Original Research Article

Science Practicum Assessment on 21st Century Skills: Systematic Literature Review

ABSTRACT:

Assessment is a collection of evidence that is carried out intentionally, systematically, and continuously and is used to assess student competence. Assessment helps teachers make decisions about students' needs and guides the planning of learning programs. This study uses a systematic literature review method using Preferred Reporting Items for Systematic Review (PRISMA). The research objective was to identify science practicum assessments in education era 4.0 that support 21st-century skills. Articles are collected from various databases, such as Scopus, Web of Science, Google Scholar, and Researchgate, from 2010-2023. The research results obtained from 115 potential articles show that the practicum is part of teaching in the form of applying the theory learned. The conclusion is that practicum is a vehicle to develop cognitive, affective, and psychomotor aspects simultaneously. Every time there is development and progress in the education system, there will also be changes in the learning and assessment systems as well as the quality of education services in the 21st-century skills era.

Keywords:*science, science practicum, assessment, 21st-century skills*

INTRODUCTION

Quality human resources are important for a country to become a developed, strong, prosperous, and prosperous country. Efforts to improve the quality of human resources cannot be separated from the problem of national education. It is in school that all aspects of learning or education meet and process. Teachers with all their abilities, students with all their backgrounds and individual characteristics. The curriculum with all its components and the materials and learning resources with all the subject matter meet and combine and interact in class. Even the results of education and teaching are largely determined by what happens in the classroom. Therefore, it is appropriate for the class to be managed properly, and professionally, and must be continuous. The problems found in the learning process are seen as phenomena that provide awareness for teachers to always provide innovations in the selection and use of models in the learning process. Learning conducted by the teacher should not only convey information to students but also be able to create a conducive atmosphere so that students are interested and able to learn.

The desired expectations from teaching itself are all deliberate efforts to provide motivation, guidance, direction, and enthusiasm to students so that the learningprocess occurs. During the learning process, teachers are expected to be able to grow, improve, and maintain student learning motivation (Kim et al., 2019; Islam et al., 2018; Keiler, 2018). Without high student learning motivation, it would be difficult for teachers to achieve optimal learning outcomes. Therefore, teachers must be able to apply motivational strategies in their learning activities. (Romadhon et al., 2021; Mauliya et al., 2020; Tafonao et al., 2019; Haryudo et al., 2019)suggest that teaching in the teaching and learning process can generate motivation and stimulate learning activities and even bring psychological influence on students. Natural Sciences is a science that has a lot to do with everyday life. Science learning in junior high schools aims to enable students to master science concepts so that in the learning process students can be invited to think about science in their lives. This learning process is called learning science process skills. So far teachers have not trained science process skills in the concept discovery process so science process skills in students are still low. To the subject matter in this study, one of the methods that can be used as an effort to increase students' activity and science process skills is the experimental or practicum method.

Science learning cannot be separated from practicum activities. (Umayah et al., 2020; Wahidah et al., 2021; (Tanti et al., 2020); Sukmawati et al., 2022; Rusmini et al., 2021)put forward four reasons for the importance of science practicum activities, namely: First, practicum can generate motivation to learn science. Second, practicum develops basic skills for conducting experiments. Third, practicum becomes a vehicle for learning a scientific approach, and fourth, practicum supports subject matter. Teaching objectives will be achieved optimally if adapted to the teaching and learning activities

applied (Coman et al., 2020a)Through practicum activities, students are expected to be able to learn science by direct observation of the symptoms and processes of science, can experience or do it themselves, follow a process, observe an object, analyze, prove, and draw conclusions. Students are also expected to gain knowledge based on the practicum they do themselves, so that students not only tend to memorize all the material that has been taught, but students can better understand the concepts in solving related problems.

Practicum-based learning has objectives including (1) to provide practical experience of how scientists use the scientific method to make scientific observations, starting from making hypotheses to conducting experiments to obtain evidence supporting or disproving the hypothesis; (2) to provide skills in practical work, the use of tools and the ability to apply scientific theories (Ermayanti et al., 2020; Sudarsono & Sukardi, 2017; Suryati & Akmal, 2022;Likita et al., 2020). Achievement or failure in realizing practicum-based learning objectives is generally determined by the implementation of the practicum activities themselves. And the education sector requires assessment instruments. Because assessment is a very important part of educational practice and is carried out through assessment to improve the quality of learning and to improve the quality of teaching (Ibarra-Sáiz et al., 2021;Schildkamp et al., 2020;Andrade, 2019). The teacher is one of the main factors that greatly determine the success of students in learning which has an impact on the quality of the learning process (Van Wart et al., 2020;Ofoghi et al., 2016). The quality of the learning process carried out by the teacher at school is influenced by the lesson plan prepared by the teacher (Udim et al., 2018).

Evaluation of learning is a process of collecting data and information in making decisions about learning activities, including programs, curricula, learning methods, and other school activities (Nugraha et al., 2018). Evaluation of learning aims to determine the effectiveness and efficiency of the learning system which includes objectives, materials, methods, media, learning resources, learning environment, and assessment systems in learning, as well as knowing the level of knowledge, skills, attitudes, and values of students for certain types of education. (Haleem et al., 2022; Kintu et al., 2017; Singh et al., 2021). In carrying out learning evaluation activities, teachers need evaluations that are good and right on target so that they are right on target. There needs to be a good concept in learning evaluation. The concept consists of the purpose of evaluating the learning process and the stages of implementing the evaluation. To be able to measure the learning success of good students, good measuring instruments are needed. Otherwise, the information received cannot be trusted and may not give a true and fair picture of learning outcomes. Assessing student learning outcomes is one of the routine tasks that must be carried out by educators in the world of education. Assessment of learning outcomes is carried out, among other things, to diagnose student strengths and weaknesses, monitor student learning progress, and assess achievement of curriculum objectives, especially those related to skills.

The main problem that often exists in the field is the low understanding of teachers regarding 21st-century skills and their lack of skills in evaluating learning assessments related to 21st-century skills (Stehle & Peters-Burton, 2019; van Laar et al., 2020; Santosa et al., 2022). This is not optimal and results in student learning that is contrary to the curriculum design used. In general, there are two types of tests, namely subjective tests and objective tests, which are administered by teachers to assess student learning outcomes. Assessing learning outcomes and learning activities is the task of a teacher. But in practice, teachers focus on assessing learning outcomes, but learning assessment is often ignored or at least pays little attention. The progress of a learner is not only reflected in his learning outcomes but also in the way his learning process is monitored (Panadero, 2017). To overcome these problems, the teacher must be able to read all of his assignments in reading the challenges and problems that exist now. Teachers must be able to find explanations on their own and be able to solve problems that arise due to the impact of the progress of the times, where not all progress in this era has a good impact, some have a bad impact that should be given more attention. The demands from the international community on teacher duties entering the 21st era are not easy. A professional teacher should be a well-educated and well-trained person who has rich experience in his field. Currently, there are many modern or technology-based assessment tools that teachers can use to provide assessments or assessments to students (Wolf & Lopez, 2022). This of course can make the teacher's assessment more effective and efficient.

The use of competency-based assessment tools is also expected to make tests more comfortable for students (Jacob et al., 2022; Halimi & Seridi-Bouchelaghem, 2021; Gyll & Ragland, 2018). Another study (Nashir & Laili, 2021) found that using e-learning-based learning would make the learning assessment process more efficient because students could access it from anywhere. Several modern technology-based evaluation tools that can be used by teachers to create quizzes or record students' opinions in learning and carrying out science practicums are such as Kahoot, quizizz, socrative, poll Daddy, verso, poll everywhere, google form, class maker, and so on (Adriyono et al., 2022). Teachers

can use these tools to welcome modern assessments that are more interesting than making quizzes with paper or whiteboards which are still conventional, of course in implementing this modern technology-based assessment the teacher must also pay attention to 4C skills in 21st-century learning. The assessment can also be developed to provide formative assessments to students. The research objective was to identify science practicum assessments in the 4.0 education era that support 21st-century skills.The results of the formulation of research questions related to Science Practicum Assessment in the 21st-Century Skills Era: Systematic Literature Review which can be seen in Table 1.

Table 1. Research question

Code	Research question	Motivation
RQ1	How is the development of the Science Practicum?	Identification of articles related to science practicum
RQ2	How is the science practicum assessment?	Identification of articles related to the science practicum assessment

METHOD

Article selection process and criteria

The research method is a systematic literature review and selected scientific articles follow the PRISMA diagram (Preferred Reporting Item for Systematic Review and Meta-analysis), described in Figure 1. Keywords science, science practicum, assessment, 21st-century skills using databases, such as Scopus, Web of Science, Google Scholar, and Researchgate from 2010-2022 to conform with the latest findings. The procedures carried out in systematic literature review research, namely writing the background and research objectives, compiling research questions, searching the literature, selecting articles, extracting articles, assessing the quality of basic studies, and synthesizing data.Publications were selected based on the title of the article and abstract, followed by the full text of the article following the inclusion and exclusion criteria (Table 1).

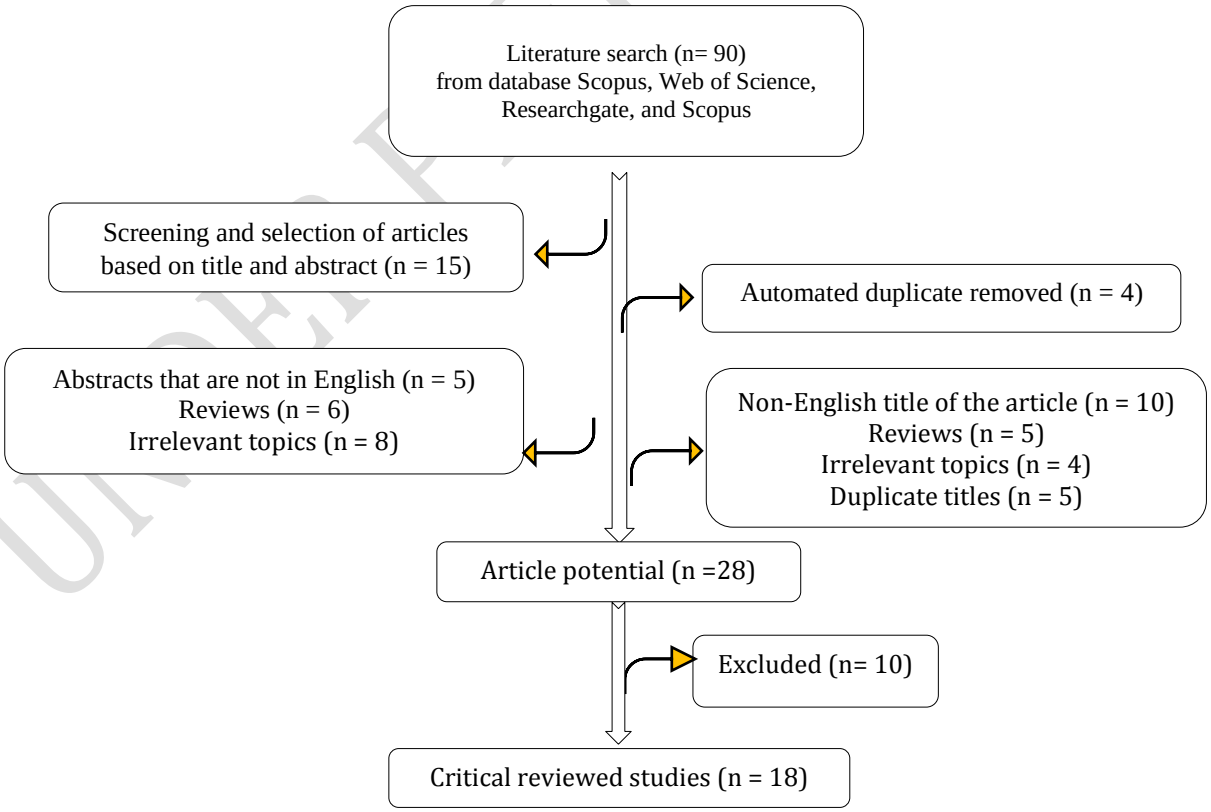

Figure 1: The PRISMA method in a systematic literature review

Table 2. Inclusion and exclusion criteria

INCLUSION	EXCLUSION
Science Practicum Assessment on 21st-Century Skills	1. Review
Be in Google Scholar, Web of Science, Scopus, and Researchgate	2. Not written in English
Be published before 2023	3. Irrelevant topics to Science Practicum Assessment on 21st-Century Skills
Be written in English	4. Duplicate titles

RESULT

Literature search

A literature search was carried out on relevant articles using keywords, namely Science, science practicum, assessment, and 21st-century skills. Articles are collected from various databases, such as Scopus, Web of Science, Google Scholar, and ResearchGate. The strategy used to search for articles was predetermined inclusion and exclusion criteria. It aims to occur a determination in finding the article you are looking for. Literature search results obtained 90 articles.

Screening and selection of articles

Screening and selection of articles used inclusion criteria to guide the search and selection of English-language research articles.Complete articles published in international journals starting in 2016-2022 indexed in the database.Screening and selection of articles results obtained 28 potential articles.

Data Extraction, Primary Study Quality Testing, and Synthesis

Data extraction aims to collect data to answer predetermined research questions. The research quality test plays a role in determining the interpretation of the synthesis of findings and compiling the conclusions described. Data synthesis aims to collect evidence from selected studies to answer research questions.Results of data extraction, primary study quality test, and synthesis obtained 18 articles used for critical review studies.

DISCUSSION

Evaluation comes from the word evaluation (English) which means assessment or assessment. The word is absorbed into the Indonesian term to become "evaluation". Meanwhile, according to the term evaluation is a process of planning, obtaining, and providing information that is needed to make alternative decisions.

Science practicum

The rapid development of science, especially science and technology, on the one hand has indeed provided many benefits for the provision of various human needs. But on the other hand, this is at the same time a challenge for us in education to be able to prepare a generation of people who have scientific literacy, namely people who are able to open their self-sensitivity, examine, filter, apply, and participate in contributing to the development of science itself to increase welfare. and the benefit of society. Scientific literacy is very important for today's life. Science with its scientific characteristics and methodology for the development of science and technology is the heart of modern civilization. According to (Ploj Virtič, 2022);(Ali et al., 2022);(Fausan et al., 2021), a society with scientific and technological literacy must: 1) have an understanding of meaningful aspects of science and technology and be in accordance with their mental-cognitive development, 2) be able to find science fun and appreciate it, 3) use scientific and technological knowledge to fulfill and enjoy life. Various issues of health, energy sustainability, natural resources, environmental quality, and the dynamics of the human population and its culture require better scientific attention and thinking from society. If we are not ready to play a role and face this challenge, then our society will get worse left behind and become an object for other, more advanced societies. In this context, science teachers are the spearhead of the process of preparing and establishing a science-literate society. Through learning that is in accordance with the scientific nature of science, it is possible that the community's needs can be fulfilled. The characteristics of science as a body of knowledge, science or natural science are formed from the interrelationships between scientific attitudes and processes, investigations of natural phenomena, and scientific products.

The description above explicitly states the importance of applying scientific processes and scientific attitudes in science learning. The development and mastery of scientific attitudes and science process skills are also one of the important goals in learning science (Suryanti et al., 2018). Learning with a process skills approach is an ideal learning for fulfilling the demands of applying the scientific process and scientific attitude. To support the science learning process, in addition to providing material or subject matter theoretically, it is also necessary to prove it with the existing reality in the form of practicum (Budiarti et al., 2022);(Yulkifli et al., 2019). Based on the terminology, practicum can be interpreted as a series of activities that allow students to apply skills or practice something (Anjum, 2020). In other words, in practicum activities it is very possible to apply a variety of science process skills as well as develop a scientific attitude that supports the process of acquiring knowledge in students (Wiwin & Kustijono, 2018);(Laila et al., 2022);(Wulandari et al., 2020). This is where it can be seen how practicum has a very important position in learning science. Learning through practicum allows the achievement of learning targets as a whole in students and in accordance with the demands of the characteristics of science (Darling-Hammond et al., 2020).

Science PracticumAssessment

Broadly speaking, participation is the participation of students in the learning process which includes receiving responses from outside, responding to a problem, and answering a problem that is being discussed. Student participation in class will affect the learning process itself, where with high participation an effective learning atmosphere will be created. Student participation in learning is very important to create active, creative and fun learning. Thus the learning objectives that have been planned can be achieved as much as possible. There is no learning process without the participation and activeness of students who learn. Every student must be active in learning, only what distinguishes it is the level/weight of student activity in learning. There is activity in the low, medium and high categories. According to (Haleem et al., 2022b); (Stehle & Peters-Burton, 2019b); (Coman et al., 2020b) that in terms of process, learning and competency formation it is said to be successful and of good quality if all or at least the majority (75%) of students are actively involved, both physically, mentally and socially in the learning process. Here the teacher's creativity is needed in teaching so that students participate in learning. The use of appropriate strategies and methods will determine the success of teaching and learning activities. Teaching and learning methods that are participatory by the teacher will be able to bring students into a more conducive situation because students participate more openly and sensitively in teaching and learning activities so as to be able to create a lively classroom atmosphere, namely there is interaction between teachers and students and students with students . This is related to the assessment of the Science Practicum in which the assessment of actions or practical tests can be used effectively for the purpose of collecting various information about the forms of behavior that are expected to appear in students during the ongoing Science practicum (Ahmed et al., 2019). Models of practicum activities are not only oriented towards discoveries, but can also be oriented towards proof or as a vehicle for finding solutions to problems.

According to (Wibowo, 2018) There are three kinds of models in practicum activities, namely the inductive practicum model, the verification practicum model, and the inquiry model. a) the inductive practicum model developed by Francis Bacon suggests that practicum activities are collecting patterns of relationships between data and then finding theories to rationalize everything, or in other words from facts to generalizations; b) the verification practicum model developed by Popper according to this understanding views scientists starting their investigations with a hypothesis derived from the results of experience and creativity. This verification model activity is more directed at proving the theory that has been studied by students before. c) the inquiry practicum model, namely students are like a scientist doing an experiment, they are required to formulate problems, design experiments, assemble tools, make careful measurements, interpret data, and communicate it.

Excess Practicum assessment (Dewi & Kartowagiran, 2018) is being able to assess competence in the form of skills, it can be used to match suitability between knowledge about theory and skills in practice so that the assessment information becomes complete, in practice there is no opportunity for students to cheat, and the teacher can get to know more deeply about the characteristics of each student. The disadvantages of practicum assessment are that it takes a long time, costs a lot and is tedious, must be carried out in full and complete, and the skills assessed through action tests may not be of comparable quality to the skills demanded by the world of work because advances in science and technology are always faster. from what you get. Science practicum assessment demands more comprehensive assessment techniques and methods.

Comprehensive assessment is an assessment carried out as a whole which includes several aspects of the science practicum participants (Elfrida et al., 2021), namely knowledge, understanding, skills, and attitudes; or it can also refer to the measuring instrument used. Assessment of science learning

processes and outcomes demands more comprehensive assessment techniques and methods. In addition to the aspects of learning outcomes and practicum that are assessed must be comprehensive, namely cognitive, affective, and psychomotor aspects, assessment techniques and assessment instruments should be more varied, both tests and non-tests carried out to determine the extent to which competency has been achieved. Learning outcomes can be divided into knowledge, reasoning, skills, work and affective. The results of the practicum can be revealed or detected through several ways or techniques such as: limited choice or response, essay assessment, performance assessment, and personal communication so that it can clearly collect information related to students and can be used to make decisions that are appropriate to learning and science practicum and find out what quality they expect students to have in the era of education 4.0.

CONCLUSION

Assessment is the collection of evidence that is carried out intentionally, systematically, and continuously and is used to assess student competence. Assessments provide feedback on student learning progress for students, parents, and teachers. The assessment also helps teachers to make decisions about student needs and guides planning learning programs. In addition to this, assessment must be an integral part of the learning program. Teachers need to pay attention to evidence of learning from the daily activities carried out by students. This evidence will show what students already know, and what they still need to know. Assessment literacy is defined as an understanding of the principles of assessment. Teachers who have solid assessment literacy will be in a good position to integrate assessment into learning, because they use appropriate forms, according to learning. It can be concluded that practicum is part of teaching in the form of application of the theory learned. Besides that, the practicum is also a vehicle for developing cognitive, affective, and psychomotor aspects simultaneously. The learning process with practicum places more emphasis on direct student involvement in the learning process. An important part of this learning assessment is how to carry out the assessment, what are the assessment procedures, data processing, scoring, and reporting. Every time there is development and progress in the education system, changes will also be made to the learning and assessment systems.

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