When I study in this course, I set goals for myself to direct my activities in each period of study (L1) While studying, I create questions to help focus (L2) If the material feels elusive, I change the way to learn (L3) Before I learn a new topic, I skim through the material (L4) I look at my notes during lectures to complete a given assignment (L5) I thought of the best way to learn before I started learning (L6)

Student creativity in developing Integrated Natural Science teaching materials was measured by the rubric of creativity assessment in the four stages of teaching material development. The indicators used in the creativity assessment are adapted from Yoon (2017). The operational definition of creativity in developing Integrated Natural Science teaching materials is the ability to establish original Integrated Natural Science teaching materials that follow context and needs. There are two aspects to creativity, namely innovation and transformation. Innovation is divided into originality and fluency, while transformation is subdivided into elaboration and resistance to premature closure. Each indicator was translated into four rating criteria on a scale of 1 to 4 (1 = less, 2 = sufficient, 3 = good, 4 = very good) and described according to each stage of the development of integrated science teaching materials, namely the development of concept maps, the formulation of learning indicators, and the development of student worksheets.

The results of observing each student's creativity in developing teaching materials are poured into a graph to show a pattern of observations. The plot is then analyzed to see if there is an upward, downward trend, or fixed. The result of the observations used rubrics assessment for each stage of teaching material development consisting of four indicators, then calculated on average and categorized into five categories (excellent, good, sufficient, lacking, and not good).

Analyzing of Data

Self-regulated learning is analyzed descriptively based on the results of filling out the questionnaire. Creativity assessment obtained from the assessment rubric of each stage of the development of teaching materials is raised in the form of a graph. Two people evaluated the rubric. The analysis is carried out by first looking at the visible graph from time to time, examining the apparent tendency of the chart. The graph is undoubtedly made for each participant. Up, down, or stay trends are subsequently analyzed descriptively. The reliability of the data analysis cannot be demonstrated by inter-rater reliability because only one instructor administered the creativity assessment. However, the researchers conducted a content validation stage on the creativity assessment rubric. The validation results showed that the aspects of the suitability of the indicators with the measured variable constructs had an average score of 3.5; the suitability of the descriptors with the measured indicators had an average score of 3; and 3) the clarity of the scoring gradation had an average score of 3.5. Before conducting this study, the researcher had submitted a research permit and received faculty permission to research integrated science learning.

Findings/Results

At the beginning of learning, lecturers explore students' initial insights into integrated science learning, both in the development process and its implementation. The exploration to measure students' initial ability to develop integrated learning. When the students were asked about how integrated learning practices in elementary schools today, the students who have worked as teachers judged that integrated learning practices are considered to fulfill the principle of integration because several subjects are taught in one learning theme. In learning activities, teachers only refer to books published by the government without further analysis and development, especially on basic skills that can be integrated into integrated learning.

After asking more questions about how to find the stages of developing integrated learning, there are misconceptions about how to interpret and implement integration in the learning process. Students do not examine the concepts to be taught in a topic through concept mapping. Conversely, this stage is beneficial for teachers to present material coherently and comprehensively. Third, students have not been able to develop integrated learning indicators in a concept. Thus, a concept in one subject cannot be related to other subjects. For example, when learning about respiration, the teacher only presents the concept through the field of science without linking the concept of respiration to students' mathematical thinking skills, such as obtaining and presenting data, analyzing data, and drawing conclusions. The learning is separate when it should be thematic and integrated.

Students then explore a variety of literature to deepen their understanding of the basic science concepts that need to be taught in elementary schools, the principles of integrated science learning, and models of topic development. Creativity begins to be observed and measured when students design Integrated Science teaching materials by collaborating with practitioners.

Self-regulated learning ability is measured at the end of learning. In contrast, creativity in developing Integrated Science teaching materials is measured in the last three meetings, namely when developing concept maps, formulating learning indicators, and designing student worksheets. Integrated Science is one of the subjects in elementary school that should be developed in the learning process according to the principles of integrated learning. The results of the creativity assessment in developing Integrated Science teaching materials from stage to the next step are raised in the form of graphs to see whether the tendency is up, down, or constant. Such charts are created for the individual. The following is presented in Table 3 of the results of the creativity assessment in developing Integrated Science teaching materials but in the form of the average of the four students. The result of the observation used rubrics assessment for each stage of development of teaching materials consisting of four indicators, then calculated the average and categorized into four categories (good, sufficient, lacking, and not good).

Table 3. The Results of The Assessment of Creativity

Assessed Aspects	Maximal Level	Average	Category
Concept Map	4	4	Good
Formulation of Learning Indicators	4	3,56	Good
Learner Worksheets	4	3,5	Good

The table above shows that the average student's creativity in developing Integrated Science teaching materials is well categorized. The limitation of the research at this stage is that the observer assessing the students' creativity is only one instructor. The assessment would be better if done by two people to avoid subjectivity and to obtain inter-rater reliability. The following is an elaboration of the observation results of each student using a reference to the developed assessment rubric. Both observers and assessors of student creativity are instructors who teach integrated science courses. During the evaluation process, the instructor used an evaluation rubric to assess student creativity in designing concept maps, compiling learning indicators, and developing instructional materials. Based on the rubric scoring criteria, the instructor scored each indicator for each material development stage. The assessment results of the four creativity indicators at each stage of development were then averaged, and the final score was presented in graphical form.

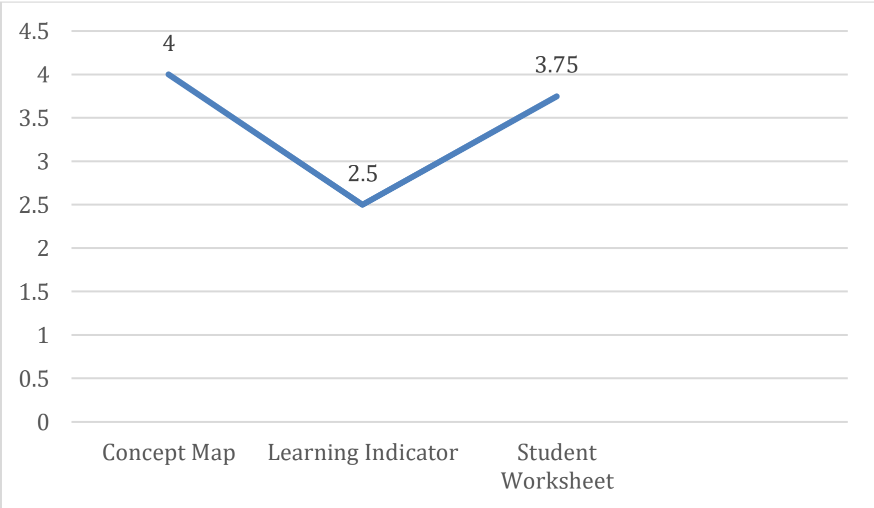

Figure 2. The Observation Result of the G1

Figure 2 shows a change from stage to stage of teaching material development—the G1 student-designed teaching materials for the clean air for health theme. In the next step, students analyze the essential competencies covered in the theme. Based on the basic competence of science content, students review material from various references and then compile it into a concept map. The ability of the 1st student to develop a concept map is already good. Of course, the preparation of the concept map is through several times guidance from lecturers and improvements. At first, students have not shown the arrangement of the concept map as it should be, namely without hyphens and labels between concepts, and there are still those that are not concepts inserted into the concept map. The concept map compiled shows the material's depth and breadth at a specific elementary school level.

Next, the student compiles the learning indicators based on the concept map. Concept maps are used as a basis for teachers to identify concepts that must be taught to students. Concept maps also serve as a summary or representation of the teacher's understanding of the depth of the concepts taught. Concept maps represent knowledge that is organized and consists of concepts that are linked with connective words to form a proposition and are arranged hierarchically. The learning indicators developed should include learning indicators for several lesson content that can be combined to show the integration of learning from several lesson contents in one theme. However, the 1st student still compiled indicators that only referred to the science content. Second, the indicators formulated have not been oriented toward teaching higher-order thinking skills.

The problem in the field is mainly in respiratory material; elementary students have not understood the relationship between breathing and daily human activities. Thus, the 1st student and practitioners decided to design project-based student worksheets. The designed worksheets already show the stages that encourage students to develop ideas freely by identifying problems, finding solutions, considering solutions taken, and starting from student work plans in implementing projects.

Figure 3 below is the result of observing the creativity of the W1 student in developing concept maps, learning indicators, and worksheets. Based on the results of the problem study with practitioners, a problem was found, namely concretizing the human digestive process. Therefore, a solution was taken with the method of learning role-playing. This method is used as a reference for designing activities in student worksheets.

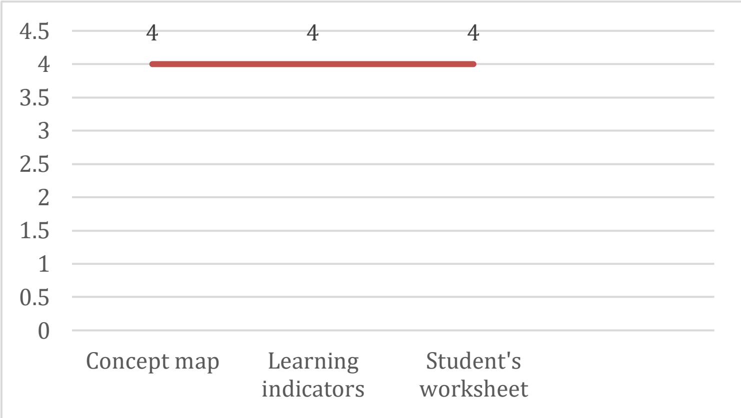

Figure 3. The Observation Result of the W1 Student

The W1 student showed a constant tendency at each stage of development. The theme used as a reference in the development is healthy food. Based on the theme, students demonstrate the integration of the content of science, Indonesian, social studies, and civics lessons. After reviewing essential competencies, students review material from various references to ensure the depth and breadth of the material.

The concept map compiled includes the digestive system, indigestion, and diet. The W1 student developed a more detailed concept map that was easily mapped into other lesson content. The formulation of learning indicators evidence this mapped to four lesson content so that the integration of the learning to be designed is precise. In addition, the indicators formulated have also referred to higher-order thinking skills.

This worksheet designed by the W1 student shows the integration in teaching the competencies in the content of science, social studies, and Indonesian lessons. In addition, it is not only the cognitive realm that is emphasized in the activities on the student worksheets but also activities to develop the psychomotor realm. The designed worksheet encourages students to develop ideas to invite people to maintain healthy eating habits and teaches students to appreciate the surrounding environment that has provided a variety of foodstuffs. Students are asked to do activities to build awareness that the role and profession of individuals in society who can produce food must be appreciated.

Figure 4 below is the result of the W2 student observation. Based on the graph, the W2 student tends to go down from development stage 1 to the next stage but is constant from stage 2 to stage 3. The student collaborated with practitioners to overcome the problem found in science learning, namely the low awareness of students about the importance of preserving the environment to remain balanced. The theme used in developing teaching materials is Various Occupations. Based on this theme, students examine its essential competencies, namely basic competencies for the content of science, Indonesian Language, social studies, socio-cultural and craft, and civics lessons.

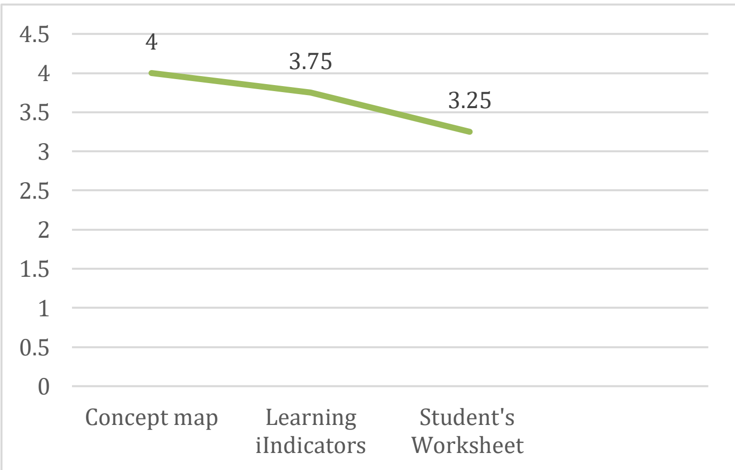

Figure 4. The Observation Result of the W2 Student

The concept map compiled by the W2 student with practitioners initially did not meet the elements of the concept map that it should have. After several guidance and revisions, the compiled concept map finally included essential concepts that needed to be conveyed to high-grade students. The concept map developed subsequently becomes a reference in formulating learning indicators.

Learning indicators developed from the beginning should already include all lesson content covered in the theme: science, social studies, Indonesian, civics, and cultural arts and crafts. However, students and practitioners only develop learning indicators for science lesson content, while indicators for the other four lesson content students directly originated from essential competencies. Nonetheless, the indicators developed can show the cohesiveness of the five lesson contents. Some indicators for science lesson content have shown higher-order thinking skills.

When designing student worksheets, learning indicators are reduced to learning objectives where students add audiences and conditions. The activities developed in the worksheet still do not fully demonstrate the scientific methods listed. Students are only invited to review videos and images, then present and concluded.

Next is the observation of the W3 student, shown in Figure 5 below. Based on the chart, there is a constant tendency from stage 1 to stage 2 and a decrease from stage 2 to stage 3. Students and practitioners find a problem in learning related to magnetism. When learning about magnetism, students have difficulty understanding the existence of magnets on Earth, their work, and their role in everyday life. In students' thinking, the recognized magnets are only bar magnets available in markets.

Based on the problems found, students determine the theme used as a reference in development, namely Entrepreneurship. In this theme, the essential competencies studied include basic competencies for science, social studies, civics, Indonesian Language, and mathematics content. Content or material in the basic science competence is mainly analyzed from various references as a step to design a concept map by first determining the depth and breadth of the concept according to the level of thinking of high-grade students.

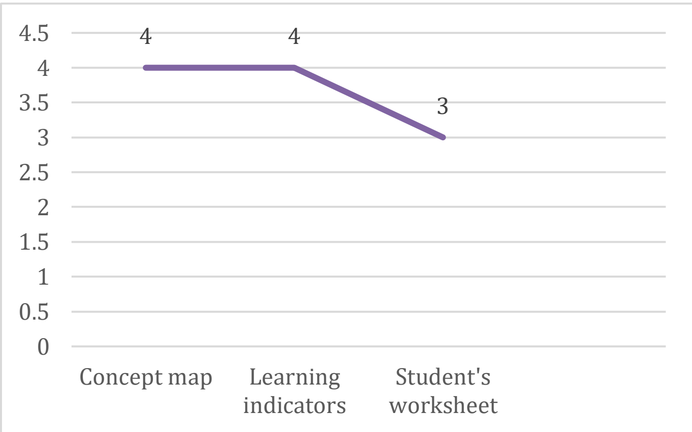

Figure 5. Results of W3 Student Observations

The concept maps developed initially have not shown the systematics or sequence of concepts from general concepts to specific ideas regarding magnets. Some are not included in the concept map. Intensive guidance between lecturers and students and collaboration with practitioners; finally, the concept map was successfully improved and already had essential concepts about magnets.

The next step is to compile learning indicators following the concept map created. The indicators developed by students have shown integration in learning 5 lesson contents. In addition, indicators have also used cognitive process dimensions to teach higher-order thinking skills. However, students and practitioners have not optimally designed student worksheets according to the indicators developed due to certain obstacles, namely, students have started maternity leave. Designed learner worksheets are only created up to the learner worksheet framework stage. Thus, observations also showed values that were not optimal.

Assessment of self-regulated learning variables uses an SRL questionnaire adapted from the questionnaire instrument developed by previous research. Because there are only four students, the results of measurements are only analyzed descriptively. The following are the results of measuring students' SRL abilities during community-based project learning. The abbreviations for the self-regulated learning statements used in Table 4 below refer to the earlier explanations in Table 2.

Table 4. Student SRL Ability After Learning

Statement	Never (%)	Seldom (%)	Usually (%)	Often (%)	Always (%)
T1	0	0	25	50	25
T2	0	0	0	25	75
T3	0	0	0	0	100
S1	0	0	0	50	50
S2	0	0	0	100	0

Table 4. Continued

Statement	Never (%)	Seldom (%)	Usually (%)	Often (%)	Always (%)
S3	0	0	0	25	75
L1	0	0	25	50	25
L2	0	0	25	75	0
L3	0	0	25	75	0
L4	0	0	50	50	0
L5	0	0	0	0	100
L6	0	0	25	75	0

Based on the data presented in Table 4 above, it can be seen that students are extrinsically and intrinsically motivated. One student attaches importance to achieving the best grades as encouragement from outside to maximize learning. Competency improvement is the primary goal of all students while attending Integrated Science lectures.

In the second SRL indicator, namely confidence in learning, most students are confident in their ability to master the material, even though it is complex. There is a tendency for students to struggle mightily to understand how integrated science learning should be applied in elementary schools and skillfully collaborate with the community or practitioners in the same field to create integrated science teaching materials that suit the needs of students.

The third SRL indicator is to find and learn information, and it seems that students already have an ongoing strategy to overcome their learning difficulties. First, half of the students think setting goals is vital at the beginning of their studies. Students have a habit of asking themselves questions about the content being studied. It directs students to look for additional answers so that they are more focused on mastering and understanding the content. When they find difficulties, students seek alternative strategies to overcome them.

Reading material before starting a lecture has been done by some students. Second, students take advantage of their lecture notes to complete tasks. The strategy of reading before the course starts, followed by considering learning strategies that are best for students. It certainly supports students in exploring more profound ideas for solving problems in a community environment or issues found during collaboration with practitioners. Reading provides a framework for understanding the direction and scope of the content of the material being studied.

Discussion

In implementing Integrated Science learning, it is not uncommon for students to find various problems encountered in learning practices in elementary schools, especially for students who have worked as teachers in elementary schools. The problem stems from the lack of ability of teachers to develop integrated learning, and it has an impact on achieving student competencies. Integrated learning in primary schools has not shown its integration, so learners continue to learn the learning content separately. Students show up when the instructor asks them about their experience teaching in elementary school. Once students are asked to explore their initial insights and knowledge in designing thematic learning, the train of thought and the stages of its development have not shown the learning thematically. In addition, learning in elementary schools still uses teaching materials obtained from publishers whose arrangement and content are irrelevant to achieving goals. Elementary school students still face short answering activities, low-level cognitive questions, and a lack of exploration of higher-order thinking skills. Based on these problems, students are given a community-based project learning model to develop teaching material creatively according to the needs of the field. During the collaboration between postgraduate students and practitioners, practitioners can also gain insight from student understanding during integrated science lectures. The two parties synergize to develop Integrated Science teaching materials that are relevant to the needs and follow the principles of integrated learning.

Based on the results obtained from the study, we can conclude as follows. First, community-based project learning allows students to explore and investigate the problems more deeply according to the topic of the issue being discussed (Sayyah et al., 2017). For example, one of the students shared his observations of a lesson at school that the integrated learning implemented did not follow the principle that learning should be holistic and that students should be trained to think critically and creatively. Instead, students are taught only low-level thinking skills, and learning activities are still teacher-centered learning. The problems identified are then pursued in the fourth stage of learning, problem-solving. Based on the results of filling out the questionnaire, all students (100%) were able to understand the complex material presented in the integrated science learning course (one of the statements from the learning confidence indicator (S2)). Complex material here is, for example, mapping the essential competencies that can be taught in a subject, developing a concept map of the material to be taught, and continuing to develop learning indicators that include all the subjects identified as being integrated. For example, the learning about magnets developed by the graduate students (W2) was initially presented only from a scientific perspective, leaving elementary school students with only a partial understanding of the concept of magnets. Students have not understood the role of magnets in community life for citizenship subjects, the shape and size of magnets in mathematics subjects, and using magnets as technology facilitates human work in cultural arts and crafts. With the problems, students must be able to solve them by going through the stages of developing integrated learning.

This method also facilitates students to be able to manage their actions to overcome a problem, make decisions, and determine alternative strategies when experiencing difficulties (Sierens et al., 2009; Stanton et al., 2016). According to the questionnaire result, 50% of students often determine the main goals to be achieved in their learning to guide the steps to achieve those goals. In addition, 75% of students often use alternative learning strategies when encountering obstacles, and 75% think about and choose the best way to proceed before beginning their learning. Based on observations while using the assessment rubric, as students develop integrated learning designs, they always discuss with practitioners about things that have and have not been following the problems obtained in the field. Thus, students do not make hasty decisions and still consider the team's opinions in their community according to the conditions of the problems found in elementary school students.

Learning that requires students to produce a product based on the problems found encourages them to critically develop their thinking skills and generate creative ideas (Kłeczek et al., 2020). Based on the assessment results using the creativity assessment rubric, the four students' ability to develop concept maps and student worksheets has gone well. However, at the indicator development stage, one student, G1, tends to be less than optimal. The observation shows that the learning indicators are formulated at a low level of thinking, and the fluency aspect of describing learning indicators is lacking because the indicators are developed only for science subjects and the indicators have not been detailed into learning objectives such as explaining the human respiratory process using a simple model of respiratory organs. Explanation is a narrow scope of indicators that cannot be broken down into learning objectives.

The second discovery, collaboration with practitioners, provides several advantages in implementing this community-based project learning. First, students can obtain factual information about learning problems, especially thematic learning. Second, students receive information directly in the field regarding the needs that must be met to support thematic learning. Third, students and practitioners exchange ideas as much as possible related to the advantages and disadvantages or challenges of a strategy that will be applied in learning in elementary schools. Fourth, collaboration opens up opportunities to create work on target. These benefits are consistent with the research conducted by Powell and Wimmer (2015) that working with a team is very effective in producing a quality product, and developing the product can provide comfort in learning because many ideas can be discussed together. Advice can be given to each other when difficulties are found. However, there are still limitations at the problem-solving stage, namely that materials developed with practitioners are not followed up by testing with students. The aim is to involve primary school students, as users of the materials, directly in providing suggestions and input, for example, on aspects such as the attractiveness of the presentation of the materials, readability, and ease of use.

Students and practitioners exchange helpful information for developing Integrated Science teaching materials when implementing community-based project learning. When delivering basic concepts related to the nature and principles of Integrated Science learning, students have been invited to explore problems in the field. It supports students to be able to focus on facts that are not following current learning expectations or demands. Digging for information from practitioners in a community, observing the learning process, or evaluating learning activities carried out in class is a strategy for students to understand problems that must be solved together. This condition is similar to the findings of Lobczowski et al. (2021) that project-based learning can encourage students to work together to achieve common goals.

Teaching materials developed by graduate students and teachers, especially student worksheets, have been prepared according to the stages of the learning model. The inquiry learning model is one of them that is used in teaching the concept of sound. Sound is associated with traditional musical instruments and the mathematical idea of data tabulation. The design is very different from the book used by the previous school, which did not pay attention to aspects of student-centered learning and training students to think. This finding is consistent with the research conducted by Barak et al. (2020) that students can develop creative ideas through collaborative problem-solving. The difference lies in the collaborating parties, where this research involves students and elementary school teachers in collaboration.

Practitioners in elementary schools as resource persons certainly understand students' learning characteristics. This information is crucial for graduate students to design a solution based on their needs. Graduate students who have studied basic concepts in the classroom can provide additional insight into the principles that must be met in integrated learning. Both parties are involved in intensive communication until they reach a common goal. This result is consistent with the finding that communication helps gather information to complete a project (Usher & Barak, 2020). Thus, the results obtained from this study show that growing a new idea or thought can be facilitated through the investigation of fundamental problems and collaboration with practitioners in the field. The different backgrounds between students and practitioners do not hinder the collaboration process. Barak and Yuan (2021) have researched that collaboration between students in student exchange programs can effectively produce innovative ideas.

The issues in integrating learning can lead students to capture real problems related to thematic learning in elementary schools. Connectivity to real-world problems is essential in the learning process to encourage students to produce creative solutions according to the needs of the field (Meijerman et al., 2016). The problem faced during thematic education found by students, in general, is that students have not been able to think holistically, relating concepts to one another, especially concerning daily life. With this community-based project learning, students can apply their knowledge to solve these problems and learn more meaningfully because it is done based on real experiences. Collaboration with practitioners in the community encourages students to build more diverse ideas. Krajcik and Blumenfeld (2005) and Thompson and Beak (2007) have explained that the environment around students is beneficial and can potentially engage students in a meaningful learning process.

Assignments can be completed within a certain period to enable students to reactivate their knowledge in long-term memory and manage their learning strategies to develop their self-regulated learning skills. As Merrill (2015) explained in his research, real-world problems or tasks require problem-solving steps that encourage students to make decisions according to their conditions. It is in line with previous research that the learning environment with long-term assignments activates the ability to manage to learn independently to produce maximum achievement in completing tasks (Hirt et al., 2021). It begins with students reflecting indirectly based on the questions presented in the module, especially teacher practice during teaching at school. The question, for example, is how to instill curiosity in students or a scientific attitude in students. These questions will automatically lead students to assess whether the practice of learning has led to the question so far.

Integrated science learning activities using a community-based project learning model from the orientation stage invite students to explore initial knowledge (Yilmaz, 2017). At this stage, students begin to manage their self-regulated learning abilities. Students have implemented a strategy to focus by making possible questions about the topic's subject to be studied and investigated for problems (Linda Bol & Garner, 2011). The next step is reviewing the issue. The problem posed is not a simple problem but rather a complex problem. The problem requires students to reason and make decisions in utilizing the resources needed and what actions to overcome them (Grant & Branch, 2005). With intrinsic and extrinsic motivation, students can build their confidence that during lectures, they can confidently master complex content (Zimmerman, 2000).

Students' creativity in developing the Integrated Science teaching materials was triggered by questions that led students to investigate real problems in the field. For example, the questions are about what topics are often complex for students to understand during the learning process and how we can overcome students' difficulties in mastering specific topics. The information about these questions is expanded by gathering information from sources, namely teachers in elementary schools. Students identify the causes and characteristics of students learning so that the design of the developed teaching materials follows students' needs. The presentation of exciting teaching materials with clear and structured learning stages helps elementary school students to master the topic being studied. The characteristic of a complex and unusual problem becomes an erratic problem that requires many alternative solutions. A problem that is unfamiliar and related to everyday practice belongs to a problem whose answer is uncertain. It leads students to develop their thinking skills creatively (Beghetto, 2021). Moreover, collaboration with practitioners encourages students to exchange information, communicate effectively, and provide input to each other to improve students' ability to explore creative new ideas (García-García et al., 2017). Collaboration between the two students and practitioners builds a different learning environment that is very important to support the achievement of collaboration goals (Matuk et al., 2016).

Refers to students' self-regulated learning abilities; students are extrinsically and intrinsically motivated. Students believe they can get the best results at the end of the lecture and can master simple and complex content to develop their competencies. As the empowerment model developed by Eger et al. (2018) that, a person's self-confidence can develop during the empowerment process. Participation in a community encourages students to share their resources and knowledge so that changes in one's knowledge and skills occur. One of the competencies here is developing Integrated Science teaching materials. It is in line with previous research that motivation is related to the ability to develop creative ideas (Puente-Díaz & Cavazos-arroyo, 2017).

Conclusion

In conclusion, community-based project learning is essential to develop the competence of postgraduate students, primarily regulating independent learning and building new ideas appropriate to the issues. The results of this study fill the gap identified in the literature that self-regulated learning can be activated through a lesson that exposes graduate students to real-world challenges and problems in integrated science learning in elementary schools. The contextual learning environment supports them to more than understand the problem; however, students are triggered to take real action in fixing the problem. A community of elementary school science teachers and postgraduate student gives a new atmosphere in that a lot of meaningful information could be shared to widen our insight into the real problems, especially for the practice of integrated science learning. The complexity of issues resulting from discussion and community observation encourages postgraduate students to activate a suitable learning strategy for self-regulated learning. It is relevant to the previous study by Barak and Yuan (2021) and Splichal et al. (2018) that collaboration between people within groups with different backgrounds in completing the project facilitates students' regulation. They believe the challenge helps them improve their competence in constructing integrated science teaching material relevant to elementary school students' needs. According to the previous analysis, it shows that students are extrinsically and intrinsically motivated. Students believe they can get the best results at the end of the lecture and can master simple and complex content to develop their competencies. One of the competencies is creativity in developing Integrated Science teaching materials. It aligns with previous research that motivation is related to the ability to develop creative ideas (Peng et al., 2013; Puente-Díaz & Cavazos-arroyo, 2017).

Recommendations

Further research is necessary to implement community-based project learning to a broader sample of postgraduate students who take general courses. The same activity could be implemented in the same subject in other different degrees to have more data and compare them. Practitioners who teach integrated learning should consider presenting materials contextually according to the conditions in the environment around students so that integrated learning can connect theory and practice in real terms.

Limitations

The limitation of this research is that the sample used is limited. Second, the problem-solving stage in the syntax of the community-based project learning model still needs to be developed with an evaluation stage, namely, applying the design of teaching materials prepared in collaboration with practitioners so that the products of this project learning get improvements from the suggestions given by students in elementary schools. Third, the creativity assessment is done by only one teacher, so it could not support the inter-rater reliability.

Ethics Statements

The studies involving human participants were reviewed and approved by Universitas Negeri Malang. The participants provided their written informed consent to participate in this study.

Conflict of Interest

I declared there is no conflict of interest.

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Authorship Contribution Statement

Mashfufah: Conceptualization, design, analysis, and manuscript drafting. Dasna: Editing/reviewing, supervision. Utama: Critical manuscript revision, statistical analysis, final approval.

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