# Investigating Elementary School Teachers' Challenges and Needs in Implementing STEM Education: The Case of Nusa Tenggara Barat Indonesia

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**Abstract.** Elementary school teachers in Indonesia, especially in Nusa Tenggara Barat have implemented STEM in their classroom. Unfortunately, not all of them succeed. Therefore, this study is to identify elementary school teachers' challenges and needs in implementing STEM education. The study used quantitative research of survey design. The data were analyzed using descriptive statistics using frequencies and percentage through SPSS 20 version. The finding indicates the challenge and needs of elementary school teacher in implementing STEM education. The results of the study found that there was connection between teachers' challenge and needs in implementing STEM education. 'Lack of hands-on training for students' which was 94,4%, 'lack of opportunities for STEM seminars/training/workshop' and 'difficult to find ideas for the STEM challenge' at 90,6%, 'lack of teacher's expertise in using activities of experiments' was 86,8%, and for 'lack of teacher's expertise in integrating all STEM subjects' was 84,9%. All the findings have linked with the result for the STEM education needs of 100% need 'seminars/workshop/training in STEM education', 'guidance or handbook for implementing STEM education', 'guidance or handbook for students in STEM', and 'training programs for students. Furthermore, the other big challenge was 'lack of investment and government interest in STEM was 83%. This challenge has linked with all the needs to implement STEM education, included the need of book or ideas for creating STEM challenge at 99%. The result strongly emphasized for training/workshop and guidance/handbook for teachers and students and can be a consideration for government and further research.

**Keywords:** Challenges · Elementary school teachers · Implementation · Needs · STEM

## 1 Introduction

STEM (short for science, technology, engineering, mathematics) education is an interdisciplinary method of instruction where the conventional boundaries between the four disciplines are omitted to integrate them into practical and meaningful learning experiences for students [1]. The interest to implement STEM education is growing massively to cope with demands of global market where science and technology are being


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emphasized [2]. Hence, implementing STEM in the classroom properly is very important, because strong implementation of STEM in education will develop students with twenty-first century competences (knowledge, skills, and values) [3]. These competencies are considered crucial prerequisites for success in STEM-related studies and careers [4].

Governments around the world have demonstrated their perception on the importance of STEM education, as evidenced by the development of STEM policies governing the teaching of science and mathematics at the primary, secondary, and tertiary level education, as well as research in the STEM disciplines [5]. Improving the quality of STEM education has become a priority in both emerging and long established economics in their pursuit of economic growth [6]. Meanwhile in Indonesia the present curriculum named *Kurikulum Merdeka* or Emancipated Curriculum is prioritizing project-based learning strategies. This means that students will implement the topic they learn in the classrooms through project or case study to understand the concepts better. In line with this, *Kurikulum Merdeka* provide a lot of room to implement STEM education, because STEM focuses not only on remembering the facts related to science, technology, engineering, and mathematics, but also on exploring, inquiring, discovering, and problem solving using the aforementioned disciplines [7].

Teachers hold prior's role that will influence STEM implementation. Before Kurikulum Merdeka or Independent Curriculum was established, STEM education has been spreading throughout Indonesia. Many teachers have implemented STEM in their classroom. It is proven from many studies and research about STEM in Indonesia. Based on preliminary research found that the interest to implement STEM education is also growing in Nusa Tenggara Barat, one of Indonesia province. In some schools' teachers have implemented STEM in the classroom. But not all of them succeed.

Unfortunately, implementing STEM education is not without its challenges and problems [8], especially those faced by the teachers. This is especially the case of Nusa Tenggara Barat, Indonesia. Teachers are interested in implementing STEM but facing difficulties. Some of them told that they faced some challenges in implementing STEM education, meanwhile the other talked about what they need to implement it. The teacher faced difficulty in integrating STEM in the classroom because the educational backgrounds of most elementary school teachers were not in mathematics or science, but elementary school education, social studies, or language [9]. This phenomenon implies the necessity to do the study elementary school teachers' challenges and needs in the implementation of STEM education, especially in Nusa Tenggara Barat.

The main purpose of the study is to identify elementary school teachers' challenges and needs in the implementation of STEM education in Nusa Tenggara Barat. This study is built on the previous research which have brought forward the challenges and problems in implementing STEM education [10]. This study is important to make appropriate recommendation or promote solution of for STEM implementation so that teachers are more prepared in implementing STEM education in each curriculum.

## 2 Methods

The study used quantitative methods. To achieve the objectives, survey design was used for the study. The survey design was used to meet the purpose of the study regarding to elementary school teachers challenges and needs in implementing STEM education [11].

The data were collected using questionnaire adapted from Kiazai et al. [12]. The questionnaire consisted of two parts. First part had 25 questions that related to expected challenges of STEM implementation. Meanwhile second part are 14 questions related to teachers' need in STEM implementation. Both part using Likert scale ranging from strongly disagree, disagree, neither agree or disagree, agree, and strongly agree.

Judgmental convenience sampling technique was used for the study. The sampling for this study were the participants of online Teacher Training Program and STEM Workshop held in Nusa Tenggara Barat during 2019 until 2020. For identifying issues, defining ranges of alternatives, or collecting other sort of non-inferential data, convenience samples were used for the study. There were 153 teachers in Nusa Tenggara Barat who completed the survey.

The data was analyzed using descriptive statistics using frequencies and percentage through SPSS 20 version.

## 3 Result and Discussion

Table 1 shows the challenges in implementing STEM education in Nusa Tenggara Barat, while Table 2 shows the needs in implementing STEM education in Nusa Tenggara Barat. Underneath both tables discussion will follow related to the findings, on top of more detailed discussion in the Discussion section.

The demographic information of the participant who completed the survey were 153 teachers in Nusa Tenggara Barat. They came from Kabupaten Lombok Timur, Lombok Tengah, Lombok Barat, Sumbawa, Dompu, Sumbawa Barat, Bima, Kota Mataram, and Kota Bima. The male teachers who participated were 78, meanwhile female teachers were 75. The age of them were about 31 – 50 years old. All of them are class teachers who have implemented STEM in their classroom.

From the demographic information, the teachers were mostly constructive and productive generation. All of them were experienced in STEM training and workshop during 2019 until 2020 both online and face to face. Based on post STEM training and workshop feedback, not all of them have implemented STEM actively.

Table 1 indicates that the greatest challenge was 'lack of hands-on training for students' which was 94,4%. This was followed by 'lack of opportunities for STEM seminars/training/workshop' and 'difficult to find ideas for the STEM challenge' at 90,6%. At the third most chosen challenges were 'lack of teacher's expertise in using activities of experiments' was 86,8% and for "integrating all STEM subjects' was 84,9%, meanwhile lack of investment and government interest in STEM was 83%.

It is evident from the findings that there was various result in all practices as the expected challenged in STEM education for elementary school teachers in Nusa Tenggara Barat. The result was from 34% until 75,4%. However, there was also expected

**Table 1.** The Challenge in Implementing STEM Education in Nusa Tenggara Barat

| No. | Statement | Strongly Agree | Agree | Total |
|---|---|---|---|---|
| 1. | Lack of sufficient material supply | 13,2% | 34% | 45,6% |
| 2. | Unavailability of well-equipped laboratories | 22,6% | 39,6% | 62,2% |
| 3. | Lack of systemic working | 22,6% | 39,6% | 62,2% |
| 4. | Difficulties in time management | 35,8% | 28,3% | 64,1% |
| 5. | Unclear directions | 15,1% | 35,8% | 50,9% |
| 6. | Lack of guidance | 50,9% | 22,6% | 73,5% |
| 7. | The inclusion of multiple activities | 52,8% | 22,6% | 75,4% |
| 8. | Lack of space for individual activities | 17% | 26,4% | 43,4% |
| 9. | Lack of space for group activities | 15,1% | 31,1% | 46,2% |
| 10. | Classroom strength | 1,9% | 32,1% | 34% |
| 11. | Managing number of the groups | 7,5% | 18,9% | 26,4% |
| 12. | Lack of teachers' expertise for integrating all STEM subjects | 58,5% | 26,4% | 84,9% |
| 13. | Lack of teacher's expertise in using activities of experiments | 39,6% | 47,2% | 86,8% |
| 14. | Lack of teacher's expertise in handling issues and problem solving | 41,4% | 34% | 75,4% |
| 15. | Issues in evaluation of students' progress | 7,5% | 39,6% | 47,1% |
| 16. | Monitoring students' free-time activities | 7,5% | 39.6% | 47,1% |
| 17. | Lack of collaboration among colleagues | 17% | 54,7% | 71,7% |
| 18. | Lack of opportunities for STEM seminars/training/workshop | 62,3% | 28,3% | 90,6% |
| 19. | Lack of hands-on training for students | 45,3% | 49,1% | 94,4% |
| 20. | Poor facilities of instructional media | 18,9% | 30,2% | 49,1% |
| 21. | Lack of investment and government interest in STEM | 43,4% | 39,6% | 83% |
| 22. | Lack of motivation of students towards STEM subjects | 3,8% | 18,9% | 22,7% |
| 23. | Lack of support from the school system | 13,2% | 50,9% | 64,1% |
| 24. | Difficult to find ideas for the STEM challenge | 56,6% | 34% | 90,6% |
| 25. | Poor planning for STEM education | 43,4% | 24,5% | 67,9% |

challenges that below 34%, there were 'managing numbers of group' at 26,4% and 'lack of motivation of students towards STEM subjects' at 22,7%.

**Table 2.** The Needs in Implementing STEM Education in Nusa Tenggara Barat

| No. | Statement | Strongly Agree | Agree | Total |
|---|---|---|---|---|
| 1. | Seminars/workshop/training in STEM education | 77,4% | 22,6% | 100% |
| 2. | Training for teachers for teaching STEM | 77,4% | 20,8% | 98,2% |
| 3. | Convey subject material knowledge and pedagogical skills for STEM subjects | 66% | 30,2% | 96,2% |
| 4. | Guidance or handbook for implementing STEM education | 67,9% | 32,1% | 100% |
| 5. | Training for teachers for time management | 45,3% | 45,3% | 90,6% |
| 6. | Training for teachers in using various learning strategies/model in implementing STEM | 73,6% | 24,5% | 98,1% |
| 7. | Training for teachers in class management | 49,1% | 37,7% | 86,8% |
| 8. | Supporting learning media/facilities for improving students' motivation | 45,3% | 47,2% | 92,5% |
| 9. | Guidance or handbook for students in STEM | 64,2% | 35,8% | 100% |
| 10. | Government support for STEM subject | 64,2% | 34% | 98% |
| 11. | Training programs for students | 56,6% | 43,4% | 100% |
| 12. | Book of ideas for creating STEM challenge | 67,9% | 31,1% | 99% |
| 13. | Well-equipped laboratories | 62,3% | 30,2% | 92,5% |
| 14. | Sufficient supply material for STEM | 62,3% | 34% | 96,3% |

Table 2 showed that 100% of elementary school teachers in Nusa Tenggara Barat need 'seminars/workshop/training in STEM education', 'guidance or handbook for implementing STEM education', 'guidance or handbook for students in STEM', and 'training programs for students. At the second most chosen need was the need of book or ideas for creating STEM challenge at 99%. The interesting finding were almost all the expected need were at 92,5% until 98,2%. Meanwhile the least was 86,8% for 'training for teachers in class management'.

The results of the study found that there was connection between teachers' challenge and needs in implementing STEM education. 'Lack of hands-on training for students' which was 94,4%, 'lack of opportunities for STEM seminars/training/workshop' and 'difficult to find ideas for the STEM challenge' at 90,6%, 'lack of teacher's expertise in using activities of experiments' was 86,8%, and for 'lack of teacher's expertise in integrating all STEM subjects' was 84,9%. All the findings have linked with the result for the STEM education needs of 100% need 'seminars/workshop/training in STEM education', 'guidance or handbook for implementing STEM education', 'guidance or handbook for students in STEM', and 'training programs for students. Furthermore, the other big challenge was 'lack of investment and government interest in STEM was 83%. This challenge has linked with all the needs to implement STEM education, included the need of book or ideas for creating STEM challenge at 99%.

The result strongly emphasized for training/workshop and guidance/handbook not only for teachers but also for students, because those assistance equip future teachers with not only knowledge but also skill and experience. Previous study found that teachers were worried and less confidents to teach STEM in the classroom [13]. The other problem is the lack of training primary school teachers have to teach science [14]. That is why, if government can provide free training or workshop for STEM education, teachers will be more experience, and hopefully can emphasize their confident and skilled after joining it. The evidence supports the statement that the integrated approach in teaching and learning is central to produce generations that is not only interested and skilled in STEM, but also responsible [15].

Having teacher with good knowledge, skill, and experience in teaching STEM is very important. That is why teachers must be trained well. Teaching with STEM in primary education effectively, from nursery onwards, will make children to have their starting point. With teacher's enthusiasm, care and professional practice, students' skills in questioning, testing, analysis, and evaluating will grow and flourish. Since most of elementary school teacher's education background are not science or mathematics, supports in the form of integrative STEM resources can be an example teachers can learn from [9].

To be successful in STEM is not only about being able to think critically and creatively, but also able to apply concept to solve problem. Students will encourage with confidence to apply their developing knowledge and understanding of the way the world works not only to enhance their own lives but also to tackle the world problem. STEM possesses the first promising potential to reinvasion the educational orientation from the bottom up [16].

Science allows us to link isolated facts into coherent and comprehensive understanding of natural world; continually refining and expanding our knowledge of the universe and this requires collaboration [17]. Teacher education and professional development programs certainly need government's interest and supports [18]. Especially in Indonesia where mostly teachers are work in public school that belonged to the government.

Even though private sector can do, but government role is a must. Stakeholders and parents must support because the successful implementation of STEM requiring sufficient planning, well-defined goals, and sufficient supports for all stakeholders and parents by sharing vision and strategic plans [19]. Having class that is familiar with STEM learning will make the students had an increase learning outcome as well as motivation dimensions such as confidence ([20]. To accomplish meaningful learning and comprehension of a subject, students must encounter a subject that engage their multiple intelligences numerous times [21].

Finally, the result of this study can be a consideration for the government and all stakeholders to conduct STEM training/workshop for teachers and students. Government needs to invest on STEM education especially on teacher education and professional development programs [18]. Appropriate investment, time, and planning are the main requirement for the effective STEM implementation [22].

On the other hand, the result for this study can be a recommendation for the research and development of STEM guidance/handbook for teachers and students.

## 4 Conclusion

This study indicated that there was connection between teachers' challenge and needs in implementing STEM education. The result strongly emphasized for training/workshop and guidance/handbook not only for teachers but also for students. All those need government interest and support, especially on teacher education and professional development programs.

This study can be a consideration for the government and all stakeholders to conduct STEM training/workshop for teachers and students. Indonesian STEM guidance/handbook that bring local context for teachers and students are highly recommend to design. Further research and development of STEM should be done to investigate the real achievement and impact in implementing STEM education.

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