Natural Science Mini Project Practicum: Alternative Solutions In Improving Science Process Skills

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Abstract. 21st-century learning requires the ability to communicate, think critically, think and act creatively, and collaborate. One of the efforts recommended by experts to achieve this is through science practicum activities and project learning. Combining science practicum activities and project learning produces a mini-project practicum model. The science practicum mini-project model that uses, performs, and utilises naturally is expected to improve students' science process skills. This literature review aims to describe in more detail related to science practicum, natural mini projects and science process skills. This article is reviewed through analysis and synthesis of articles originating from reputable journal articles, such as Scopus and Sinta. The article was obtained by searching for articles with the publish or perish application with the keywords Science Practicum, mini projects and Science Process Skills. The results of this study recommend an alternative model of the mini-project science practicum as a solution to improve science process skills.

Keywords: Science Practicum; Project Based Learning; Mini Project; Science Process Skills.

INTRODUCTION

Referring to the four pillars of UNESCO as recommendations for efforts to face and adapt to future challenges, namely Learning to Know, Learning to Do, learning to Be, and learning to live together, learning is expected to lead to learning that demands the role of students to develop their potential. Science learning at the junior high school level directs students' abilities to understand science knowledge, especially related to facts, concepts and procedures. This knowledge is obtained based on curiosity about science, technology, art, and culture related to various events visible and felt by the senses. In line with the development of 21st-century education, each student is expected to achieve competency in critical thinking, creativity, collaboration and communication [1, 2]. Global competition and technological developments in the 21st century are fast and dynamic and require individuals with 4C skills or soft skills that are applied in everyday life [3]. Of course, all of these competency achievements will be obtained if learning is carried out that supports them. One form of learning experts recommend is implementing project-based learning (PjBL).

Several studies have been carried out by implementing and developing project-based learning. According to [4], PjBL definitions vary widely, but most have criteria including:

- projects driven by real-world and authentic questions;

- they engage students in rigorous and ongoing investigations;

- they offer students the right to speak, vote, and vote in a collaborative learning environment;

- they provide many opportunities for reflection, revision, and assessment;

- culminate in authentic peer production and be felt by the public.

Implementation of PjBL is expected so that students can collaborate to solve problems that occur in the real world. Students can get wider opportunities to apply the concepts obtained in the subjects they receive, which can increase learning motivation [5]. The PjBL stages are orientation, problems and collecting data, organisation and representation, analysis and interpretation, presentation and evaluation. According to [6] states that the learning steps include:

Arrange which cover determining learning objectives, deciding on projects to work on and managing project implementation time as well as possible;

*Begin*ie starting work on the project;

Change, namely making the necessary changes to improve the project being worked on;

Demonstrate, i.e. show what has been achieved through the presentation.

Observing the explanation above, the PjBL will be implemented if there is a sense of community in each stage or syntax. The ability to practice learning in the community and the surrounding environment will be a strategic medium to shape innovation in each student [7].

So that the practice carried out by students is more directed and by the goals to be achieved, one of the activities that make students experience themselves, discover, and communicate the results obtained can be through practicum activities. Implementing practicum activities in educational units still needs to overcome many obstacles. Problems that are often faced and experienced by teachers in carrying out practicum activities, such as lack of practicum equipment, lack of teacher knowledge and skills in carrying out practicum activities, practicum activities or laboratory activities are practically rarely carried out; practicum takes up a lot of time and energy [8]. For these problems to be reduced, the practical implementation needs to be in line with everyday life and is very much needed by the community. Practicum is not only carried out in the laboratory but can be carried out independently at the students' own homes.

Practicum activities carried out in the laboratory and outside the laboratory (nature) will produce students' skills and abilities. Students will be more skilled in various things to meet future demands. Science learning so that students can realise skills that reflect the correct behaviour of scientists in designing experimental activities and solving problems in every field of science. KPS is the core of science concepts and research, so these skills are developed effectively and efficiently in teaching and learning processes in various countries. For example, the American Association for the Advancement of Science has developed the KPS [9]. Science process skills help students learn, provide opportunities to discover and research ways and methods, increase the continuity of learning, make students active, increase student responsibility, and help them understand the material practical study, increasing the sense of responsibility for their education [10].

Based on the explanation above, this article review *aims* to obtain a broader picture regarding three study variables: Natural Science Practicum, Natural Mini Project and Science Process Skills. From the analysis and synthesis carried out on the three variables, it is hoped that it will produce an update related to developing the mini-project science practicum model to achieve student process skills.

METHOD

The method of writing this review article is a qualitative descriptive method based on observations, experience, and a literature review from several journals. In this article, the author uses the literature study method or conducts studies on various scientific articles published in reputable international journals (Scopus) and National (Sinta). The scientific article is obtained using the application publish or perish with the keywords Science Practicum, Mini Project and KPS. The search results obtained 33 articles on Project Learning (PjBL), 19 on science practicum, and 27 on science process skills (KPS). All of these articles were then summarised, and the gist of the articles was obtained. All articles were then analysed and synthesised to obtain things that could be recommended for the following study. This literature review looks for various things that have been implemented. Then, it links these three things into a new idea related to developing a school environment (nature) based on a mini-science practicum model. The latest idea is expected to produce new knowledge and contribute to a science that can be useful for the public.

RESULTS AND DISCUSSION

Science practicum. Science learning is a process that emphasises natural phenomena and the interrelationships between these symptoms. It also emphasises cognitive aspects and includes attitudes, methods, products, and applications that must be carried out. Science learning requires skills in connecting concepts and extracting evidence. The proof process is done through practicum activities to prove the concept [11].

Practicum, in a narrow sense, is a structured and scheduled learning activity that complements face-to-face theory conducted in the laboratory. This activity can be in the form of carrying out standard procedures. Practicum can be done in the laboratory, field or classroom using demonstrations. Demonstration is a way to show how to do something; this includes the materials used in the work being taught, showing what is being done and how to do it, and explaining each step of the process. Practicum activities are learning processes that provide accurate, direct interaction to students through their five senses. This will undoubtedly give a science learning experience that can be felt directly [11]. Practicum activities by making observations that involve students' senses can provide meaning and make sense of the experiences experienced in the form of perceptions in response to objects from their senses. Practicum activities will support the success of learning, and, of course, they must be carried out adequately given the importance of practicum activities in the science learning process as a form of activity that can develop knowledge, skills and attitudes. Therefore, a science practicum model was developed for practicum activities to achieve what is expected. Science practicum is conducted in a teaching laboratory designed for practicum, not research.

Science material or concepts are not appropriate if they are only taught by giving and conveying concepts because science concepts are discovered through an experimental stage. In this regard, the proper teaching of natural science material is to use practicum. In general, practicum activities are based on lesson plans that have been made and determined by the teacher to improve psychomotor skills, which include the ability to use tools, work attitude, ability to analyse problems, arrange sequences of activities, ability to read and describe pictures. and can perform activities quickly [12]. On the other hand, teachers must also serve and prepare themselves before practicum activities begin. The teacher must address every student's complaint, answer all student questions, and even administer the laboratory [13].

Preserving hereditary knowledge of therapeutic properties using plants is essential for national policies that ensure food safety and health [14]. Implementing science practicum to prove various knowledge about medicinal plants [15, 16].

Project Based Learning. PjBL is a learning model that gives students hands-on, real-world experience related to engineering to enrich their understanding of technical theories and concepts [17]. It is a constructive learning model that places students so that their knowledge increases based on their existing knowledge. Students become active learners. Students have high academic involvement while studying with the PjBL model because they are facilitated with interesting, challenging projects related to everyday life phenomena and relevant to societal needs [18].

PjBL has been developed by several experts [19], who state that PjBL can improve academic skills and motivation. PjBL implementation is a series of activities, tasks, investigations, provision of resources, scaffolding, collaboration, and opportunities for reflection and sharing experiences gained during project implementation [20]. A classroom action research activity conducted at a high school in Semarang showed that PjBL can improve students' (psychomotor) skills [21].

PjBL can increase collaboration in student groups, but there is a finding that in forming study groups, the composition of prepared student groups must allow the teacher to provide intensive support to students who need it the most. It is recommended that groups be formed when preparing PjBL projects by using reflective discussions during implemented learning projects to promote inclusion and support active student participation [22]. The project-based learning model can also be combined with other learning models, such as problem-based learning, which can be used to develop 21st-century skills [23].

Another thing that has been done to support the implementation of PjBL is using tissue culture media tools for students of SMAN 1 Bangsri. Students' ability to do activities increases through PjBL using tissue culture media tools [24]. Related to high school physics learning by applying PjBL, its scientific skills are growing with the help of the physics practicum module [25]. In line with PjBL's research with the physics practicum module, PjBL can also be used with Green Chemistry and Ethnoscience-based worksheets to improve students' thinking skills [26], even related to the current IT-based module has been developed as a tool in PjBL [27]. Project-based learning is applied to students and can improve prospective teachers' abilities. According to [28], project-based learning can be used by prospective teachers. Project-based science learning effectively improves pre-service teachers' literacy and creativity skills in learning about waves and optics.

Based on some studies above, project-based learning has advantages and disadvantages. Some benefits of implementing project-based learning include changing students' mindsets, developing students' abilities to apply knowledge, attitudes, and skills in an integrated manner, following modern learning principles, increasing student motivation, improving problem-solving ability, increasing collaboration, and improving resource management skills.

In addition to the advantages that can be obtained or felt by students by participating in learning using project-based learning, there are also several weaknesses in the application of project-based learning; namely, class conditions are rather challenging to control, and it is easy to become noisy during project implementation because there is freedom for students so that it provides opportunities to be rowdy and for this, the teacher's skills in reasonable classroom control and management are needed, and requires more time to achieve maximum results, costs and equipment needed more, and the tendency of students to be less disciplined in doing projects.

Mini Project Practicum Model. Mini Projects generally have eight stages: introduction, training, problem orientation, designing, presenting proposals, implementation, reporting and evaluation [29]. In line with these needs, various mini-projects are developed to address the natural environmental conditions of daily life and allow natural investigations to be carried out. The community can feel the product results from the mini-project through various pieces of evidence to prove the truth of the data obtained. The impact resulting from multiple activities with the environment is the presence of a scientific attitude, one of which is environmental concern. An example of a mini project practicum activity in the early stages of practicum participants is divided into groups of 3 participants, each identifying three plants. The material used to carry out the mini project is related to the theory in the course by taking different materials from the material used during the practicum [30]. In the first stage, namely the introduction of practicum activities in the form of a pre-test, then the teacher explains the Mini-Project laboratory that will be carried out and the research schedule [31]. The second activity forms groups. From this preliminary activity, because there is already an explanation of the schedule, students have yet to be encouraged to think individually about the sample or object to be practised. The third activity is problem orientation. The teacher gives students problems to solve in mini-project activities. These three stages can be adapted to project-based learning and scientific learning by involving 21st-century skills such as observing samples, exploring the usefulness of samples through the ability to ask questions of the public and finding out by utilising information technology. Initial understanding through observing and asking activities will result in advanced skills in students, namely the ability to ask questions for research.

The next stage of the mini project's eight steps is designing, presenting, and implementing proposals. These three stages are very suitable for forming 21st-century abilities or skills because they can train students in creating, communicating and implementing proposal plans that have been prepared. The next stage is reporting and evaluation. Skills developed are the ability to communicate and self-reflection. Of course, these stages are almost in line, meaning that what will be presented is in the form of a report. The evaluation stage contains activities to conclude and a final assessment. Compared with the stages of project learning, these eight things are mini-project learning. What needs to be added is related to product testing.

Science Process Skills. The American Association for the Advancement of Science states that Science Process Skills (KPS) are very suitable for science learning, and science learning should be directed at learning that makes students active, provides real experience, and trains their thinking skills [32, 33]. IPA includes the disciplines of chemistry, biology and physics. The education provided in science lessons can help students understand the concepts of chemistry, physics, and biology by relating them to real situations. In science learning, every phenomenon, problem, and process is interrelated [34]. All science disciplines expect scientific process skills, which refer to the skills that students have the same as scientists in the process of scientific discovery. Scientific process skills encourage skills to acquire knowledge -and disseminate this knowledge to improve mental and psychomotor skills optimally [35].

Learning must be student-centered. In learning, they actively construct knowledge by identifying phenomena, solving problems, reading, seeking information, investigating, and applying knowledge. Learning must be done collaboratively. Students are trained to work together in conducting investigations, solving problems, and doing assignments. Learning must have a real-world context. Teachers motivate students to apply everything they have learned in class to real-world situations they encounter in everyday life. Learning materials must be related to people's lives [1]; basic science process skills include observing, asking, classifying, measuring, and predicting. Second, integrated science process skills include identifying and defining variables, collecting and changing data, creating data tables and graphs, describing relationships between variables, interpreting data, manipulating materials, recording data, formulating hypotheses, designing investigations, summarising and generalising. Basic science skills can be applied through practicum activities [35].

Ratnasari and friends used several indicators to determine the ability of students' science process skills, including formulating hypotheses, designing experiments, analysing data, applying concepts, communicating, and drawing conclusions. This ability measurement activity was carried out on five materials in high school physics lessons [32]. KPS can also be measured with conceptual-based LKS development activities. Authors [33] describe KPS as several indicators, including observing, classifying, communicating, using space and time relationships, measuring and using numbers, predicting, and concluding. Integrated science process skills consist of operationally defining, controlling variables, interpreting data, making hypotheses, and experimenting. The KPS ability was measured at SMA Negeri 1 Magelang with 20 students for the limited test and 33 students for the field test.

KPS ability is also measured by teachers in Turkey [37]. Fifty-four teachers at level 3 were given pre-tests and post-tests related to the impact of laboratory activities. The measured KPS ability indicators are observing, concluding, measuring, communicating, classifying, and predicting. Indicators of advanced KPS that lead to scientific processes include determining variables, operationally defining, formulating hypotheses, interpreting data, conducting experiments, and formulating models. Like the KPS ability indicators, KPS measurements are carried out on learning activities using the green learning method (GeLeM) with an inquiry approach and an environmental conservation perspective [38]. The indicators used include observation skills, classification skills, communication skills, measurement skills, prediction skills, and inference skills. Other researchers also applied the same KPS aspects [39-47].

Science skills are related to identifying research questions, formulating predictions and hypotheses, designing investigations, organising and interpreting evidence and drawing appropriate conclusions [48]. Related to this, other researchers have carried out in the previous year directed the development of KPS measurements. KPS measurement indicators for inquiry learning by [49], namely observing, proposing hypotheses, planning programs, interpreting data and graphics, predicting and applying concepts, and communicating. Next, [50] surveyed 400 grade IV and V teachers and 1200 groups of students from 10 UPTs in five districts/cities in DIY regarding KPS. Aspects of science skills, which include basic skills, include 1) observation skills, 2) recording data/information, 3) following instructions, 4) classifying, 5) taking measurements, 6) performing motion completion, and 7) implementing procedures for using the equipment. The aspects of science process skills, which include processing/processing skills, are 1) inference skills, 2) prediction, and 3) selecting procedures.

The subsequent development of KPS measurement was by developing investigative skills by B. Subali himself [51]. Subali is divided into 1) basic KPS: Making observations, Recording data/information, Following orders/instructions, Taking measurements, Performing processing, Implementing procedures/techniques/equipment use; 2) Process KPS: making predictions, making inferences, and selecting procedures; 3) Investigating Skills: Designing investigations, investigations, and reporting the results of investigations.

KPS is readily observed when students conduct practicum or experimental activities [52]. Process skill observation sheets consist of skills for measuring, predicting, communicating, summing skills, compiling data tables, making graphs, obtaining and processing data, and making hypotheses. All items use a rating scale of one to four. Refers to [6], the practicum is conducted to encourage them to learn science because it provides an experimental process through science process skills. Practicum activities are essential in discovering concepts [49].

According to [53], KPS ability can also be affected by gender. The research activity is in the form of investigations related to the scientific processing ability of VIII grade junior high school students regarding demographic characteristics (gender, parents' educational level, parents' occupation, and family's monthly budget). It turned out that the study's results stated that the total KPS score of female students was higher than that of male students. This finding indicates that female students are more competent in acquiring KPS than male students.

KPS measurement in a series of learning activities is not only carried out at the elementary to high school level. Colleges also do the same for some courses. In improving KPS, supporting things such as technological means in physics material (PhET) are also used [54]. KPS is measured by instructors and students using the Scientific Ability Assessment Rubric (SAAR). This rubric evaluates project presentations and papers (formative assessment).

Based on a series of studies, the authors obtained information that each KPS to be measured must be by the activities to be carried out. The KPS aspects generally include observing, asking, classifying, measuring, and predicting. Some KPS processes include identifying and defining variables, collecting and modifying data, creating tables and graphs, describing relationships between variables, interpreting data, manipulating materials, recording data, formulating hypotheses, designing investigations, summarising and generalising. Various aspects of PPP from all the research conducted, if arranged in a table of PPP aspects, it will be possible to obtain a combination of the same elements from all research related to PPP. These aspects include making observations/observations,

According to each aspect, indicators are extracted from various forms of activity. The following describes the KPS indicators.

Table 1 – PPP indicators

Aspect	Indicator
Observation	- Using as many senses as possible. - Gather/use relevant facts.
Grouping or classifying	- Record each observation separately. - Note the differences and similarities. - Contracting traits. - Comparing looks for the basis of grouping. - Correlate the results of observations.
Interpreting data	- Correlate the results of observations. - Finding patterns in a series of observations. - Conclude
Forecast/predict	- Using patterns of observations. - State what might happen in situations that have not been observed
Asking question	- Ask what, how and why. - Ask questions with a hypothetical background.
Hypothesise	- Recognising that there is more than one possible explanation for a study. - Realising that an explanation that an explanation needs to be tested for its truth by obtaining more evidence, do more problem-solving methods
Planning Experiments / Research	- Determine the tools/materials/resources to be used. - Determining variables/determining factors. - Determine what will be

Aspect	Indicator
	measured, observed and recorded, and carry out what will be carried out in the form of work steps.
Using Tools / Materials	- Using tools/materials. - Know the reasons for using tools / materials. - Know how to use tools or materials - Applying Concepts - Use learned concepts in new situations - Use concepts from new experiences to explain what is going on
Communicate	- Describe empirical data from experiments/observations with graphs / tables / diagrams. - Develop and deliver results reports systematically. - Explain the results of experiments/research. - Read graphs / tables / diagrams. - Discuss the results of the activities of a problem/an event

For assessing KPS indicators, you can use an evaluation with a Likert scale, using values of 1, 2, 3, and 4 in the less, sufficient, good, and very good categories.

CONCLUSIONS

Based on the discussion above, several conclusions are obtained:

1. The PjBL model is a constructive learning model that places students so that their knowledge increases based on their existing knowledge. Students become active learners. Students have high academic involvement while studying with the PjBL model because they are facilitated with interesting, challenging projects related to everyday life phenomena and relevant to society's needs.

2. The PjBL Learning Syntax can be integrated with the practicum method at the implementation stage.

3. The practicum method is a structured and scheduled learning activity that complements face-to-face theory conducted in the laboratory. This activity can involve standard procedures and laboratory, field, or classroom demonstrations.

4. One form of practicum is the phytochemical test practicum, which tests the chemical presence of natural ingredients in medicinal plants.

5. In implementing PjBL, which is integrated with practicum methods, it is hoped that students' abilities, namely science process skills, will be formed.

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