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Internalization of indigenous knowledge in the education curriculum for next generation science standards (NGSS)

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ABSTRACT

Indigenous knowledge in Indonesia is very diverse, but some of it is threatened with extinction due to the impact of modernization on people's lifestyles. This research aims to find new methods of integrating indigenous knowledge into the curriculum for preparing prospective science teachers. The new method is targeted to become a reference for prospective science teacher education providers in Indonesia. The research uses mixed methods to find the impact of integrating indigenous knowledge in the curriculum for preparing prospective science teachers, according to the NGSS. The impact on prospective science teachers' profiles is the ability to integrate indigenous knowledge in preparing NGSS. The research targets were 15 heads of science education study programs from 15 different tertiary institutions and 20 prospective science teachers from three different study periods (one year, two years, and more than three years). The difference between study periods is considered because applying a curriculum integrating indigenous knowledge has only begun in the three classes used in this study. The research results found that the longer the study period, the more prospective teachers have the skills to integrate indigenous knowledge more clearly. The N-Gain test obtained a result of 0.5 (medium), meaning that the existing curriculum on the skills of applying science concepts to prospective science teachers about indigenous knowledge is in the medium category. Systematic integration of the curriculum for preparing prospective science teachers makes NGSS and indigenous knowledge in academic texts, courses, teaching materials, and final projects for graduation requirements.

Keywords: Indigenous knowledge, curriculum, Next Generation Science Standards.

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INTRODUCTION

Every country has indigenous knowledge that other countries do not have. Indigenous knowledge in Indonesia is very diverse, but some of it is threatened with extinction due to the impact of modernization on people's lifestyles (Hadiprayitno, 2015; Daniel et al., 2021; Nugroho et al., 2022). Analysis of various research findings further strengthens the urgency of saving indigenous knowledge through education (Zidny et al., 2020; Thompson et al., 2022; Kgope, 2023). Education is essential to preserving indigenous knowledge because it will be used as study material adapted to the studied knowledge. Science learning in Indonesia is essential to conserving indigenous knowledge because the threat of extinction is very worrying (Nugroho et al., 2018; Sumarwati, 2022). Science is not only studied but also a process of discovering and reconstructing knowledge from society and the environment. Future generations with concern for indigenous knowledge tested in the past will have a healthy lifestyle that is one with nature.

Future generations in Indonesia will make science knowledge a way of life concerned with indigenous knowledge. Future science generations in all countries are formulated internationally in the Next Generation Science Standards (NGSS). NGSS international education standards integrate modern scientific knowledge and people's living habits to create a generation that unites science with life (Yesilyurt et al., 2021; Christian et al., 2021). The NGSS aims to improve the

quality of human life through sustainable science education. The NGSS standards allow every prospective teacher to practice designing learning processes that stimulate students' interest in the classroom. Preparation of prospective science teachers who meet NGSS standards includes the skills to find sources of knowledge from the environment (Drew, 2018; Christian et al., 2021).

The urgency of being able to integrate indigenous knowledge is under the goals of education in Indonesia, which demands that education is an integral part of preserving national culture, traditions, and identity (Hasan, 2012; Ambrose, 2017; Faisal, 2019; Zidny et al., 2020). The international standards in the NGSS strengthen the preparation of future generations who have the skills to integrate scientific knowledge with diverse traditions in a country through science. The prospective teacher education curriculum's preliminary study of this research was analyzed in three Science Education Study Programs to analyze the readiness of the curriculum under national education goals and NGSS standards. A preliminary study was conducted on three different higher education clusters: the PTNBH cluster (Universitas Negeri Semarang), PT Satker (Universitas Tidar), and PTS (Universitas Pancasakti). The analysis results found that curriculum content that integrates the culture or traditions of society is still minimal and has different integration patterns. There is no similarity yet because the curriculum for preparing prospective science teachers differs in integrating indigenous knowledge.

Based on the analysis of various previous research findings published in various reputable international journals regarding indigenous knowledge in Indonesia, some indigenous knowledge is extinct because it is no longer applied in society (Mardatillah et al., 2019; Cassata, 2021; Cahyaningsih et al., 2021). Society prefers modern knowledge that is more quickly used to meet the needs of life. People leave behind much indigenous knowledge because of the difficulty in finding objects or materials from it in society (Beltrán et al., 2022). Preparing the future science generation must combine two strategies: learning orientation that suits the nation's needs and meeting NGSS standards. Future generations who can apply scientific knowledge are prepared through learning experiences integrated with everyday life (Occelli et al., 2021; Arcoverde et al., 2022).

The needs analysis conducted through a preliminary study in this research found an urgent problem that needed a new strategy for internalizing indigenous knowledge into the educational curriculum for prospective science teachers to prepare NGSS in Indonesia. This research aims to find new methods of integrating indigenous knowledge into the curriculum for preparing prospective science teachers. The new method is targeted to become a reference for prospective science teacher education providers in Indonesia. In detail, the problem formulation in this research is as follows: (1) How to integrate indigenous knowledge into the curriculum for preparing prospective science teachers? (2) How is indigenous knowledge integrated into the curriculum in preparing NGSS? (3) What is the profile of prospective science teacher graduates who can integrate indigenous knowledge in preparing NGSS?

The problem-solving approach is integrated into various courses that meet the criteria for being linked to indigenous knowledge. Integration is carried out into scientific and educational subjects. Indigenous knowledge is inseparable from the syllabus, semester learning plans, teaching materials, and assessments. The success of this research anticipates various challenges in preparing prospective science teachers today, which are increasingly complex. The characteristics of the millennial generation who are being prepared to become prospective teachers are that they are mentally unstable, lack patience, and tend to choose to achieve things quickly (Bhattacharya, 2020; Brailovskaia, 2020; Looi, 2022). The weakness of the millennial generation in learning is that they are impatient in doing things in stages and are easily influenced by digital content on social media. Prospective teachers from the millennial generation face the difficult challenge of learning directly in society because of their high dependence on online media information.

The new findings of this research will have a tangible impact on saving indigenous knowledge in Indonesia through a curriculum that meets needs. The new findings can become a reference for preparing prospective science teachers in Indonesia and internationally because all countries have the same need to save indigenous knowledge as national identity. An Indonesian learning orientation by making science lessons in schools can save indigenous knowledge, which

is partly extinct in life in society (Hamm et al., 2020). Prospective teachers are trained to develop learning tools, from syllabi, lesson plans, teaching materials, and assessments integrating indigenous knowledge. Contextual science learning resources contain studies and examples of knowledge in society with a strong appeal to students (Wibisono et al., 2020; Aptyka et al., 2022). The profile of future science teachers is required to be skilled at integrating science in a multidisciplinary scientific manner with the culture and traditions of society by applying science concepts so that humans can survive (Parmin & Khusniati, 2021; Tan, 2023).

METHOD

The research used mixed methods (Creswell, 2013) to find the impact of integrating indigenous knowledge in the curriculum for preparing prospective science teachers according to the NGSS. The impact on prospective science teachers' profiles is the ability to integrate indigenous knowledge in preparing NGSS. The research was initiated to reveal the attitude of 15 managers of science education study programs in Indonesia from 15 tertiary institutions and measure their skills in teaching graduates to integrate science with indigenous knowledge. All study program management populations in this study were used as samples, so no sample selection or saturated sampling techniques were used because the population size was relatively small (Daniel, 2012). Prospective teachers used as samples in this study were taken randomly with stratified random sampling, referring to Tompson (1912). From the same tertiary institution, samples of students who had attended lectures for one year, two years, and more than three years were taken.

The research targets were 15 heads of science education study programs from 15 different tertiary institutions and 20 prospective science teachers from three different study periods. The study periods used as research targets were one year, two years, and more than three years. The difference between study periods is considered because applying a curriculum integrating indigenous knowledge has only begun in the three classes used in this study. The research data collected included an analysis of the integration of indigenous knowledge in the curriculum to prepare prospective science teachers to integrate indigenous knowledge in science lesson plans in schools as an impact of curriculum delivery. The internalization analyzed in the curriculum started from whether indigenous knowledge became a separate course, learning materials, final project topics, or skills of prospective graduates in developing learning tools.

Data on skills to integrate indigenous knowledge in science learning tools in schools was measured using learning tool quality assessment. Teaching skills included providing explanations, examples, and assignments about and applying scientific concepts in people's lives that apply indigenous knowledge. The data analysis used assessed the level of integration of indigenous knowledge in the curriculum of 15 tertiary institutions. The level of curriculum integration was based on the answers to a questionnaire of 12 items. The criteria for determining the level of integration in this study referred to the Likert Scale with four categories. Data on the skills of prospective science teachers who were the targets of implementing a curriculum integrating indigenous knowledge were analyzed using comparative analysis with ANOVA (Analysis of Variance), which referred to Elliot and Woodward (2007). Homogeneity analysis of variance was performed with Levene's homogeneity-of-variance test. Statistical t-tests and ANOVA were used to compare data samples. The t-test was used to compare samples, while ANOVA was used to compare more than three groups of data samples. The ability to apply science concepts to prospective teachers regarding indigenous knowledge before and after learning using the curriculum was analyzed by calculating the Normalized gain (N-gain).

FINDING AND DISCUSSION

Finding

The curriculum for preparing prospective science teachers that integrates indigenous knowledge in 15 universities in Indonesia is presented in Table 1.

Table 1. Profile of Internalization of Indigenous Knowledge in Preparing Prospective Science Teachers

Internalization	Level			
	Very Low	Low	High	Very High
Learning Source	1	10	3	1
Separated Course	-	-	15	-
Integrated into Other Courses	5	10	-	-
Lecturers' Teaching Tools	-	2	10	3
Students' Research Topics	-	6	8	1
Graduates' Competencies	-	-	13	2
Students' Basic Teaching Skills	-	2	10	3

The curriculum of science teacher education providers in 15 universities has differences but also similarities that indigenous knowledge is needed to prepare prospective science teachers. Education managers integrate it into learning resources developed by lecturers as lecture material, have the same opinion that a separate course on indigenous knowledge is needed, make it a research topic for prospective teacher students' final assignments, make it part of the description of graduate competencies, and make it future science teachers' basic skills. The average difference in the level of internalization developed by the 15 education providers is in the high category, indicating that the difference is reasonable.

Curriculum analysis at 15 tertiary institutions found similarities and differences in the forms of internalization of indigenous knowledge from the one-year, two-year, and three-year study periods. The internalization profile found in the research is presented in Table 2.

Table 2. Indigenous Knowledge Internalization Profile

Indigenous Knowledge Profile	Prospective Science Teachers' Study Period		
	One Year	Two Years	Three Years
Attitude	Have an interest in learning	Have the desire to browse	Have a desire to discover through research
Knowledge	Know basic concepts through theory from lectures	Have experience in exploring the community through lecture assignments	Find through minor research activities
Skill	Give examples in the lecture assignment result	Integrate it into assignments to create science lesson plans	Use in developing science teaching materials as preparation for the final project

Prospective science teachers are equipped with indigenous knowledge to meet the needs of future science teachers in Indonesia. The longer the study period, the more prospective teachers have skills to integrate indigenous knowledge. Since the first year, students have been interested in studying various indigenous knowledge related to learning science. Students desire to have experience uncovering indigenous knowledge and planning it as a topic in writing a final assignment or thesis. Prospective teachers' attitudes, knowledge, and skills improve throughout the study period, showing continuous integration.

Differences in study periods on research targets from data on indigenous knowledge integration skills are presented in Table 3.

Table 3. Homogeneity Test Results

		Levene Statistic	df1	df2	Sig.
Aspects of Indigenous Knowledge Integration	Based on Mean	5.290	2	477	.005
	Based on Median	3.725	2	477	.025
	Based on the Median and with adjusted df	3.725	2	464.195	.025
	Based on trimmed mean	4.864	2	477	.008

The significance value of the Test of Homogeneity of Variances using the Levene test is greater than 0.05, which means that the data on aspects of indigenous knowledge integration based on the study period have the same (homogeneous) variance. Analysis of data on prospective science teachers' skills in integrating indigenous knowledge with a comparison of length of study is presented in Figure 1.

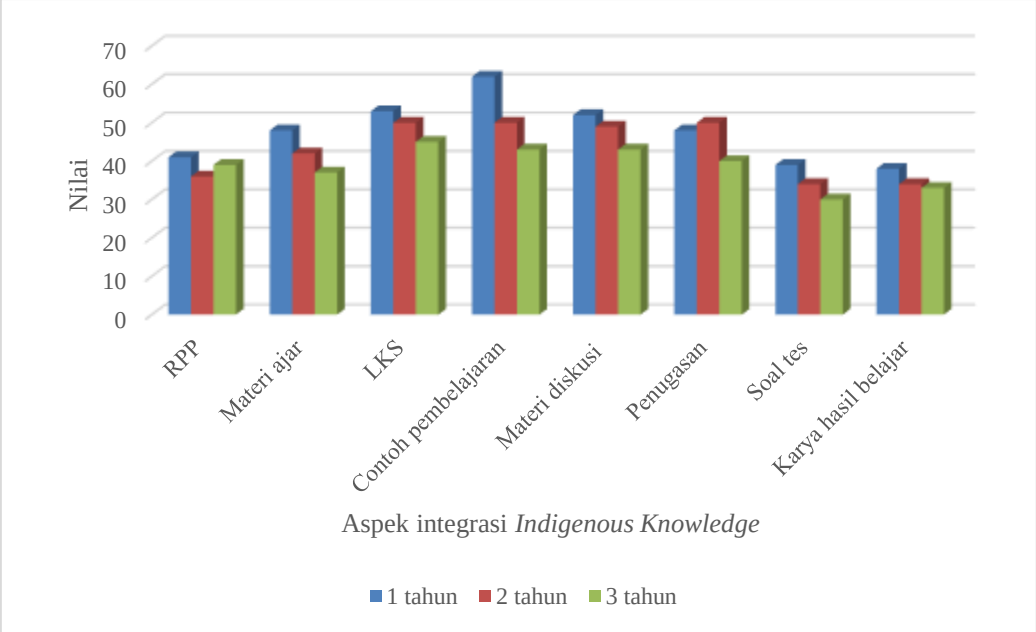

Figure 1. Prospective Science Teachers' Skills in Integrating Indigenous Knowledge

There is a decrease in the integration of indigenous knowledge based on the teacher's length of service. This research found that the longer the study period, the weaker the level of skills in integrating indigenous knowledge into learning. Exemplifying indigenous knowledge is easiest to do in the internalization stage. The skills of prospective teachers are good in using indigenous knowledge as material for discussion in class. Figure 1 shows the trend where the more prolonged the study period, the weaker the ability to integrate indigenous knowledge.

Discussion

Each manager of the education provider has a program structure to produce science teachers with the skills to use Indonesian indigenous knowledge. The education curriculum for prospective science teachers integrates various indigenous knowledge. Equation integration is done through learning resources in several subjects, such as basic biology, chemistry, chemical compounds, natural materials, and ecology. Several study programs choose indigenous knowledge more strictly in separate subjects, such as ethnoscience and local wisdom. Only a few tertiary institutions providing science education are bolder in making indigenous knowledge a separate subject. Indigenous knowledge can be used as a separate scientific study to better understand its use in learning (Zurba, 2023). Its integration into other subjects provides a less substantial portion of indigenous knowledge studies, making it less of a concern to students.

This research limitedly explores the learning tools lecturers developed in integrating indigenous knowledge. Integration of teaching materials most often appears in the form of examples. Lecturers often use video media to display various forms of indigenous knowledge. Teaching materials that integrate local wisdom are more interesting to study because they exist and can be found in the environment (MacKenzie et al., 2022). The curriculum in nine of the 15 study programs made indigenous knowledge the topic choice for students' final project. Final projects that examine indigenous knowledge in science learning at school as a graduation requirement were found. Research on indigenous knowledge through learning in schools is a fundamental part of maintaining the scientific tradition of society (Rogers, 2023). Research published in various media is part of promoting the importance of studying indigenous knowledge.

This research proves the impact of a curriculum that integrates indigenous knowledge. The longer the student study period, the deeper their knowledge level about indigenous knowledge. The curriculum structure impacts prospective teachers' interest in studying it more broadly, as evidenced by students with a three-year study period who desire to discover more indigenous knowledge. For prospective science teachers, the motivation to discover local knowledge hidden in life in traditional communities can impact the development of learning resources. Learning sources from the community about indigenous knowledge requires a reconstruction process before being used as teaching materials (Akcay et al., 2022). Converting indigenous knowledge into scientific knowledge is a prerequisite before making it into learning material.

In this study, Indigenous knowledge integration in the curriculum also impacts the Next Generation Science Standards (NGSS) preparation, analyzed by acquiring curriculum assessment scores on the NGSS indicators. NGSS indicators include the ability to apply science concepts. The N-Gain test obtained a result of 0.5 (medium), meaning that the existing curriculum on the skills of applying science concepts to prospective science teachers about indigenous knowledge is in the medium category. In this study, applying scientific concepts is measured by the ability to solve applicable questions. The medium category of the analysis obtained means that curriculum integration still requires reinforcement in the learning activities of prospective teachers. The higher ability of prospective science teachers to answer applicable questions is a sign that they understand the importance of science for life in the future. Science is integrated into life, so it must function to guarantee future survival for future generations (Steele et al., 2019). The NGSS developed in Indonesia is a form of continuing education to preserve various indigenous knowledge through education.

CONCLUSION

The preparation of prospective science teachers refers to two standards as prerequisites for producing teachers who have science knowledge and teach according to the needs of society in a country. Modern science knowledge is obtained through the application of international standards such as NGSS, while teaching skills require adjustment to the needs of society by integrating indigenous knowledge, which is a nation's cultural wealth. Systematic integration of the curriculum for preparing prospective science teachers makes NGSS and indigenous knowledge in academic texts, courses, teaching materials, and final projects for graduation requirements.

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