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 learning process 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., 2020) 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 learning evaluation?	Identify articles related to learning evaluation
RQ2	What are the learning assessments?	Identify articles related to learning assessment
RQ3	How is the development of learning assessment in Education 4.0?	Identify articles related to the development of learning assessments in Education 4.0
RQ4	How is the development of the Science Practicum?	Identification of articles related to science practicum
RQ5	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).

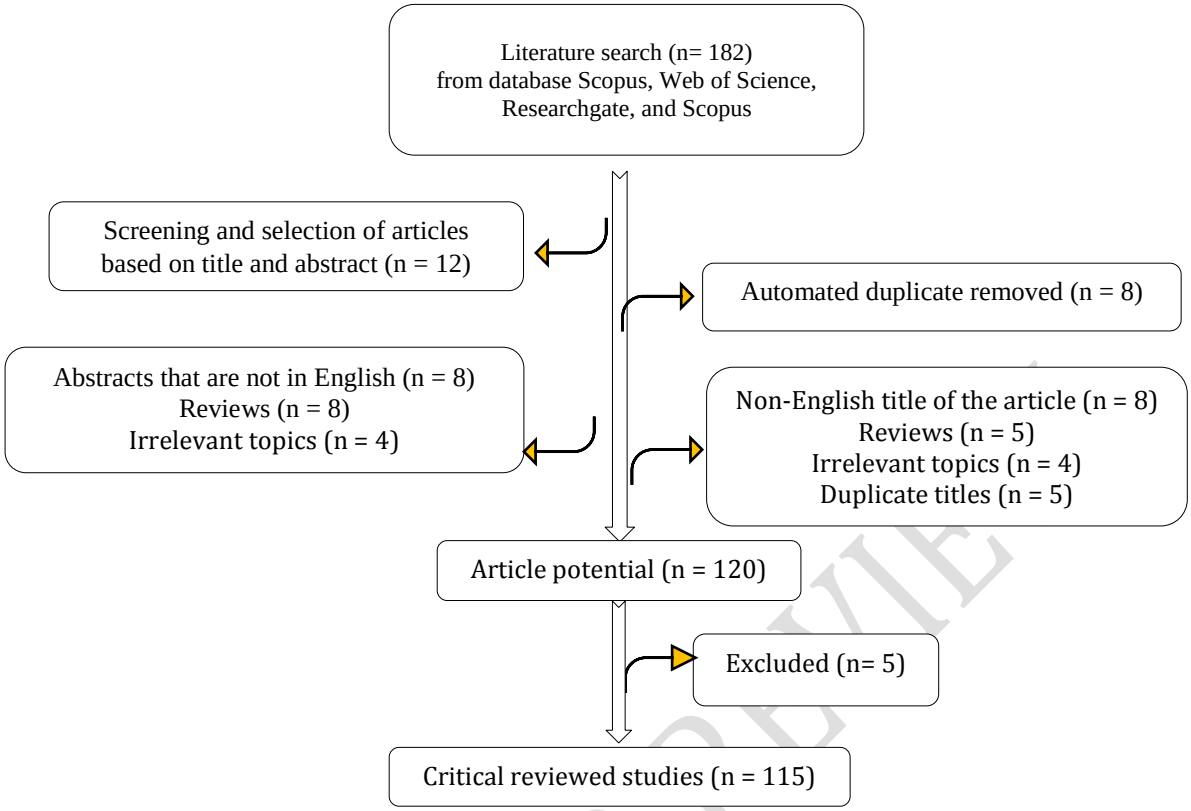

Figure 1: The PRISMA method in a systematic literature review

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 182 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 2010-2023 indexed in the database. Screening and selection of articles results obtained 120 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 115 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.

Learning Evaluation

Evaluation or assessment activity is a process that is deliberately planned to obtain information or data, and based on the data then a decision is tried to be made. Of course, the information or data collected must be appropriate data and support the planned evaluation objectives. According to the definition of the term, evaluation refers to or implies an action or a process to determine the value of something. Included in the teaching activity relationship (Wanzer, 2021). About teaching activities, evaluation contains several meanings, including:

1. Evaluation is a systematic process to determine the extent to which the goals are achieved by students (Aziz et al., 2018).
2. Evaluation is the process of understanding or giving meaning, obtaining and communicating information to guide decision-making parties.
3. Evaluation is the activity of collecting data as wide as possible, as deeply as possible, which is concerned with student capabilities, to find out causes and effects and student learning outcomes that can encourage and develop learning abilities (Seo et al., 2021).
4. Evaluation is an activity to assess how far the program has run as planned.
5. Evaluation is a tool to determine whether educational goals and the process of developing knowledge are on the expected path (Swiecki et al., 2022).

Evaluation in a broad sense is a process of planning, obtaining, and providing information that is needed to make alternative decisions. Based on the description above, it can be concluded that knowing the learning process of students is by the implementation plan of learning that has been implemented and obtaining certainty about student success, and providing input to teachers about what is done in class learning. The purpose of an evaluation is a deliberate activity in which evaluation activities are carried out consciously by the teacher to obtain certainty regarding student learning success and provide input to the teacher about what he is doing in teaching activities (Lodge et al., 2018).

An educator must know the extent to which the success of his teaching is well achieved and to improve and direct the implementation of the teaching and learning process, and to obtain this decision, an evaluation process is needed in learning or also known as learning evaluation. Evaluation of learning is an assessment of student learning activities and progress which is carried out periodically in the form of exams, practicums, assignments, and or observations by the teacher (Mirizon, 2021). The form of the exam includes midterm exams, final semester exams, and final assignment exams where the weighting is determined by the cooperation between the course supervisor and the syllabus drafter or the agency concerned. Students are allowed to take the exam with certain requirements. In discussing evaluation issues in the field of education, three terms are often used, namely measurement, assessment, and evaluation (Hayati et al., 2020). Measurement is the act of comparing something with a certain size. In other words, measurement is a process or activity to determine the quantity of something (Yew & Goh, 2016). Assessment is the process of collecting and processing information to determine the quality of learning outcomes from students. Evaluation is an action or activity that is systematic and sustainable to determine the quality of something based on certain considerations and criteria (Sala et al., 2015). One of the professional teacher competencies is the ability to conduct evaluations (Astutik & Roesminingsih, 2021). Evaluation of learning by the teacher is carried out continuously to monitor the process, progress, and improvement of results in the form of daily tests, midterm tests, final semester tests, and grade increase tests.

In general, the purpose of learning evaluation is to determine the effectiveness and efficiency of the learning system. The intended learning system includes objectives, materials, methods, media, learning resources, the environment, and the assessment system itself. In addition, learning evaluation is also intended to assess the effectiveness of learning strategies, assess and improve the effectiveness of curriculum programs, assess and improve learning effectiveness, assist student learning, identify strengths and weaknesses of students, and provide data that assists in making decisions (Fatkhurrokhman et al., 2018; Hibana & Surahman, 2021) stated that the function and purpose of learning evaluation are to develop learning and accreditation obtained from the results of information or data in learning evaluation. Based on this explanation, the purpose and function of learning evaluation are carried out to assist teachers in obtaining various information needed so that

the quality of learning can be improved again. The type of evaluation seen from its function consists of (Parker, 2020)

1. Formative evaluation is an assessment carried out at the end of the learning program to see the level of success of the learning process. Formative assessment is process-oriented, which will provide information to teachers on whether the program or learning process still needs improvement.
2. Summative evaluation is an assessment carried out at the end of a program unit such as the end of a quarter, end of the semester, or end of year. The purpose of this assessment is to find out the results achieved by students, namely how far students have achieved the competencies set out in the curriculum. This assessment is oriented to the product/result of a learning process.
3. Diagnostic evaluation is an assessment that aims to find out student weaknesses and their causal factors that aim for tutoring purposes, remedial teaching, and finding cases related to or influencing student learning processes and outcomes.
4. Selective evaluation is an assessment carried out to select or screen students. For example, choosing students who excel in representing schools for school or inter-city competitions.
5. Placement evaluation is an assessment that aims to determine the prerequisite skills needed for a study program before starting learning activities for the program. With this, the teacher can find out the placement of students in their readiness to face a new program.

This type of learning evaluation is seen from the target, namely (Handayani et al.,2019; Qu & Zhang, 2013):

1. Input evaluation is an evaluation that is directed to know the resources and strategies used to achieve the goal.
2. Evaluation of the learning process is an evaluation aimed at seeing the implementation process such as the smoothness of the learning process, conformity with plans, supporting factors, and inhibiting factors that arise in the learning process.
3. Evaluation of output is an evaluation that is directed to see the results of the program achieved as a basis for determining the final decision, repaired, maintained, or increased.
4. Autome evaluation is an evaluation that is directed to see further student learning outcomes, namely evaluation after being in the community.

This type of learning evaluation is seen from the scope of learning, namely (Santi et al., 2019):

1. Evaluation of lesson planning is an evaluation that includes learning objectives, the content of learning programs, learning strategies, learning media, and learning aspects.
2. Evaluation of the learning process is an evaluation process that includes the suitability between the learning process and the outline of the learning program, which are defined as competency standards and basic competencies, the teacher's ability to carry out the learning process, the ability of students to participate in learning and accept the learning process.
3. Evaluation of learning outcomes is the evaluation of learning outcomes including the level of student mastery of the objectives defined learning, both general and specific, reviewed in terms of cognitive, affective, and psychomotor.

The type of learning evaluation is seen from its measurement, namely (Wardani, Danti Ayu, et al., 2021):

1. The test is a research tool or technique that is often used to measure students' abilities in achieving certain competencies by teachers.
2. The non-test is an ordinary evaluation tool for assessing the affective and psychomotor aspects of students such as attitudes, interests, skills, and motivation.

This type of learning evaluation with an online system can be evaluated by type, namely (Al-Fraihat et al., 2020):

1. Formative Evaluation Model - Scriven Summative

Formative evaluation is an assessment process carried out on an ongoing program to determine the program's progress in achieving its goals. If the progress of the program goes well in achieving the goals then there is no need for improvement but on the contrary, it is hoped that it can be improved. Formative evaluations focus on questions about planning and conducting online learning evaluations. Thus formative evaluation is very useful, especially for program developers. By conducting a formative evaluation of program components that are not running as expected, the program developer can repair, modify, or make adjustments so that the program can run as expected again. On the other hand, a summative evaluation is a final evaluation of the program which is very useful to find out how far the program has been achieved. Summative evaluation answers questions as opposed to formative evaluation, namely about changes, responses, and results of learning evaluations with online systems (Ismail et al., 2022). When conducting a summative evaluation, the main attention

should be placed on measuring the main outcomes or effects of the program rather than measuring outside influences that may have affected program participants.

2. Stufflebeam's CIPP Evaluation Model

The CIPP evaluation model (Context, Input, Process, and Product) is an evaluation model that emphasizes the evaluation of context, input, process, and product as follows:

   a. Context evaluation is to help decision-making about planning (planning). Context evaluation can be done by system analysis, surveys, documents, opinions, interviews, and diagnostic tests.
   b. Evaluation of inputs is to help make decisions about the structure of the program to be implemented. Input evaluation can be done by collecting and analyzing human resources and material sources to be used, using problem-solving strategies or case studies.
   c. Process evaluation is to help make decisions about program implementation. Process evaluation can be carried out by monitoring program implementation by observing and interviewing.

3. Kirkpatrick's Evaluation Model In evaluating a training program, this evaluation model is divided into four levels as follows:
   a. Level 1 is the participant's evaluation of the implementation of the training program.
   b. Level 2 is the evaluation of the participants after participating in the training program.
   c. Level 3 is an evaluation of the participant's behavior after returning to the workplace.
   d. Level 4 is an evaluation of the results obtained by the institution or company after the participants who were sent to attend the training returned to the workplace.

Learning Assessment

Assessment is a systematic process using appropriate instruments to determine learning behavior, placement, and learning. Several opinions about the definition of assessment, namely (Rowles & Mills, 2019)] Assessment is a process of gathering information that will be used to make judgments and decisions related to children's learning. Assessment is a comprehensive assessment and involves team members to find out the weaknesses and strengths of the child, where the results of the decision can be used to determine the educational services needed by the child as a basis for developing a learning plan (Escolano-Pérez et al., 2017) Assessment is a systematic process of collecting data on a child whose function is to see the abilities and difficulties faced by a person at that time, as material for determining what is needed. Based on this information, teachers will be able to develop realistic learning programs by objective reality. (Mandinach & Schildkamp, 2021) Assessment is the process of collecting data to make decisions and implement the entire decision-making process, from the earliest diagnosis of developmental problems to the final determination of the child's program. [60] Assessment is a process carried out to collect information and data related to helping someone make decisions related to educational issues. It can be concluded that the definition of assessment is a systematic process that is comprehensive, in the form of information to find out the symptoms and their intensity, the obstacles experienced, as well as the weaknesses and strengths of the child.

There is a comparison of this information with a parameter/measurement using instruments. Some actors collect information and use it to develop a learning program that is needed by children that is realistic, and by reality objectively. The purpose of the assessment is to obtain relevant, objective, accurate, and comprehensive data about the child's current condition, to know the child's profile as a whole, especially the problems and learning obstacles they face, their potential, as well as the carrying capacity of the environment needed by the child, to determine the services needed to meet specific needs and to monitor progress (Alonzo et al., 2021; Bilgin et al., 2019). The function of assessment is as a tool/material to see the abilities and difficulties faced by a person at that time, as material to determine what is needed in student learning. (Shepard, 2000). Assessment is used to find and determine where the problem is and what the learning needs of a child are. Teachers will be able to develop realistic and objective learning programs on the difficulties encountered. Assessment (Khilmiyah, 2021) can be seen from its implementation before, during, and at the end of learning, as it continues without stopping. Terms of content are based on the problems and abilities that students have and goals are based on the problems and abilities that students have. As for the evaluation of its implementation at the end of content learning, it is based on the problems and abilities that students have, content based on the material that has been given, where the purpose of the evaluation is

To measure how far the material that has been given can be absorbed by students. Assessment is carried out in natural situations, looking at the child's real behavior in a variety of environmental situations. The assessment is carried out starting with (Septiana et al., 2020), 1) Observation, making observations of an object, symptom, event, or process that occurs in a situation whether it occurs in

humans or their environment, 2) an Interview is one of the data collection techniques that is carried out through verbal communication by holding questions and answers either directly or indirectly with respondents, 3) Tests, where tools or procedures are used to find out or measure something in an atmosphere, in ways and rules that have been determined, 4) Inventory, is a collection tool data whose nature is to measure the tendency of individual behavior characteristics. The scope of the assessment is divided into two, namely 1) Cognitive development, and 2) Academic with reading, writing, and counting (Nurhayani et al., 2023).

Learning Assessment in the Education 4.0 Era

Industry 4.0 was born from the idea of the fourth industrial revolution. Its existence offers many potential benefits, especially in 21st-century learning. According to (Ryalat et al., 2023), education 4.0 is the integration of Cyber-Physical Systems (CPS) and the Internet of Things and Services (IoT and IoS) into industrial processes including manufacturing and logistics and other processes. (Matana et al., 2020). CPS is a technology to combine the real world with the virtual world. This merger can be realized through the integration of physical and computational processes in a close loop (Lee, 2015). According to (Panggabean et al., 2021; Maknun et al., 2021). 21st-century learning is oriented toward digital lifestyles, thinking tools, learning research, and how knowledge works. Three of the four 21st-century learning orientations are very close to education, namely how knowledge works, strengthening thinking tools, and digital lifestyles. How knowledge works is the ability to collaborate in teams with different locations and with different tools, strengthening thinking tools is the ability to use technology, digital tools, and services, and digital lifestyle is the ability to use and adapt to the digital era. Based on the description above, it can be concluded that Industry 4.0 has brought changes in the world of education with the existence of 21st-century learning that is oriented towards skills in using technology and information media to adapt to existing developments.

One important part of the implementation of learning that cannot be ignored is the implementation of assessment (Kartini & Aprilia, 2022; Moges, 2018); Chen et al., 2021). Assessment is not only done momentarily but must be carried out periodically and continuously during the teaching and learning process. In the assessment, the teacher must be able to achieve the expected learning objectives, to find out the willingness of students to learn and the learning potential of students so that of course this must be supported by good and appropriate assessment models and learning methods. The development of information technology in Indonesia has progressed very rapidly. This development is entering the revolutionary era of 4.0. The fourth world industrial evolution is where technology has become the basis of human life. Everything is limitless and unlimited due to the development of the internet and digital technology (do Livramento Gonçalves et al., 2021). In the era of the industrial revolution 4.0. This has influenced many aspects of life in the fields of economics, politics, culture, art, and even to the world of education (Gleason, 2018; K. Zervoudi, 2020). Preparing quality graduates who can compete globally and master technological developments is important for everyone and important for the future of a country. Thus, the support and role of higher education are expected to be able to increase the competitiveness of the Indonesian nation amid global competition and the rapid development of information technology. One way to educate the nation's life is through education (Idris et al., 2012). Education is very important in improving the quality of human resources. In improving quality human resources, quality education, and professional and qualified teaching staff are also needed (Subaidi et al., 2021; Sholeh et al., 2021; Harahap et al., 2020; Nurochim, 2018), as for the relationship between the world of education and the industrial revolution 4.0. is that the world of education is required to follow technological developments that are developing rapidly and utilize information and communication technology as more and more sophisticated facilities to expedite the learning process for students (Sagita & Khairunnisa, 2020). For an educator, the rapid development of technology is an opportunity that can be utilized to develop innovation in learning. In addition, it is hoped that the use of information and communication technology will be able to make the learning mindset shift from teacher-centered to student-centered. At this time, teachers should be in the era of the industrial revolution 4.0. is a professional teacher to be able to face challenges (Nababan et al., 2020). For this reason, personal competence, professional competence, and social competence, as well as the pedagogical competence of a teacher need to be developed so that they can educate students who can predict and cope.

On the other hand, professional teacher duties must be supported by an appropriate reward system (Alkandi et al., 2023; Manzoor et al., 2021), so that teachers can focus on improving the quality of services provided. Someone who works as a teacher must be able to set learning strategies, help serve, fulfill, create, and facilitate learning activities by applying the principles of active learning students (Kudryashova et al., 2015), namely by learning that involves all aspects of student development both physically and socially and according to with the child's developmental level.

Programs and learning processes must be directed at activities that can optimize students' teaching and learning activities (Fricticarani & Maksum, 2020). Furthermore, to find out whether the teacher can achieve the learning objectives expected to know the willingness of students to learn, the ability and learning potential of students, of course, must be supported by good and appropriate assessment models and learning methods. Assessment is not only done momentarily but must be carried out regularly and continuously during the teaching and learning process.

The implementation of the assessment is not only assessing something partially but must assess something as a whole which includes the process and student learning outcomes. One important part of the implementation of learning that cannot be ignored is the implementation of assessment. The implementation of the assessment is known as Assessment (Intan Safitri et al., 2020; L. R. Dewi & Kartowagiran, 2018; Lestariani et al., 2018; Siswaningsih et al., 2020). assessment is the process of obtaining information in any form that can be used as a basis for making decisions about students and teachers, whether it concerns curriculum, learning programs, school climate, or school policies (Aduloju et al., 2016). Assessments that are often carried out by teachers in Indonesia are summative assessments or Assessments of Learning (AoL) (Puad & Ashton, 2021; Purnomo et al., 2018; Hasan & Habibie, 2022). Assessment is a general term that is defined as a process taken to obtain information used to make decisions about students, curricula, programs, and educational policies, methods, or other educational instruments by an agency, institution, organization, or official institution that organizes a particular activity (Walde, 2016). Based on the opinion of the expert, assessment is a process or effort used to obtain information or data that is directly related to decisions regarding students, the teaching and learning process for students, student learning outcomes, and the format of assessing student learning progress. Based on the results of observations, the assessment was carried out manually by developing individually carried out by the teacher and as many as 68% of teachers in the initial observation class used the dominance of assessment in the cognitive domain by utilizing written tests (Hartini et al., 2021; König et al., 2022)

The current assessment process is very complex and cannot be carried out by only one teacher in one class, for this reason, technological assistance is needed to assist teachers during assessment (Webb et al., 2018). An example of an industrial revolution-based assessment product developed using the Mc program. Access (Kumar et al., 2023), the program has included assessment components that can assist teachers in documenting student assessments. This product was developed to help teachers to be more practical, effective, and efficient in managing student assessments both cognitively, affectively, and psychomotor and even to design and store portfolios based on projects carried out by students. This program can be accessed anywhere and under any conditions even though it is not connected to the internet, so teachers in remote areas need not worry about using this program.

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 can 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 in 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), people with scientific and technological literacy must: 1) have an understanding of the meaningful aspects of science and technology and are by their mental-cognitive development, 2) be able to discover science in a fun and appreciate it, 3) use science and technology 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 be increasingly 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 by 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 important goals in learning science (Suryanti et al., 2018). Learning with a process skills

approach is 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 a practicum (Budiarti et al., 2022; Yulkifli et al., 2019). Based on the terminology, a 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 by the demands of the characteristics of science (Darling-Hammond et al., 2020).

Science practicum assessment

The Science Practicum Assessment is an assessment of practical actions or tests that can be effectively used for the benefit of collecting various information about the forms of behavior that are expected to appear in students during the Science practicum in progress (Ahmed et al., 2019). Models of practicum activities are not only oriented towards discoveries- discovery 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 inductive practicum models, verification practicum models, and inquiry models:

1. Inductive practicum models developed by Francis Bacon argued 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;
2. 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.
3. The inquiry practicum model, namely students are like a scientist experimenting, they are required to formulate problems, design experiments, assemble tools, make careful measurements, interpret data, and communicate it.

The advantages of Practicum assessment (S. S. K. Dewi & Aman, 2020) are that it can assess competency in the form of skills, it can be used to match the suitability between knowledge about theory and skills in practice so that the assessment information becomes complete, in practice there are no opportunities for students to copy, and teachers can get to know more about 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 completely, 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.

A comprehensive assessment is an assessment carried out as a whole covering several aspects of the participants in the Science practicum (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, and 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 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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