PROSPECTIVE MADRASAH TEACHERS' SCIENTIFIC COMPETENCIES INTEGRATED WITH SCIENTIFIC LITERACY THROUGH THE STEM APPROACH

M. A. Rokhimawan*[1], F. Yuliawati[2], I. Kamala[3], Susilawati[4]

[1,2,3]PGMI FITK UIN Sunan Kalijaga Yogyakarta, Indonesia
[4]PGMI FITK UIN Sultan Syarif Kasim Riau, Indonesia

ABSTRACT

This study aims to measure the scientific competence of prospective teachers of Madrasah Ibtidaiyah integrated scientific literacy through a STEM approach. The research method used was descriptive quantitative with a sample of 40 students from the same study program at two different universities. The selected sample has taken basic science courses with a minimum score of B. This research used a purposive sampling technique, where the sampling actively participates in learning activities. Data were collected using a set of instruments to analyze the prospective teachers' scientific competence. The instruments were declared valid based on expert judgment and showed a Cronbach Alpha score of 0.68 before being used. Scientific competence data were obtained from the results before and after the essay, practicum, multiple-choice test, and questionnaire instruments. Data were analyzed descriptive quantitative using inferential statistics with a T-test. Inferential statistical analysis revealed differences in scientific competence of prospective madrasah teachers in Study Program A and Study Program B ($t = 5.98 > 1.83$). The measurement results of the test of science content mastery aspect with an average of 58.3 and 50.8. The practicum mastery of science process skills results from the problem-solving skills test are 48.4 and 39.6. From the questionnaire results on scientific literacy, students still need to improve their independence in studying science, scientific thinking skills, the ability to use scientific knowledge in problem-solving, and integrating the STEM approach. From the findings, it can be concluded that the analysis of the scientific competence of prospective madrasah teachers shows an apparent and significant difference. The prospective madrasa teachers' scientific competence is needed to prepare students as prospective teachers who are STEM literate.

INTRODUCTION

The demand for scientific knowledge is very high in the current industrial revolution 4.0 (Ellahi et al., 2019; Astuti & Heriningsih, 2020). The environment demands human resources in the 21st century to have adequate scientific knowledge. Scientific competence is essential to equip student teachers in the Madrasah Ibtidaiyah Teacher Education study program. Four scientific competencies must be possessed: (1) problem-

solving skills, (2) science content, (3) scientific literacy, and (4) mastery of science process skills. Understanding scientific competence must proceed from the basic (observation) to the advanced or skilled (investigating). In this study, scientific competence integrated scientific literacy is seen from the point of view of STEM indicators.

In the PISA 2018 Assessment and Analytical Framework, three scientific competencies are needed to understand critical science and technology issues. The first is to explain natural phenomena, engineering artifacts and technology, and their implications for society. The second is the

*Correspondence Address
E-mail: mohamad.rokhimawan@uin-suka.ac.id

competence to use one's knowledge and understanding of scientific inquiry to identify questions that scientific inquiry can answer, propose ways in which such questions might be addressed, and identify whether the procedures used are appropriate. The third is the competence to scientifically interpret and evaluate data and evidence and evaluate whether the conclusions are warranted (OECD, 2019). Scientific competence, according to PISA, is already linked with STEM indicators, so it is automatically integrated.

Empirical facts from study program A in Yogyakarta have been accredited A, certified by AUN-QA, and submitted international accreditation to FIBAA. The curriculum used is competency-based, with eight credits for science courses. The average value of science courses is 75% above B. Study program B in Riau has been accredited B. The curriculum used is competency-based, with ten credits for science courses. The average value of science courses is 65% above B.

Competence in learning is achieved according to the characteristics of the scientific field. Characteristics of the learning process of science students related to how to find out about nature systematically (Mardiana & Cahyani, 2018; Svendsen, 2021) because science itself is a process of mastering knowledge in the form of facts, concepts, principles through a process of discovery based on a scientific attitude (Prasetyo, 2013; Suwono et al., 2017; Wilujeng et al., 2017). The results showed that students' scientific literacy is functional and structural. Scientific writing still needs to be improved again because it is essential for developing science literacy (Suwono et al., 2017). From these characteristics, science can be defined as a process or method of investigation that includes ways of thinking, attitudes, and steps from scientific activities to obtain scientific products, for example, observation, measurement, formulating and testing hypotheses, collecting data, experimenting, and predictions.

Scientific competence is vital to be mastered by prospective teachers of Madrasah Ibtidaiyah. It is proven in research conducted by Maretika et al. (2018) that the pedagogical competency score obtained if the teacher does not have scientific competence is estimated to be 4.5. However, if a teacher has scientific competence, the owned pedagogic score is 0.4 or equal to 40%. Thus, if the teacher or prospective teacher does not master scientific competence, it will affect pedagogic competence (Maretika et al., 2018). The impact is that the teacher cannot convey the concept of science to the maximum to the students, and the students cannot understand the material presented by the teacher.

A core idea is the knowledge of science content that students must possess in a global society. Core ideas refer to concepts, principles, and relationships between scientific ideas in several phenomena experienced by students in their lives. It needs to be added and developed continuously to build an integrated conceptual understanding. An integrated understanding of core ideas is the basis for assimilating new ideas, solving problems, and making decisions (Mun et al., 2015). His research showed that the average value of global scientific literacy was 3.46. The highest dimension is 3.89 in the extent of science as a human endeavor, and the lowest area is metacognition and self-direction of 3.10 (Mun et al., 2015).

The concept of science is fundamental to the learning process and learners of science. In comparison, science process skills naturally use logic (Irwanto et al., 2018; Tanti et al., 2020). His research shows that basic science process skills are relatively moderate while integrated science process skills are relatively low. In this case, measuring the skills of the scientific process should be determined in advance what skill criteria to be measured and breastfed with science materials. Science process skills are used to solve problems related to science and can be applied in everyday life (Nurulwati et al., 2021). There are 15 elements of science process skills: observing, communicating, estimating, measuring, collecting data, classifying, inferring, predicting, modeling, interpreting data, making graphs, making hypotheses, controlling variables, operationally defining, investigating (Ostlund, 1992; Fugarasti et al., 2019). Kriswantoro et al. (2021) suggest that assessment models have good characteristics and quality. The model is functional and meets the requirements used to measure students' abilities.

Science process skills are the ability to carry out an activity in science learning to produce concepts, theories, principles, laws, facts, or evidence (Savitri et al., 2017). It is a particular skill for simplifying science learning, which encourages students to be active, develops students' sensitivity to learning, and makes the concept that what they have learned stays in their minds by teaching them using the scientific method (Carey et al., 2007; Ratnasari et al., 2018). Science process skills are needed in discovery, investigation, and thinking, which help students become lifelong learners (Farsakoğlu et al., 2008; Cigrik & Ozkan, 2015; Hernawati et al., 2018).

Science process skills consist of basic and integrated skills. Basic science process skills cover several variables, such as observing, classifying, communicating, relating space and time, measuring and using numbers, predicting, and inferring.

Integrated science process skills include defining, controlling variables, interpreting data, hypothesizing, and experimenting (Mbewe et al., 2010; Rani et al., 2017).

Science process skills are divided into two, basic and integrated. Observation, classifying, measuring, inferring, predicting, and communicating are included in the basis. Meanwhile, the integrated science process combines two or more basic science processes (Nworgu & Otum, 2013; Hernawati et al., 2018). Basic science process skills consist of six skills: observation, classification, communication, measurement, prediction, and inference (Chabalengula et al., 2012; Hernawati et al., 2018). Integrated science process skills include controlling, operational definition, hypothesis, data interpretation, and experiment (Hernawati et al., 2018).

Besides, science process skills are instrumental in daily life (Chabalengula et al., 2012; Siahaan et al., 2017), science skills are not only valuable for learning activities. With this, students are required to solve various problems that occur in the community. Science process skills can be obtained through science practicum activities in the laboratory. By conducting experiments or practicum, students can gain direct experience through science learning activities in the laboratory. Science practicum in the laboratory can encourage students of Madrasah Ibtidaiyah Teacher Education to conduct scientific research in the field of science.

Dewi explained that the competence of students in basic science courses in the science study program in planning scientific research in the field of science could be developed through practical activities in the laboratory, the percentage of basic competence in planning scientific research in the field of science is 67% in the moderate category (Dewi, 2012). As prospective teachers, it is important to have scientific research competence in science to support teacher competence and the learning process. In this case, problem-solving skills are used to implement optimal science learning in the classroom. Life skills are essential for prospective teachers because they can make the right decisions or conclusions and be accompanied by empirical data evidence. The information provided to them is used to criticize the claims made by others based on the evidence presented.

Scientific competence is needed by prospective Madrasa Ibtidaiyah teachers (Naumescu, 2008; Akcanca & Ozsevgec, 2018; Asy'ari et al., 2019; Taufiq & Rokhman, 2020). The importance of scientific competencies that prospective madrasa teachers must master are scientific lite-racy, problem-solving ability, scientific content, and mastery of science process skills. To develop scientific competence, prospective madrasa teachers need to integrate learning Science, Technology, Engineering, and Mathematics (STEM) to make it easier to solve science problems (Kelley & Knowles, 2016; Shernoff et al., 2017; Sumar-ni et al., 2021). Through STEM, it is hoped that prospective madrasa teachers will be able to develop their scientific competence to compete in the future and solve problems (English, 2016; Kelley & Knowles, 2016; Wahono et al., 2020) faced in everyday life through the use of technology.

Prospective madrasa teachers need STEM to master science learning skills integrated with scientific literacy (Moore et al., 2015; Park et al., 2016; Attard et al., 2020; Rahman et al., 2021). 85% of students choose STEM interests for their future careers (Dou et al., 2019) because STEM learning presents games with electrical devices (cars, batteries, bulbs, radio, television) and mechanical devices (guns, bows, and arrows, car jacks, pulleys). In line with Keiler (2018) opinion, teachers who follow STEM training programs get drastic changes and are more readily accepted by students. Prospective madrasa teachers need the skill to use complex multi-model representations in science (Lemke, 1998; Tang & Williams, 2019) and develop scientific literacy skills in interpreting data and constructing diagrams, charts, numbers, and graphic symbols (Knain, 2006; Tang & Moje, 2010; Tang & Williams, 2019). It can be integrated with analytical methods systematically in developing instructional theory from time to time in classroom practice (Disessa & Cobb, 2009; Anderson & Shattuck, 2012; Moore et al., 2018; Paugh & Wendell, 2021). Scientific literacy requires the analytical skills of an object in science learning.

Literacy is the ability to read or write (Wijayanti & Basyar, 2016). Scientific literacy can be defined as understanding scientific processes and engaging with scientific information available in everyday life (Fives et al., 2014; Khaeroningtyas et al., 2016). It is scientific knowledge and understanding of the relationship between science, technology, society, and the environment (Yuenyong & Narjaikaew, 2009; Widiyanti et al., 2015). Wang et al. (2019) suggested that scientific literacy is divided into three parts: scientific competence, scientific knowledge, and scientific attitudes. In China, mastery of scientific competence is 23.7%, scientific knowledge 65.5%, scientific attitudes 10.8%. While in Finland, mastery of scientific competence is 33.2%, scientific knowledge 56.4%, and scientific attitudes 10.4%.

Scientific literacy is concerned with preparing society for the future to make personal and collective decisions on socioscientific issues (Christenson et al., 2014; Ardianto & Rubini, 2016).

Science literacy is an important thing that must be mastered by students (Gucluer & Kesercioglu, 2012; Khaeroningtyas et al., 2016). It is the value of students for life, regardless of scientific requirements and needs (Dawson & Venville, 2009; Ardianto & Rubini, 2016). Literate individuals can be described practically with their skills to solve practical health and survival problems and their participation in debate and decision-making in social practice. Individual achievements in science and skills imply their readiness in the future era of using advanced technology (Khaeroningtyas et al., 2016; OECD, 2019). Adnan et al. (2021) showed that the ability to read scientific information by 36.23% and categorized science literacy is still relatively low. So the importance of science literacy in learning to solve science problems.

Scientific literacy requires supporting tools because of the broad study object in science (Sentürk & Sari, 2018; Pahrudin et al., 2019) and is used as an indicator to see the quality of education and human resources in a country (Winata et al., 2016; Pahrudin et al., 2019). The science education curriculum's main aim is to provide learners with opportunities to use their understanding of science in public debate and make balanced information and decisions about socioscientific issues that affect their lives (Ardianto & Rubini, 2016).

There are various uses of scientific literacy in (Norris & Phillips, 2003): (1) Knowledge of the substantive content of science and the ability to distinguish science from nonscience; (2) Understanding science and its applications; (3) Knowledge of what counts as a science; (4) Independence in studying science; (5) The ability to think scientifically; (6) Ability to use scientific knowledge in problem-solving; (7) Knowledge required for intelligent participation in science-based social problems; (8) Understanding the nature of science, including its relationship to culture (9) Appreciation and comfort with science, including its wonders and curiosity; (10) Knowledge of the risks and benefits of science; (11) Ability to think critically about science and deal with scientific expertise.

This research was conducted because scientific competence is needed for prospective teacher students at the Madrasah Ibtidaiyah level. First, the students' scientific competence scores are still low; second, the low ability to use science laboratory equipment; third, the low ability to read the results of the practicum; fourth, the low ability to solve problems; fifth, the ability to link science, technology, engineering, and mathematics is still low. This is by the argument presented by Darling-Hammond et al. (2019) that scientific competence is one of the abilities that every prospective teacher needs to have in facing the challenges of the 21st century. Scientific competence is also closely related to scientific literacy because both play an essential role in improving the cognitive ability of learners.

This study aims to measure the scientific competence of prospective teachers of Madrasah Ibtidaiyah integrated scientific literacy through a STEM approach. The problems in this study are how the scientific competency measurement test results for prospective madrasah Ibtidaiyah teachers are integrated with scientific literacy through the STEM approach and how the results of the prospective Madrasah Ibtidaiyah teachers' scientific competence are integrated with science process skills with the STEM approach.

METHODS

This research uses descriptive quantitative research methods. The quantitative method tests objective theory by testing the relationship between variables (Creswell, 2015). This type of quantitative descriptive research was conducted by measuring the results of a scientific competency test with a scientific literacy approach from two classes of prospective teachers of Madrasah Ibtidaiyah from two state universities in Yogyakarta and Riau. This research was conducted to explore the scientific competence of future madrasah teachers with an integrated STEM approach to scientific literacy. Researchers sought to uncover the scientific competencies of madrassa teachers by giving formative tests. Stem approaches are integrated with scientific literacy to enhance conceptual knowledge of science.

The scientific literacy indicator used in this study is the scientific literacy indicator, according to Gormally et al. (2012). The scientific literacy indicators used in this study are (a) identification of valid scientific arguments, (b) evaluating the validity of sources, and (c) evaluating the use and misuse of scientific information. The following indicators of scientific literacy are (d) understanding the elements of research design and how they affect scientific findings/conclusions, (e) loading graphic representations of data, and (f) reading and interpreting graphical representations of data. Furthermore, (g) solve problems

using quantitative skills, including probability and statistics, (h) understand and interpret basic statistics, and (i) justify inferences, predictions, and conclusions based on quantitative data.

Empirical facts from study program A in Yogyakarta have been accredited A, certified by AUN-QA, and submitted international accreditation to FIBAA. The curriculum used is competency-based, with eight credits for science courses. The average value of science courses is 75% above B. Study program B in Riau has been accredited B. The curriculum used is competency-based, with ten credits for science courses. The average value of science courses is 65% above B.

Participants in this study are students of the Undergraduate Madrasah Teacher Education Study Program who have taken science courses 1. The samples in this study used purposive random sampling techniques. This sampling technique compares the results of science compels through an integrated STEM approach of scientific literacy. The sample involved in this study was 40 students of Madrasah Ibtidaiyah Teacher Education from 2 state universities in Yogyakarta and Riau. The forty samples were selected because they had taken science courses 1 and had a minimum grade of B. The students involved in this study were 20 men and 20 female students. All the students involved in the study sample were aged between 19 and 21. Meanwhile, the samples involved in this study were differentiated by gender. This is because gender is one of the indicators in the selection of participants.

This difference will affect the ability to think, behave uniquely and gender equality. Furthermore, the conditions used in determining and selecting the institutions used in this research are by considering several things, including that these two universities are state universities and have an "Excellent" accreditation value. The selected study program has been accredited Very Good and has ASEAN University Network-Quality Assurance (AUN-QA) certification. In addition, the quality of graduates from these two universities is widely absorbed into the world of work and continues to study at the master's level. Third teaching staff or lecturers in the study program, 60% have doctoral degrees.

Data was collected through 2 kinds of instruments to determine the scientific competence of prospective madrasa teachers who were integrated with the scientific method, namely the scientific method integrated scientific competency test instrument and the integrated scientific concept understanding test instrument in the form of objective, subjective tests. Scientific competencies data was obtained from test results with integrated scientific method test instruments, multiple-choice tests, and practicum. The scientific method integrated test consists of 80 comprehensive questions. The form of the test is in the form of multiple-choice as many as 60 items, and the material includes measurement, quantity, unit, motion, force, work, energy, fluid, temperature, heat, waves, sound, light, optical devices, electricity, magnetism, earth, and space.

The practicum uses an observation sheet with 13 density and cell material questions. The first and second instruments determine scientific competence with a STEM approach integrated with scientific literacy. The instrument was declared valid based on experts' assessment and showed a Cronbach Alpha score of 0.68 before being used. Meanwhile, the lesson plan that uses the STEM approach in this study has the characteristics that there are eight stages in implementing learning in the classroom. The eight stages of learning include (a) asking questions and defining problems, (b) developing and using models, and (c) planning and carrying out investigations. Meanwhile, the following stages are (d) analyzing and interpreting data, (e) using mathematics and computing, (f) building explanations and designing solutions, (g) arguments and evidence, and (h) obtaining, evaluating, and communicating information.

Based on the eight stages in the STEM approach, the stages of using computation and evaluating have not been maximized. Meanwhile, aspects of science process skills measured in this practicum include observing, measuring, using tools, predicting, concluding, and experimenting. The student worksheets used in this study also applied the STEM approach. Like the lesson plans, the student worksheets used in this study also contain eight learning steps using the STEM approach. The student worksheets compiled in this study applied an eight-step STEM approach to facilitate and help to construct the knowledge of prospective madrasah ibtidaiyah (MI) teachers. Students' worksheets based on the STEM approach can also improve problem-solving skills in developing scientific concepts. Meanwhile, applying student worksheets based on the STEM approach is carried out in the science learning process. This is so that they are happy and easy to understand the concept of science with a STEM approach.

The data analysis technique in this study uses quantitative descriptive analysis with a statistical model assisted by SPSS 25 application. Descriptive analysis in this study is used to deter-

mine the average and typical values of scientific competencies result from two study programs, A and B. Test data is analyzed descriptively using inferential statistics with T-tests. Analysis of this T-test to find out the difference in scientific competence results from two study programs, A and B. The results of this study are useful as information on the scientific competence of prospective madrasah teachers related to the properties of phenomena. They can reference learning improvements integrated with scientific methods and STEM.

RESULTS AND DISCUSSION

The results of scientific competence of prospective Madrasah Ibtidaiyah teachers integrated scientific literacy. After collecting data on prospective madrasah ibtidaiyah teachers' scientific competence, the data were analyzed with descriptive statistical analysis. The results of descriptive analysis on the scientific competence of future madrasah teachers integrated scientific literacy can be shown in table 1.

Table 1. Scores of Scientific Competence Test

Study Program	Mean	N	Std. Deviation	Std. Error Mean
A	58.30	20	6.37512	1.42552
B	50.80	20	6.75589	1.51066

Referring Table 1 shows the results of scientific competencies tests of prospective madrasah teachers who are integrated scientific literacy obtained an average grade of Study A of 58.30 and Prodi B received an average of 50.80. with the difference, Standard Deviation mastery of scientific competence of prospective madrasah teachers ibtidaiyah integrated scientific literacy for Study Program A amounted to 6,375, and Prodi B amounted to 6,756. The number of question instruments as many as 60 points of questions done by 40 students. The science content in it is science concepts under the content standards set by the government where prospective madrasa teachers must master all the concepts set and use a STEM paradigm or point of view where the science learning process must link technology as software and hardware to make work easier. Engineering applies science in the form of systems, tools, or machines. Mathematics trains higher-order thinking rationally, logically, and with reason.

The score shows that the average student mastery of science knowledge competence is not satisfactory because it has only reached 50% of all concepts in the scientific competencies test. Students need to understand natural phenomena and changes in the surrounding environment, especially physics and life sciences.

There is a slight difference in the number of courses and credits. Study Program A has three science courses with ten credits, while Study Program B has three science courses with eight credits. The difference in the number of credits will impact the standard of graduates from each study program. The scientific competence obtained by Madrasah Ibtidaiyah Teacher Education students will be different even though they use the same standard, referring to the KKNI.

Students' scientific attitude and motivation are outstanding when participating in science learning activities, but the science process skills shown by students are still low. The science process skills showed by Study Program B students are lower than Study Program A students, although the number of semester credit units for science courses in Study Program B is more than Study Program A with a ratio of 5:4. In the learning process of science courses, Study Program A is superior. In Study Program A, eight credits include practical activities, 75% theory, and 25% practicum in the laboratory. While in Study Program B, ten credits are 100% theory, and there are occasional visits to natural laboratories (sea and mountains). The material considered difficult by students is physics calculations and chemical calculations.

Table 2. T-test Results of Scientific Competence Test Scores

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Scientific competence score of Study Program A – Scientific competence score of Study Program B	7.500	3.37950	.75568	5.91834	9.08166	9.925	19	.000

Based on Table 2, the results of the scientific competencies t-test between Study Program A and Study Program B experienced a significant change. Study Program A's score is higher than Study Program B's because Study Program A's cognitive skills are better than Study Program B based on new student input. This result is in line with Cahyani et al., which states that the average cognitive score is still low (52.45) (Cahyani et al., 2014). Scientific attitudes need to be improved for mastery of scientific competencies to build the habit of applying scientific concepts and scientific work. After collecting data on the scientific competence of prospective madrasah Ibtidaiyah teachers, the data were analyzed using descriptive statistical analysis. The results of the descriptive analysis regarding the scientific competence of future teachers of Madrasah Ibtidaiyah integrated Science Process Skills can be shown in Figure 1.
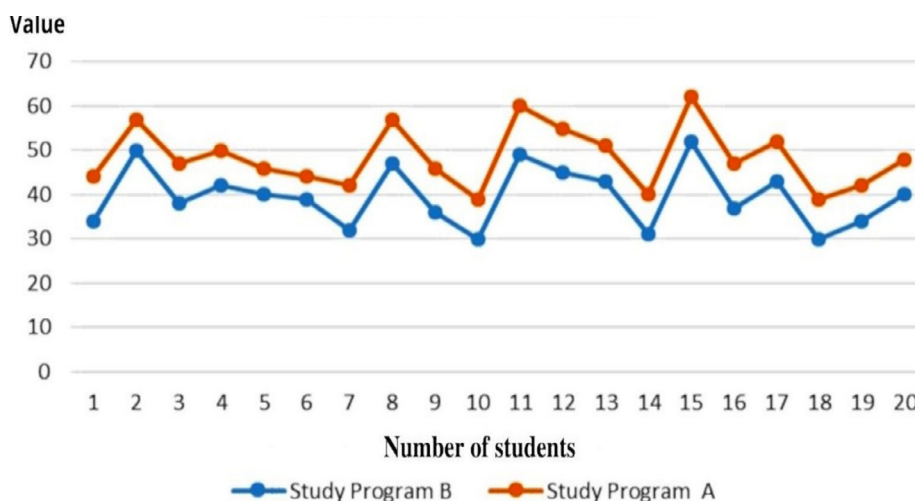
Figure 1. Scores of Scientific Competence Test Integrated with Scientific Methods

From the practicum results, 75% of students are not yet skilled in collecting and classifying observational data. These results indicate that students' interest in science practicum is very low, so the results are unsatisfactory. It is proven that this Study Program B rarely does practicum in science courses, only twice in one semester. Meanwhile, Study Program A conducted 28 practicums in face-to-face lectures, 14 times in theory in class, and 14 times in laboratory practices, including review sessions and pre-tests. These numbers show a striking difference in skills in collecting and classifying data in practicum.

The observations made were to determine the initial basic skill of the prospective madrasa teachers' science process skills. It contains high-level thinking skills, activities in the laboratory, collecting data, and communicating it in the form of a practicum report. From the data in Figure 1, the practicum scores produced by Study Program A are 48.4 and 39.6 for Study Program B. These scores indicate that the results from the practicum have not been very encouraging because of the lack of practical work in the laboratory and science laboratory facilities. The science practicum is still based in basic physics, basic chemistry, and basic biology laboratories, so the content of the science practicum is not well integrated. The modules, tools, and materials used still follow the laboratory's policies. The standards used are still too high and impact the low grades of prospective madrasa teachers.

Using specimens, students can describe these cells with reasonably good results from observations through animal and plant cell practicums. However, students are not yet skilled in cutting the materials to see the cells in making specimens with onions. Students do not yet have a way or strategy in cutting into small sizes, so the student-made specimens have not been appropriately seen in the microscope. Students still need to be trained again to see the shape of the cell directly. In line with the opinion of Angreani et al. that practicum activities can involve activities where students see objects and materials for real (Angreani et al., 2020).

Figure 1 shows that the scientific competence integrated with the scientific method is not yet good. The highest score is 72, and the lowest is 35, with 80 test items. It is necessary to add theoretical enrichment in the learning process of science courses for the competence of prospective madrasa teachers because prospective madrasa teachers are required to master the materials specified in the content standards. The content standards for science at the madrasah level are still comprehensive, so prospective madrasa teachers must read and write a lot of science knowledge.

Table 3. T-test Result of Science Practicum Scores

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Scientific competence score of Study Program A – Scientific competence score of Study Program B	8.8000	1.50787	.33717	8.09429	9.50571	26.100	19	.000

Based on observations during the practicum, it was found that there were discontinuities and differences between prospective madrasa teachers in Study Program A and Study Program B. Prospective madrasa teachers in Study Program B were not yet skilled at reading the results of microscope observations correctly and adequately, this was related to their literacy ability to read measurement results from a microscope. Likewise, the resulting slices are still very thick when slicing onions using a razor blade. The skill of measuring the thickness in slicing onions does not meet the established standards quantitatively. After observing onion cells with a microscope, prospective madrasa teachers were asked to draw the results of the onion cell observations. When presented in images, the results are different from reality.

Meanwhile, the observations show that prospective madrasa teachers in Study Program A can read the results of microscope observations correctly and adequately; this is related to their literacy ability to read the measurement results from the microscope. Study Program A can also take samples of shallots well. In addition, when pouring observations into the form of pictures, prospective madrasa teachers can explain according to observations seen under a microscope.

However, there are some drawbacks for Study Program A students when using a microscope when doing science practicum about cells in the laboratory. First, using a microscope should start from the smallest magnification and then the largest magnification, but during the practicum, the student goes straight to the largest magnification. Second, students could not raise the object table on the microscope, and they were confused when extending the object table. Third, on a microscope, the magnification of 10 is 10x10 = 100, but the students answered that the magnification of 10 is 10. Fourth, the order and administration of water were inverted (object glass-water-object-glass cover). The correct order is object glass-object-water-glass cover. Fifth, the cover glass broke due to the student's pressure from the rotating cover lens. Sixth, the magnification of the image was 10. Seventh, students of Study Program A have almost no knowledge of microscopes at the junior high/high school level. Eighth, Study Program A students could not return the microscope to its original condition.

Field findings of the scientific competence of students of Study Program A and Study Program B show a difference between study programs A and B caused by the mastery of materials and study time in different villages. Study time for study A student is for eight credits during the study period, and study program B for ten credits during the study period. In addition, the skill in using measuring instruments for student A is more skilled and precise in measurement while student B is still not so professional. Aside from that from input from Madrasah Ibtidaiyah Teacher Education students from the two universities, which were almost the same high school. Students come from various majors, such as science, social, language, religion, accounting, automotive, computer and network engineering, and many more. These diverse inputs become capital and a problem for teachers of science courses.

These factors can affect each student's ability. The variety of majors and study programs can affect the basic abilities of each student in mathematical arithmetic, reasoning, using logic, and problem-solving skills. Therefore, the research results have not been maximized by the achieved indicators. In comparison, the learning experience must be built from students' cognitive structure (Yucel & Ozkan, 2015). Students of the same age from the same culture will have the same cognitive structure. However, students with different cognitive structures may require different learning materials. This affects the learning outcomes of students' scientific competence with the STEM approach. In this study, it was revealed that students' mastery of scientific concepts

was still low. However, remedial teaching should be held to improve understanding of scientific concepts integrated with scientific literacy.

According to Yucel & Ozkan, 2015 there are four problem-solving skills: (1) Understanding the problem, (2) Devising Plans, (3) Carrying out the plan, (4) Looking back. The data was taken by using the questionnaire instrument of the researcher through Google Docs. This questionnaire aims to see problem-solving skills and what factors affect students' difficulties when taking science courses. The number of respondents in this study was 64 students. The learning motivation of Study Program A students and Study Program B students in participating in a series of learning activities for science courses is high. 71% of students like science. Students who do not like science are also enthusiastic about learning science and participating in various activities in the science learning process. For students of Study Program A and Study Program B, science can be helpful in everyday life, such as problems regarding electrical circuits, moving things to high places more easily using inclined planes, crossing plants, and many others.

The problem-solving skills of prospective madrasa teachers are not optimal because the learning process in the classroom has not used learning models that can arouse scientific literacy skills and solve scientific problems. At the stage of identifying the problem and making a problem-solving plan (mind mapping), students can understand it. In line with Nurita et al.'s research, students can understand problems (100%) and planning (93.3%) (Nurita et al., 2017). However, in practice, students still need to be trained and have the courage to change their mindset in solving problems. Problem-solving skills have been recognized as the core of innovative behavior in the face of disruptive change to maximize positive thinking (Kim et al., 2018).

Students generally like science courses. The questionnaire results show that 50% of Study Program A and B students have no difficulty when the science material is mostly memorizing, formulas, and arithmetic. This statement is in line with 75.8% of the value of science courses above B. When they were at the high school level, not all students of Study Program A and B came from the science department and the religious, social department, and vocational high school (accounting, electrical engineering, chemical analysis).

According to Study Program A and B students, the materials that are difficult to understand are physics, chemistry with calculations, plant and animal anatomy, and mathematical calcula-

tions. The reason is because of the diversity of backgrounds from high school majors. However, students are always active in participating in the science learning process, taking notes from lecturers' explanations, and practicing math problems. Materials that are difficult to understand will be discussed further with classmates outside of class hours.

In line with Dale's Cone Experience theory, direct learning, such as practical activities in the laboratory, will be more memorable. Doing research and scientific experiments independently and interacting directly with the tools and materials used during the cell structure and density practicum will be more embedded in students' understanding. Science material requires experimentation to mature science process skills. This result will be inversely proportional if the student does not get any practicum. The learning outcomes obtained will be less than optimal. Whereas in a series of process activities in learning science courses, students are required to have and be able to develop science process skills, grow and instill scientific attitudes, and produce scientific products. Therefore, to fulfill students' scientific competence, science practicum activities in the laboratory are needed to conduct trials and scientific science research.

Scientific literacy provides an understanding of scientific concepts and processes that enable people to deal with everyday scientific situations and help them participate in a society where science and technology are fundamental (Kähler et al., 2020). In the context of learning science education literature, scientific literacy is generally appreciated and recognized among academics as an expected student learning outcome (Smith et al., 2012; Nuhfer et al., 2016). The view of globalization on the characterization of scientific literacy (Winarni et al., 2020) has five dimensions: (1) content knowledge, (2) habits of mind, (3) character and values, (4) science as a human endeavor, (5) metacognition and self-direction.

This type of quantitative descriptive research was conducted by measuring the results of a scientific competency test with a scientific literacy approach from two classes of prospective teachers of Madrasah Ibtidaiyah from two state universities in Yogyakarta and Riau. The findings in this study indicate that the scientific competence of prospective madrasah teachers with a STEM approach integrated with scientific literacy received a positive response from the participants of this study. Participants get much practical experience from all the materials used. Participants are trained to solve problems from

science concepts and practice doing science material tests. The STEM approach must involve the active participation of many parties, including students, teachers, administrators, and laboratory assistants (Altan & Ercan, 2016; Al Salami et al., 2017; Houchens et al., 2017; Suebsing & Nuangchalerm, 2021). STEM learning has the following characteristics: (1) focus on world issues and problems; (2) the engineering design process in learning; (3) involve students directly; (4) students are involved in productive work teams; (5) apply rigorous science and mathematics content in learning; (6) failure in practicum is an important lesson material to find the correct answer (Toto et al., 2021); (7) the ability to read and write science and think scientifically.

CONCLUSION

The scientific competence of prospective madrasa teachers integrated scientific literacy with the STEM approach, resulting in the average test score for Study Program A of 58.30 and Study Program B of 50.80, with the criteria still relatively low. The value of science practicum integrated with science process skills obtained an average of 48.40 for Study Program A and 39.60 for Study Program B, so prospective madrasa teachers in problem-solving still experienced many obstacles. Scientific literacy skills are still low, marked by untrained critical thinking and high-level thinking skills. This figure shows differences in the scientific competence of prospective madrasa teachers with the STEM approach between Study Program A and Study Program B with t = 5.98 > 1.83 categorized as having a significant difference. Based on the findings of this study, further research can establish a minimum standard of scientific competence with a STEM approach for primary, secondary, upper, and higher education. Minimum standards of scientific competence with a STEM approach need to be designed and adapted to current and future curricula.

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