

# Teachers' belief toward science and local wisdom's integration in mathematics instruction

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**Abstract.** Teacher beliefs affect classroom management. It has caught the attention of many researchers, but few have discussed teacher beliefs in the integration of Science and local wisdom in the teaching of Mathematics. This integration is needed to give students the relevance of learning a subject matter. This study tried to find out the teacher's beliefs in integrating Science and local wisdom in Mathematics instruction and the inhibiting factors that teachers faced. This research was conducted through a qualitative approach, involving four teachers with different teaching experiences. Data was gathered through in-depth interviews and analysed through Miles and Huberman concept. All participants believed that the integration of science and local wisdom in mathematics instruction had a role in constructing students' view toward mathematics, but only one participant was able to provide a unique example of the application of science integration and local wisdom in teaching mathematics. The biggest obstacles were experienced by all participants when integrating local wisdom in mathematical instruction due to their lack of knowledge of local wisdom and way to integrate it. Further research is needed to strive to strengthen teachers believe in this integration. Moreover, discussions between subject teachers need to be focused on integration so that the teacher's insight, especially about local wisdom, can be wide open.

## 1. Introduction

A teacher has some important roles in the classroom: to educate, teach, guide, direct, train, assess, and evaluate. Teachers' beliefs have a greater impact than their knowledge in planning their lessons. Henson suggests that teachers' beliefs influence classroom management, which is essential for effective classroom teaching [1]. A number of studies claim that the practice of teachers is determined by their beliefs ([2], [3]). Teacher's belief also affects the ability to identify their behavior towards the learners [4]. When teachers can determine the ability of learners, they will be able to choose and modify their teaching attitudes and preferences appropriately [5].

Beliefs are propositions that people consider to be true and which are often tacit, have a strong evaluative and affective component, provide a basis for action, and are resistant to change [6]. Teachers' beliefs in educational literature focus on how teachers think about teaching and learning [7]. The term belief refers to the teacher's pedagogical beliefs related to beliefs about language, teaching and learning [8]. Belief is an experiential knowledge, a personal decision formed from experience [9]. Beliefs also define as teachers' arguments and their views on teaching and learning [10]. In this study, beliefs are defined as teachers' arguments and their views on teaching and learning.

The Indonesia's learning principle, such as from the shift of partial learning to integrated learning and recognition of individual differences and cultural background of learners, implies that in



implementing learning, teachers should be able to provide learning which is integrated with the context of the topic and other subjects and be able to provide learning about the recognition of learners' different cultural background. Furthermore, one of the Indonesia's lesson planning principles is accommodating thematic-integrated learning, cross-cutting integrity, cross-learning aspect, and cultural diversity. The regulation also states that in the preliminary stage, teacher is obliged to give learners motivation contextually according to the benefit and the application of teaching topics in everyday life. Authentic issues can motivate students and improve their achievement [11]. Moreover, conveying broader relevance to everyday life and the broader context can help to encourage the use of student learning topics, which can then help encourage students' aspirations toward their careers [12]. Integrated learning helps students apply the knowledge they learn in school in their life experiences by connecting school education to their respective lives. Integrated learning can effectively improve critical thinking skill and effect on learning outcomes [13].

Science is not separated from Mathematics. It is used to analyze nature, discover its secrets and explain its existence, while Science is so complex and growing everyday. When students learn Mathematics, one of the greatest needs is the relevance of learning this subject, such as how the ability to do the calculations can provide benefits to them. In particular, Science plays the role of a contextual framework for the application of Mathematics to help learners build knowledge about the world in which they live, while scientists use Mathematics to verify the discovery of the nature [14].

Mathematics and Science must be related to real life situations for students to learn and be able to apply multiple knowledge concurrently as needed [15]. The integration of Mathematics and Science is significant because it enriches students' learning experiences, deepens their understanding and changes their attitudes about both of these by identifying and implementing methods that can integrate both into the learning process [16]. The integration of those two subjects in particular can enhance students' understanding of Mathematical and scientific concepts and help them to relate their knowledge of those two subjects to their everyday lives. If this is achieved, students will recognize Mathematics or Science not as an academic pursuit, but as something that can help them better understand the world in which they live. As a result, students' abilities and beliefs can be maintained as they study Mathematics and Science [17].

Teachers can provide students with understanding that one of the greatest uses of Mathematics in Science is the collection and analysis of data. Teachers can convey the use of Mathematics when giving the students a Science problem (which requires a mathematical tool) to be solved [18]. The results show that if students are given real life-related problems in learning Mathematics, then they will understand it more easily ([19], [20]). The objective of Mathematics education, such as practical goals, related to the development of the students' ability to use Mathematics to solve problems related to everyday life as well as cultural goals (that education is a form and product culture), implies that Mathematics can serve as a tool in understanding and solving problems found and encountered in everyday life [21]. Thus, it could said that science and mathematics could be integrated.

Mathematics education needs to place Mathematics as a result of human culture and as well as a process for developing a culture. The globalization causes the development of culture. Today's generation considers that foreign culture is cooler than using the local ones. If this is allowed to continue, it will lead to degradation of local wisdom. Local wisdom is the cultural values that live and thrive in society and as a cultural product produced by humans. Conceptually, local wisdom is a human wisdom that rests on a traditionally institutionalized philosophy of values, ethics, ways and behaviors [22]. Philosophically, local wisdom can be interpreted as a system of knowledge of local communities (*pribumi*) that is empirical and pragmatic. It is empirical because the processed products of society locally set out the facts that occur around their lives. The pragmatic purpose deals with all the concepts that arise as a result of thinking in the knowledge system aim at solving everyday problems [23].

Local wisdom-based education can be regarded as a model of education that has a high relevance for the development of life skills, based on the empowerment of skills and local potential in each region [24]. Learning topics should also have meaning and high relevance to their empowerment of

real life, based on the reality faced. Incorporating cultural knowledge into the school curriculum is useful in strengthening citizens' identity in a country [25]. The students' sense of nationalism can be strengthened by integrating local wisdom with the school curriculum [26]. Local wisdom is a guide in life and character of the Indonesia. Local wisdom can not only be used as an educational product, but also as a source of educational topics, which can be a bridge for students to be more familiar and closer to the cultural values in the region.

Local wisdom and mathematics could integrate through cultural values and mathematical characteristics [27]. Mathematical connections with the basic cultural values, in addition to improving Mathematics learning outcomes, also have an impact on long-term affective aspects ([28], [29]). Since local wisdom and mathematics could be integrated, it was important for teachers to have belief about the integration of these two things..

**Table 1.** Indicators of Teacher Beliefs toward the Integration of Science and Local Wisdom in Mathematics Instruction

Category	Indicator
Belief toward the integration of Mathematics and Science	The argument and view on the assimilation of Mathematics and Science to become a unified whole.
Belief toward the integration of Mathematics and local wisdom	The argument and view on the assimilation of Mathematics and local wisdom to become a unified whole.
Belief toward the integration of Science and local wisdom in Mathematics	The argument and view on the assimilation of Mathematics, Science, and local wisdom to become a unified whole.

Local wisdom has an important role in shaping the mindset of the people, before science was developed in Indonesia [30]. Long ago, ancient people believe that rice bran as a hairdresser can be used to treat dandruff. The use of rice bran to treat dandruff was a knowledge found by the local community through a collection of experiences in trying, but it turned out that this local wisdom made sense when the truth was scientifically proven. After science develops, it turns out that rice bran contains 1.33% carbon, 16.98% silica, and 33.64% oxygen to clean dead cells on the scalp [31]. So it could be concluded that science integrated with local wisdom.

Considering the fact that the integration of Science and local wisdom, integration of Science and Mathematics, and integration of Mathematics and local wisdom can be done, thus the integration of Science and local wisdom in Mathematics learning is possible to occur. There have been many studies on teacher's beliefs ([8], [34]), but only few has discussed teachers' beliefs in integrating local Science and wisdom to be applied in Mathematics instruction. Given the importance of teachers' beliefs and the integration of Mathematics subjects with Science and local wisdom, the purpose of this study is to find out the teachers' beliefs in applying Science and wisdom in Mathematics learning and the factors causing the teachers' difficulties during the integration. Indicators developed to find out the teachers' belief in the integration of science and local wisdom in mathematics instruction, as shown in Table 1.

## 2. Methodology

This research conducted a qualitative approach. The hope here was that valuable insight gained through the study of a somewhat unique individual. [36]. The participants of this study were four Grade 11 mathematics teachers, two men and two women, who had different teaching experience (DF who had 1.5 year of teaching experience, BA who had 10 years of teaching experience, teacher FK who had 15 years of teaching experience, and teacher EL who had 20 years of teaching experience). The main data of this research were the information about teachers' believes in implementing the

integration of Science and local wisdom in Mathematics instruction as well as their obstacle faced by the teachers in implementing it.

Researchers adapted the previous researchers method which used interviews to gain information about teacher beliefs ([37], [38]). Two mathematics experts (both of them are assistant professor) were asked to validate the interview's guide. The issue of reliability was addressed through replication because this research interviewed four different teachers with different years of teaching experience [39]. The interview was considered a semi-structured interview because there was a interview guide and need to be explored by the interviewer [40]. From the semi-structured interview, the transcripts were analyzed. To analyze the results of interviews, the writers employed the concept of Miles and Huberman namely data reduction: the process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in written-up field notes or transcriptions; data display: organizing, compressing assembly of information that permits conclusion drawing and action; and conclusion [41]. Because the researchers observed only four teachers, one cannot generalise the findings. However, consistent with the purpose of the study, the findings could lay the principles for making better integration in practice.

### 3. Results and Discussion

A summary of beliefs about integration and the factors that influence the beliefs of the four teachers is shown in Table 2.

#### 3.1. *Teachers' belief toward the integration of Science and Mathematics*

When asked to integrate Science with Mathematics, DF, EL, and FK provided an example that has often appeared in textbooks, on the other hand, BA was able to provide varied examples. He also integrated it with Islam, a majority religion in Indonesia. It was applied by BA during the cone slices classroom instruction. The teacher reminded the students about the shape of earth's orbit, the ellipse. Then, when the lunar eclipse occurred, the teacher asked about the lesson of the phenomenon, then the teacher explained that it was because of God's greatness through Mathematics, without Math, human beings would not know that lunar eclipses occurred on certain date and hour. Other example provided by BA was genetic integration with the science of opportunity, comparison, and percentage. This results implied that teachers actually could integrate science in mathematics instruction but not all of the teachers explore their integration ability.

BA believed that integrating Mathematics with Science was important since it offers the students not only to solve theoretical problems but also to be interested in the topic because students will know the benefits of learning Mathematics, though the benefits were not practical. In addition, with such integration, students would be encouraged to think what they learn. Students would also realized that this subject exists in many aspects of life. Similar things were also expressed by DF, EL, and FK who believed that it is important to integrate Mathematics with Science so that students understand that mathematics had a relationship with Science and that Mathematics was not just about counting and memorizing formulas. DF also stated that this integration can make students understand that Mathematics can be a support for learning Science in depth. This result is in line with previous research which also states that teachers believe about the importance of integration of Science and Mathematics ([19], [32])

DF, EL, and FK have different reasons for not / only slightly integrating science in their mathematics instruction. DF did a few integrations because he believed that some subject matters could not be associated with Science, such as polynomial. He argued that this material was only as prior knowledge for the next issue. EL did not do the integration because she did not have the confidence to integrate the material that she did not master such as science. Meanwhile, FK believed that the integration was not urgent to do because her main priority was to discuss all the problems in the book. Even so, they believed that every topic in Mathematics could be associated with Science since Science existed because of Mathematics. It depends on how creative the teacher is to think and deliver it. The fact that teachers had believed in the importance of the integration of science in

teaching mathematics but were reluctant to apply it in their instruction could be an indicator that teachers lack supervision from education supervisors. So even though the curriculum had instructed teachers to integrate science and mathematics, teachers did not do it.

**Table 2.** Results Summary

Participants	Category	Teachers' belief	Influence factor
DF	Belief toward the integration of Mathematics and Science	This integration might help students to recognize that Mathematics was not just about counting.	Some subject matters could not be associated with Science.
	Belief toward the integration of Mathematics and local wisdom	He would be able to relate local wisdom to Mathematics if he had much knowledge of the local wisdom.	A limited knowledge about local wisdom.
	Belief toward the integration of Science and local wisdom in Mathematics	It would be difficult to integrate Science and local wisdom in Mathematics learning at the same time.	It would take a long time for the teacher to think about it.
BA	Belief toward the integration of Mathematics and Science	It offered the students to be interested in the topic.	He believed that mathematics exists in many aspects of life.
	Belief toward the integration of Mathematics and local wisdom	He usually conveyed local wisdom separately from Mathematics.	He had little information about the local wisdom.
	Belief toward the integration of Science and local wisdom in Mathematics	He strongly believed that Science and local wisdom could be integrated with Mathematics.	The difficulty in finding the media (such as story) that contained all those three subjects.
FK	Belief toward the integration of Mathematics and Science	This integration could make students aware that mathematics was the basis of all fields.	Not urgent to be done because the main priority was to discuss all the problems in the book.
	Belief toward the integration of Mathematics and local wisdom	Mathematics could be linked to local wisdom, not integrated. The integration could increase the sense of nationalism.	Difficult to implement because of time constraints.
	Belief toward the integration of Science and local wisdom in Mathematics	The integration would perform if there were instructions to do it.	Many responsibilities were more urgent to fulfill.
EL	Belief toward the integration of Mathematics and Science	This integration was needed to find out the relationship between mathematics and science.	Integrating something outside the mastered area was hard to be done.
	Belief toward the	This integration was	Could be done by using

integration of Mathematics and local wisdom	necessary since it was part of the students' assessment.	terms that related to local specialities.
Belief toward the integration of Science and local wisdom in Mathematics	Integration of those three fields did not really need by students.	She believed that students need the ability to solve problems rather than the ability to integrate between subjects.

### 3.2. Teachers' belief toward the integration of local wisdom and Mathematics

When asked to integrate local wisdom with Mathematics, both DF and BA experienced difficulties. DF stated that he had never linked his learning topics with local wisdom because of his limited knowledge about the local wisdom around. He believed that he will be able to relate local wisdom to Mathematics if he has much knowledge of the local wisdom. BA was able to provide examples of Mathematical that connected with local wisdom but he usually conveyed local wisdom separately from Mathematics due to the little information about the local wisdom.

Unlike BA, who was not sure with his understanding of the integration of local wisdom in mathematics instruction, FK and EL assured that the characteristics of an area are a form of local wisdom. So that if they were asked to explore the integration of local wisdom, they could relate it to the characteristics of an area such as local foods or crafts. FK and EL's believe about the meaning of local wisdom were different from the real one. Local wisdom is a knowledge that is found by certain local people through a collection of experiences in trying then integrated with an understanding of the culture and natural conditions of a place.

Since local wisdom is a knowledge found through the experience of trying, it is normal that not all issues in mathematics also could be integrated with local wisdom. This as in line with BA's claim that not all Mathematical topics could be connected to local wisdom because some of them were too abstract and seemed unreasonable to be associated with local wisdom. Although not all problems in mathematics could integrate with local wisdom, this integration was not impossible [26]. More exploration toward local wisdom still required because of the importance of introducing local wisdom to students and introducing the contribution of mathematics in local wisdom.

DF argued that the integration of Mathematics with local wisdom is important for students since it aims to let students know the local wisdom that exists around them, so that existing local wisdom can be preserved. The same thing is also conveyed by BA who believes that Mathematics is important to be integrated with local wisdom, because nowadays, students have relatively poor attitude and morale. BA stated that when students understand Mathematics, they would know the rules and became creative without disobeying the rules, and this was one of Mathematics characteristic. It believed that one of the factors causing this concern was a very few instructions which integrate local wisdom, teachers tend to convey only the subject matter.

Although EL and FK were convinced that they knew about the integration of local wisdom in mathematics instruction, they were reluctant to apply it in their instruction. FK argued that integration activities could take a lot of time, on the other hand she felt she had an obligation to complete all the material in the book. Meanwhile, EL felt that the "local wisdom" in the book was more than enough to understand students about the characteristics of their area. This belief was not appropriate because the books in general were made for a wide scale (not only regional scale) so that it was not uncommon for the regional characteristics displayed in the book to be incompatible with the regional characteristics of students. Although local wisdom from all over the region in Indonesia needed to be known to students, teachers also needed to adjust the integration with local wisdom that really originated from the students' area.

### 3.3. Teachers' belief toward the integration of Science and local wisdom in Mathematics

In preliminary stage, teachers were required to motivate learners contextually according to the benefits and application of teaching topics in everyday life by providing examples and comparisons of local, national and international, and adapted to the characteristics and levels of learners. This indicates that the beginning of learning activities was a great opportunity for teachers to convey the integration of Science and local wisdom. In preliminary activities, DF, EL, and FK did not relate the topic to be taught with its application to everyday life, but provided the required prior knowledge for the topic to be studied. Integration of Mathematics with everyday life was done after the topic had been delivered. They believed that if integration to everyday life was done in the early stage it would spend a lot of time. On the other hand, BA was able to provide varied examples of the integration of Mathematics with everyday life. BA always tried to associate Mathematics with the phenomena that exist in everyday life. BA believed that by giving such stories, students who were originally unconditioned, could give full attention to the teacher. This was in line with previous study which stated that apperception done by the teacher at the beginning of the lesson before the learning activity begins, the goal was to attract the students' attention and prepared them to learn [41].

DF believed that not all matters can be related to everyday life, such as when connecting the concept of limit with everyday life. Cone slices matter was also difficult to be associated with everyday life. DF believed that students must had understood through the example of the given problem, without having to be associated with everyday life. In line with DF, EL believed that students need the ability to solve problems rather than the ability to integrate between subjects. On the other hand, BA believed that abstract problems such as logarithms, might not be found in real life, but if the students adhered to the principles of it, they would be able to solve problems in logarithms. BA believed that by learning logarithms, students would learn to think orderly. Therefore, he instilled belief in students, that if they learnt Math correctly, they would obey the school's rules. EL, BA and FK believed that basically an abstract concept could be integrated to everyday life and the teacher could deliver it in a creative way. However, FK believed that many responsibilities were more urgent to fulfill rather than to integrate between subjects. She would perform integration if there were instructions to do it. This showed that there was no strict instruction from the education supervisor regarding the integration activity. In fact, this activity had already instructed in the latest Indonesia curriculum.

BA believed that it was important to integrate Science and local wisdom in Mathematics instruction so that students knew the relevance of Mathematics with other matters. This way, students who favored Physics, History, or Biology but did not favor Mathematics could realize that Mathematics connected to their favorite subjects. However, it was difficult to find the media (such as story) that contain all those three subjects. Meanwhile, DF stated that it would be difficult to link Science and local wisdom in Mathematics learning at the same time. It would take a long time for the teacher to think about it, because the knowledge of Science was not as knowledgeable as the Science people, nor was the cultural knowledge. DF had the opinion that the recent teaching practice was enough by linking everyday life, no need to integrate Science and local wisdom. Since the belief that integration activities were time-consuming and not so urgent was an obstacle to the implementation of integration in teaching mathematics, thus further research was needed to overcome these beliefs.

#### 4. Conclusion

The result of this study indicated that the teaching intensity could not indicate the level of teachers believe in the integration of science, local wisdom, and mathematics. Each of the teachers had different belief depending on what they experience while teaching. In general, teachers already believed in the importance of the integration of science and local wisdom in mathematics instruction, but this belief was not in line with the knowledge and the application of integration. Only one out of four participants showed quite diverse knowledge about integration.

Teachers also believed that the integration between mathematics and local wisdom was important since students' poor attitude had become a big concern in this country. Moreover, the existing local wisdom was also poorly preserved. Teachers' belief in the importance of the integration of local

wisdom in mathematics instruction was not in line with their belief in the possibility of integration between those two. Lack of teacher knowledge about the importance and types of local wisdom were the main obstacles for teachers to integrate them.

Since the integration of local wisdom in mathematics instruction was the biggest obstacle for teachers, the integration of science, together with local wisdom in mathematics instruction, became increasingly difficult to be done. The results of this study indicated that teachers were still lack of discussions between-subject. Discussions needed to focus on integration between subjects. Teacher training programs also need to intensify integration activities so that teachers are accustomed to integrating mathematics with various contexts outside mathematics. Teachers who believed that integration wasted time and integration between subjects was not so urgent to do, needed to be self-examination because there was a participant who could overcome these wrong beliefs.

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