**Al-Ishlah: Jurnal Pendidikan**
Vol.16, 4 (December 2024), pp.4450-4461
ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/ alishlah.v16i1.5231

# Integrating STEM into Religious Education: Exploring the Role of University Lecturers in Merging Science, Technology, Engineering, and Mathematics with Faith-Based Pedagogy

**Tri Ngudi Wiyatno[1], Muhammad Zaini El Wahyu[2], Ainur Rahman[3], Sarwo Edy[4]**

[1] Universitas Pelita Bangsa, Bekasi, Indonesia; tringudiwiyatno@pelitabangsa.ac.id
[2] Universitas Pelita Bangsa, Bekasi, Indonesia; muhammadzaini@pelitabangsa.ac.id
[3] Universitas Islam Negeri Sunan Kalijaga Yogyakarta, Indonesia; hainurrahman94@gmail.com
[4] Universitas Pelita Bangsa, Bekasi, Indonesia; sarwoedy@pelitabangsa.ac.id

**ARTICLE INFO**

***Keywords:***
STEM Approach;
Learning;
Problem-solving

***Article History:***

Received 2024-04-04
Revised 2024-05-30
Accepted 2024-11-06

**ABSTRACT**

This study aims to evaluate the effectiveness of the STEM (Science, Technology, Engineering, and Mathematics) teaching model employed by religious education lecturers at Pelita Bangsa University. Integrating STEM in religious education is expected to enhance critical thinking, problem-solving skills, and the practical application of knowledge in both professional and everyday contexts. A qualitative research design was used, with data collected through interviews and surveys distributed via Google Forms. Data analysis involved four stages: data reduction, data presentation, verification, and conclusion drawing. The study sample consisted of 13 religious education lecturers from the Primary School Teacher Education (PGSD) Study Program at Pelita Bangsa University, all of whom taught Islamic religious education courses. The findings indicated a marked improvement in students' critical thinking and problem-solving abilities, particularly in their ability to apply technology during the learning process. Furthermore, all survey responses related to lecturers' preparedness and competence in implementing the STEM model showed consistently high ratings. The results suggest that integrating STEM into religious education enhances students' cognitive abilities and technological skills. The high competence and preparedness of the lecturers further support the effectiveness of this approach. This research highlights the potential of STEM-based learning in religious education and emphasizes the importance of lecturer readiness in its successful implementation. The STEM teaching model proves effective in improving students' thinking and problem-solving abilities in religious education at Pelita Bangsa University. The high levels of lecturer competence and preparedness further strengthen the implementation of this approach.



**Corresponding Author :**
Tri Ngudi Wiyatno
Universitas Pelita Bangsa; tringudiwiyatno@pelitabangsa.ac.id

## 1. INTRODUCTION

Enhancing the quality of education in Indonesia can be achieved through the adoption of educational reforms. These reforms involve a shift from traditional learning methods toward approaches that better foster critical thinking skills (Febriana & Cecep Anwar, 2022). As a result, applying STEM-based learning methods can support the development of students' critical thinking abilities. Critical thinking involves reflective thought aimed at making informed decisions on what beliefs to hold and what actions to take (Elisabeth Irma Novianti Davidi, 2021). Educational quality is a complex and evolving concept, observable from various perspectives over time. At the micro level, achieving quality education in higher learning institutions is a key responsibility of lecturers, who do so by creating impactful learning experiences and providing resources to ensure optimal learning outcomes. At the macro level, universities, through a well-structured learning system, are responsible for shaping qualified educators capable of fostering both intellectual and character development (Sinambela, 2017).

STEM can train students to apply their knowledge in making designs as a form of solving problems related to the environment by utilizing technology. This is in accordance with 21st century learning in facing the Industrial Revolution 4.0 (Permanasari, 2016). In its implementation, students are given the freedom to provide arguments during lecture discussions. Moreover, the religious education course is one of the basic legal courses that uses interactive discussion methods between students and lecturers. However, it was found that some students lacked a good level of confidence to express their arguments in front of their classmates. Therefore, the use of STEM methods will have a good influence on student development in terms of character and pedagogy. STEM education is a learning method that not only strengthens practical education in these scientific disciplines separately but also develops an integrated educational approach in these scientific disciplines by focusing on solving problems in everyday life and professional life (Aghni, 2018). STEM learning will encourage students to think, turn theory into practice, and help produce real products using theoretical knowledge learned during lectures. A STEM approach enhances creativity, communication, and collaboration skills necessary for lifelong learning, and students can be open to innovation with curiosity (Uğraş & Genç, 2018) .

According to the National Research Council, in STEM learning, the ability to apply teaching strategies is as important as educators knowing various ways of learning. Increasing STEM education at the undergraduate level is strongly recommended to adopt more flexible, active, and collaborative pedagogical practices that will reach a diverse range of students (Nurwahyunani, 2021). Problems that often arise in STEM learning are in the context of time management, adequacy of equipment or facilities in preparing STEM learning activities, and patterns of organizing activities according to individual student differences (Bal, 2022). Therefore, this research tries to analyze the role of STEM methods in character learning for students in higher education.

Research by Fathoni et al. (2020) demonstrates that STEM (Science, Technology, Engineering, and Mathematics) has been effectively implemented across various disciplines, particularly in science and mathematics. Given the success of STEM education in these areas, there is a strong case for extending its application to vocational education. In vocational learning, which emphasizes practical skills and problem-solving in real-world contexts, the integration of STEM can facilitate better understanding and more efficient problem-solving for students. Moving forward, it is anticipated that more teachers and lecturers in vocational education will adopt and expand the use of STEM in their instructional practices.

Factors inhibiting educators' readiness in implementing STEM learning are the lack of information or knowledge about STEM for educators and the low creativity of educators (Siron et al., 2020). Students who receive STEM education are expected to be able to think logically and use technology independently to solve problems, innovate and create things (Shernoff et al., 2017).

Moreover, research by Sakti et al. (2022) indicates that STEM-based educational tools and active learning strategies positively impact students' scientific literacy within the Bachelor of Science Education program at Bengkulu University. Specifically, first-year science courses in the 2021/2022 academic year demonstrated how STEM integration in teaching practices enhances students' ability to

understand and engage with scientific concepts. Supporting this, findings from Khairani et al. (2018) reveal that STEM learning fosters students' capacity to translate ideas and concepts between STEM-related disciplines, such as integrating mathematical ideas within science and vice versa, further emphasizing the potential of STEM to strengthen interdisciplinary understanding.

However, significant challenges persist in implementing STEM education, particularly in universities such as Pelita Bangsa University in Bekasi Regency. As one of the largest institutions in the area, with around 3,000 alumni and 8,000 students in the 2022/2023 academic year, Pelita Bangsa University encounters several barriers to STEM integration. Interviews with religious education lecturers in the Primary School Teacher Education (PGSD) Study Program reveal a general lack of familiarity with STEM methodologies, resulting in difficulties integrating STEM approaches into both in-person and online courses. Observations also highlight that some lecturers struggle to design STEM-based lesson plans, underscoring the need for targeted support in implementing these approaches effectively within the curriculum.

This study, therefore, aims to assess the effectiveness of the STEM teaching model currently employed by religious education lecturers at Pelita Bangsa University. By examining its application and outcomes, this research seeks to provide insights into how the STEM approach can be further developed to improve the quality and relevance of education, ultimately equipping lecturers and students with the skills necessary for contemporary academic and professional environments.

## 2. METHOD

The research methodology employed in this study is qualitative in nature, focusing on observing phenomena and interpreting the significance of these phenomena. Qualitative research typically centers on questions related to who, what, where, and how an event occurs (Supyani & F, 2021). Specifically, this study adopts a phenomenological approach, aiming to describe how lecturers in the Elementary School Teacher Education Program at Pelita Bangsa University implement the STEM model. A phenomenological approach enables a deep examination of faculty members' experiences and perceptions of STEM education, analyzing collected data to reveal underlying themes and meanings. This interpretation seeks to capture the core of their experiences within the broader STEM education context, using data from interviews and documentation for descriptive insights. The effectiveness of qualitative research depends significantly on the clarity and depth of language used in the analysis (Basri, 2014). The study was conducted during the even semester of the 2021/2022 academic year, with the population comprising all program lecturers at Pelita Bangsa University. The sample included all permanent lecturers in Religious Education within the program, offering a comprehensive view of these lecturers' experiences and insights into STEM education. This sampling enhances the validity, credibility, and richness of the findings, leading to more robust conclusions.

Data collection methods included interviews, observation, and documentation with lecturers who hold a National Lecturer Identification Number (NIDN), classified as permanent faculty at Pelita Bangsa University. Data were gathered using a Google form link, compiled, analyzed, and narrated to form conclusions. Semi-structured interviews with open-ended questions enabled researchers to explore participants' subjective experiences and perceptions regarding STEM education, aligning with the phenomenological approach. This method facilitated a nuanced and detailed exploration of participants' teaching experiences, capturing the complexities and subtleties of their perspectives.

The data analysis followed a structured procedure designed to ensure thorough and meaningful interpretation.

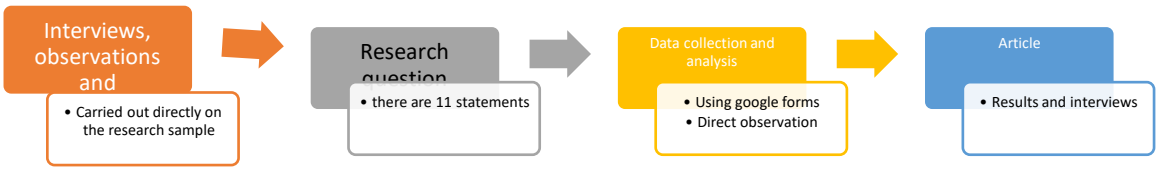


**Figure 1.** Data Analysis Procedure

## 3. FINDINGS AND DISCUSSION

### *3.1. Science, Technology, Engineering, and Mathematics Learning Management*

Implementing STEM-based learning management begins with careful planning to ensure an effective and efficient educational process that fosters students' higher-order thinking skills. To enhance learning quality, the stages of lesson study are employed: planning learning activities (plan), observing the learning process in action (do), and continuously reflecting on implemented activities (see).

The techniques, methods, and strategies that educators—especially lecturers—apply significantly impact students' attitudes and engagement in learning (Siron et al., 2020). According to an interview with the Head of the Primary School Teacher Education Study Program at Pelita Bangsa University, many lecturers struggle to connect the curriculum's value-oriented content with their students' real-life challenges. This issue is consistently highlighted in semesterly evaluations of lecturer performance (Sunaryati, 2022).

For this study, data were collected via a Google form distributed to Pelita Bangsa University lecturers. The form gathered information on lecturers' familiarity with the STEM (Science, Technology, Engineering, and Mathematics) learning model. Lecturer responses were based on a series of 11 statements rated on a Likert scale, providing insight into their perspectives and knowledge of STEM integration.

**Table 1.** Research Survey Results

| Statement | Results |
|---|---|
| Good knowledge of learning methods | Very high |
| Knowledge of knowing STEM approaches well | Very high |
| Provide a statement about the phenomenon that is happening to students | High |
| Providing scientific information that can be a solution to solving problems for students | Very high |
| Utilization of technology tools in learning | Very high |
| Technology can influence students' thinking | Very high |
| tools help continuous learning | Very high |
| Ability to develop learning technology with more creative and innovative designs | Very high |
| Students are able to provide ideas during learning | Very high |
| Students are able to analyze formulations in problem solving | Very high |
| Students are able to solve problems mathematically | Very high |

Based on the table above, data is obtained that Religious Education lecturers in the Pelita Bangsa University Elementary School Teacher Education study program have high knowledge which leads to STEM (Science, Technology, Engineering and Mathematics) learning. It can be seen in the table that the average of all statements related to the preparation and competence of lecturers in implementing the STEM learning model is very high (Sunaryati, 2022). This is one of the things that is important for the continuity of learning through STEM methods because in principle STEM learning has one goal, one of which is to create students who are able to integrate theoretical aspects learned in class with reality in class. life, meaning that lecturers must be able to provide stimulus about phenomena. That's what happens, like learning with a comprehensive case study method. So that students are able to respond to case studies with the theories they have received in previous learning. Apart from these indicators, lecturers have been proportionally able to apply the STEM paradigm to the learning process in the classroom and outside the classroom. Moreover, lecturers are required to always update aspects of learning methods and learning strategies so that the learning process in class is dynamic.

Religious education courses at Pelita Bangsa University are held for 6 semesters. Every semester students take religious education courses. This is an effort by Pelita Bangsa University to internalize religious, cultural and social values in student life so that students have superior character in accordance with one of the university's great visions, namely creating a generation with the best morals.

Through the STEM approach, lecturers are empowered to integrate religious values both theoretically and practically. STEM's focus on developing students' psychomotor and affective aspects ensures that what lecturers teach serves as a model for behaviors students can incorporate into their daily lives. To keep lecturers aligned with the latest advancements, Pelita Bangsa University implements engaging development programs. These include journal writing training, community service workshops, religious studies, and other initiatives aimed at enhancing lecturer competencies. These efforts reflect the university's commitment to equipping its faculty with the skills to bridge academic theories with contemporary societal needs, with STEM serving as a key method for achieving this integration.

It is indeed difficult to unite STEM education in learning into a single unit that emphasizes the interconnection of these four disciplines because they influence the effectiveness of STEM education programs. Considering that the STEM approach refers to four components of science, namely knowledge, technology, engineering, and mathematics, sometimes students cannot connect these four components in the learning process (Aghni, 2018).

### *3.2. Implementation of Science, Technology, Engineering, and Mathematics*

When implementing STEM-based learning, educators, and lecturers must approach the process creatively to keep it engaging and effective. This approach often involves leveraging technology to support students in developing skills to solve problems both mathematically and logically. Currently, some lecturers in the Elementary School Teacher Education program at Pelita Bangsa University rely on general lecture designs rather than specialized ones tailored to STEM. To prepare students for the challenges of the 21st century, educators must adopt effective strategies, such as STEM, that promote critical thinking and problem-solving skills (Siron et al., 2020). Incorporating STEM into the learning process not only enhances active learning but also boosts student motivation and engagement (Wahyuni et al., 2020).

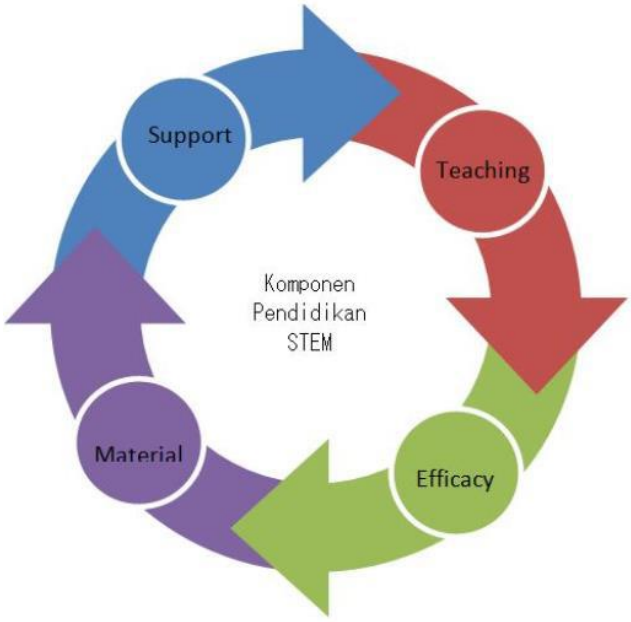


**Figure 2.** Supporting components for STEM learning

The explanation in Figure 2 is as follows: (1) Support aspect, which is related to support for the implementation of STEM learning, be it school collaboration with industry or collaboration between teachers in one school; (2) Teaching aspect, which is related to mastery of learning in class, both in terms of preparation and implementation of learning in class; (3) The efficiency aspect, related to educators' confidence in implementing STEM learning, starting from mastery of the material and commitment to implementing learning; and (4) Material aspects, namely those related to supporting learning infrastructure. These four components must complement each other so that in the learning process students can experience the STEM approach in solving a given problem (Stohlmann et al., 2012).

Skills in using technology are one form of integration in STEM learning. Because basically STEM refers to four fields of knowledge, namely science, technology, engineering and mathematics. According to the Big Indonesian Dictionary (KBBI), these four fields of science have different meanings, namely: (1) Science is systematic knowledge obtained from observation, research and testing which leads to the principles of something being investigated and studied; (2) Technology, namely all means of providing goods necessary for the continuity and comfort of human life; (3) Technique, an approach or system for doing something; and (4) Mathematics, namely the science of numbers, relationships between numbers, (National, 2018). The definition of STEM is a learning approach between two or more STEM components or between one STEM component and other scientific disciplines (Becker & Park, 2011). The following STEM goals can be seen in the following image:

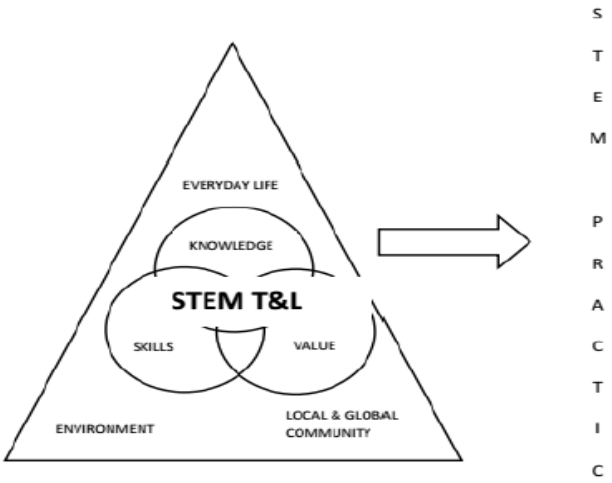


**Figure 3**. STEM Goal

Figure 3 illustrates how STEM-based learning engages students in science, technology, engineering, and mathematics within real-world contexts, linking school, the workforce, and global perspectives to foster STEM literacy. This literacy equips students with the skills needed to compete in the 21st-century educational landscape. STEM education seeks to address real-life challenges by applying integrated subjects in schools that combine students' knowledge, skills, and attitudes. The overarching goal of STEM in education is to prepare capable and competitive students who are ready to excel in their chosen fields. Therefore, effective STEM implementation requires seamless integration across disciplines (Fathoni et al., 2020).

At Pelita Bangsa University, lecturers leverage a management information system (e-campus) for the planning, organization, implementation, and evaluation of learning activities. The E-campus platform enables lecturers to link course content with real-world phenomena or case studies, enriching the learning experience through relevant applications. The following is an overview of the e-campus system:

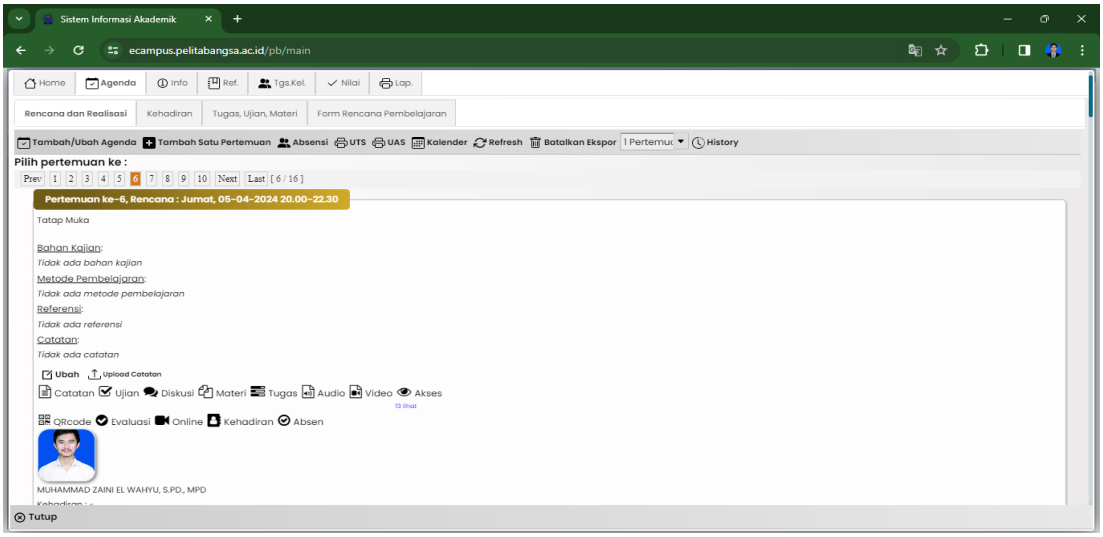


**Figure 4.** Pelita Bangsa University Management Information System

Figure 4 illustrates that all learning resources and tools at Pelita Bangsa University are integrated into a management information system known as UPB e-campus, where lecturers conduct

both lesson planning and evaluation. This system supports the STEM (Science, Technology, Engineering, and Mathematics) approach, which integrates these four fields to address real-world challenges through collaborative and systematic methods (Torlakson & Bonilla, 2014). STEM learning encourages students to tackle problems by conducting structured research (mathematics), observing and experimenting (science), applying their technical expertise (engineering), and making use of technological resources (technology) (Fathoni et al., 2020). By incorporating STEM within the UPB e-campus, Pelita Bangsa University not only enhances academic planning and assessment but also strengthens students' problem-solving skills, preparing them for real-world applications and competitive, dynamic career landscapes.

Technology is really needed by lecturers and students to access information related to STEM (Science, Technology, Engineering, and Mathematics) learning. Learning facilities that use technology during the learning process have an effect on student learning outcomes and skills (Nuragnia et al., 2021). Information technology-based education is seen as a way to prepare students for the "information or digitalization era" by teaching them the basic skills they will need in the world of work. In addition, digital competency is used to describe the skills and knowledge needed to prepare students to face global competition and for their future career development. Currently, the term includes computer interaction skills such as using a keyboard and basic software (Fraillon et al., 2014). Lecturers or educators and students will collaborate using good technology to process data and convey the information that has been obtained (Wahyuni et al., 2020). By maximizing learning using technology, STEM learning process activities which are a new model for educators or lecturers will not be a problem because they are equipped with the necessary devices and do not interfere with the learning or lecture process (Sutrisno & Hamdu, 2020).

Integrating STEM into the learning process can enhance educators' pedagogical skills, enabling them to raise both the quality of instruction and the overall institutional standard. A solid grasp of STEM allows educators to drive meaningful educational development, positively impacting institutional quality. Thus, consistent, continuous, and sustainable STEM training is essential for educators to build the competencies required to navigate the rapidly evolving challenges of the 21st century. Students in Pelita Bangsa University's Primary School Teacher Education (PGSD) program, as future primary-level educators, are expected to gain both knowledge and behavioral insights, equipping them to create a positive impact effectively and efficiently (Pramudiyani & Indratno, 2021).

STEM has been extensively researched and documented across numerous academic studies. Prior research highlights that STEM can be supported by various innovative methods to foster creativity and innovation. The application of STEM also encourages students to design, develop, and leverage technology to apply knowledge practically, addressing real-life and environmental challenges (Permanasari, 2016). Furthermore, training sessions with experts in STEM fields have proven beneficial, as they foster effective communication and address specific instructional challenges faced by educators, helping them design more innovative, technology-driven, and creative approaches to teaching (Atmojo et al., 2020).

A lecturer, derived from the Sanskrit term "Lecturer," meaning "heavy," is essentially an educator responsible for imparting knowledge. In Indonesia, the term generally refers to professional educators whose primary roles include teaching, guiding, assessing, and evaluating students. Lecturers typically work across all educational levels, from early childhood to higher education, requiring specific formal qualifications. Broadly, anyone who teaches new concepts could be considered a lecturer, with similar roles described by terms such as "Mentor," "Tutor," and "Instructor" (Sinambela, 2017).

Lecturers today must adapt to 21st-century teaching methods, where technology and information systems play a pivotal role in the learning process, especially in this era of disruption. Integrating information technology into academic settings enhances educational quality by streamlining communication between lecturers and students, facilitating access to information and resources, and diversifying learning materials. Beyond simply transferring knowledge, lecturers are expected to demonstrate comprehensive competence as outlined by Law Number 14 of 2005 on teachers and

lecturers and Government Regulation Number 74 of 2008, which includes pedagogical, professional, personal, and social competencies. These competencies are critical indicators of a lecturer's professionalism in fulfilling their role in higher education. Lecturer professionalism embodies the expertise, values, objectives, and quality essential to their educational duties. In this sense, professional lecturers are integral to a high-quality educational process, as they must continually seek personal development and self-actualization (Hatip et al., 2018).

In addition to professional competencies, lecturers should also possess spiritual intelligence to effectively transfer values to students during the learning process. Spiritual intelligence is deeply connected to soul enrichment, allowing individuals to find positive meaning in life's experiences, challenges, and even hardships. This perspective fosters a sense of inner purpose and encourages constructive actions. Major world religions recognize the spiritual aspect of humanity, suggesting that individuals are spiritual beings temporarily experiencing physical existence as part of a larger spiritual journey. An indicator of spiritual intelligence is social skills, which enhance a lecturer's ability to engage with students meaningfully (Ardana et al., 2013).

Increasing lecturer competence can be done through learning both through education inside and outside school. In schools, apart from observing and analyzing the teaching and learning process that is being implemented, lecturers' abilities can also be improved with various secondary data (books, internet, laboratories) in the school environment. For this reason, stakeholders (schools, government and school supervisors) are obliged to provide these learning facilities for the progress and success of schools in educating the community. In addition, schools are required to have lecturer competency development management that can plan and facilitate structured training to form competent lecturers. Management is necessary and useful for all types of organizations; politics, business, education, sports, government, etc. Organizations of all sizes, small organizations such as households, and larger organizations. Large educational institutions also need to be managed. Education, whether at home, in the community, or at a school/religious school, will achieve its goals optimally if it is properly managed. The application of management in the field of education is called educational management (Febriana & Cecep Anwar, 2022).

The application of STEM to the learning or lecture process begins with planning learning tools. The method used is STEM (Science, Technology, Engineering, and Mathematics) based, developing lecture materials that are appropriate to STEM learning. In the learning process, lecturers develop problem-solving abilities to train students' thinking abilities and design lecture rooms with an interactive atmosphere. Curriculum development with a STEM approach in planning and designing learning can be the main thing that can be started in implementing STEM (Sa'ida, 2021).

Another research result obtained from this research is that educators direct students' abilities in solving problems mathematically and logically with these abilities to provide meaningful learning for everyday life. In this context, educators build a more meaningful lecture atmosphere for students by connecting STEM learning with everyday life so that it can increase student success while in class (Bal, 2022). Ultimately, STEM application opportunities can model for students what engagement can look like as lifelong learners who seek to influence themselves and society more broadly (Havice et al., 2018). Educational institutions, in this case universities, are expected not only to provide formal higher education tri dharma services, namely education, research and community service, but to provide more discipline lessons based on simple reductionism and teach more skills to face increasing challenges. . complex world (Agry & Kartono, 2021). Research on education in the learning process using STEM models (Science, Technology, Engineering, and Mathematics) can support the development of prospective teachers' knowledge of teaching, growth mindset, and positive attitudes about the role of teaching models in their teaching practice (Milner-Bolotin, 2018) .

Lecturers can carry out STEM learning with various patterns and formulations, including the following: 1) Project Based Learning (PjBL) Model, Lucas' version of STEM; 2) Project Based Learning (PjBL) Model, the STEM version of Laboy Rush; 3) 5E models. The STEM-PjBL (Science, Technology, Engineering, and Mathematics-Project Based Learning) approach has several steps, each of which aims

to achieve a certain process. PjBL starts with asking questions, teaches creativity, and is carried out as a team.

The first stage of STEM-PjBL (Project-Based Learning) is reflection, where teachers introduce students to relevant problems, encouraging them to explore and investigate these issues. This phase aims to immerse students in the context of the problem, inspiring them to begin exploring solutions. It also helps students connect what they already know with what they need to learn, setting a foundation for further investigation and discovery.

Following reflection, students enter the research phase, which involves conducting in-depth investigations. At this stage, teachers facilitate learning through scientific materials and encourage students to gather information from various resources. The research phase is critical as it enables students to deepen their understanding and clarify abstract concepts. Teachers often engage students in discussions during this phase to help them solidify their understanding and ensure that they grasp the project's core concepts.

The subsequent stages include discovery, application, and communication. In the discovery stage, students apply their research findings to bridge existing knowledge and prepare for project planning. Often, students work in small groups to brainstorm solutions, fostering collaboration and critical thinking. In the application stage, students test their solutions or products, learning through practical experience and refining their work based on results. Finally, the communication stage involves students presenting their solutions, sharing insights with peers, and receiving constructive feedback. This final stage is essential for building communication and teamwork skills, often concluding with assessments based on students' presentations and collaborative efforts (Ishak et al., 2021).

## 4. CONCLUSION

The study on the learning process within the Elementary School Teacher Education program at Pelita Bangsa University reveals that implementing STEM (Science, Technology, Engineering, and Mathematics) education significantly enhances students' problem-solving skills and technological proficiency, making it highly applicable to real-life contexts. Furthermore, STEM's integration in the curriculum contributes to students' ethical development by incorporating humanistic values, while fostering lecturers' pedagogical professionalism through effective teaching strategies. These findings suggest that wider discussions on STEM implementation across educational institutions could amplify its benefits, encouraging broader application among educators in both public and private universities. However, this research is limited to a single university program, suggesting that future studies should explore STEM's impact across diverse educational settings to generalize the findings and refine STEM teaching practices further.

## REFERENCE

Aghni, AZ (2018). *Implementasi Pembelajaran I-STEM (Sains, Teknologi, Teknik, dan Matematika) untuk Meningkatkan Hasil Belajar dan Menumbuhkan Karakter Positif pada Siswa* . Universitas Negeri Semarang.

Agry, FP, & Kartono, K. (2021). Implementasi untuk Model STEAM (Sains, Technology, Engineering, Art, and Mathematic): Pembelajaran Matematika untuk Mahasiswa Pendidikan Guru Sekolah Dasar. *Prosiding Seminar Nasional Pascasarjana* , *4* (1), 126–129. https://proceeding.unnes.ac.id/index.php/snpasca/article/view/834

Ardana, IC, Aritonang, LR, & Dermawan, ES (2013). Kecerdasan Intelektual, Kecerdasan Emosional, Kecerdasan Spiritual, dan Kesehatan Fisik untuk Memprediksi Prestasi Belajar Mahasiswa Akuntansi (Studi Empiris pada Mahasiswa Tingkat Akhir (Skripsi) S1 Akuntansi FE Untar). *Jurnal Akuntansi* , *XVII* (03), 444–458. https://adoc.pub/kecerdasan-intelektual-kecerdasan-emosional-kecerdasan-spiri.html

Atmojo, IRW, Ardiansyah, R., Saputri, DY, Mulyono, H., & Adi, FP (2020). Implementasi Pembelajaran Berbasis Science, Technology, Engenering, Art And Mathematich (STEAM) untuk Meningkatkan Kompetensi Paedagogik dan Profesional Guru SD Melalui Metode Lesson Study. *Jurnal Pendidikan Dasar* , *8* (2), 119–123. https://doi.org/https://doi.org/10.20961/jpd.v8i2.44214

Bal, AP (2022). Pendapat Calon Guru Kelas tentang Pendidikan STEM STEM Eğitimine Yönelik Sınıf Öğretmeni Adaylarının Görüşleri. *Jurnal Pendidikan Kastamonu* , *30* (1), 196–204. https://doi.org/https://doi.org/10.24106/kefdergi.

Basri, H. (2014). Menggunakan Penelitian Kualitatif dalam Studi Akuntansi dan Manajemen: Bukan Agenda Baru. *Jurnal Administrasi Publik AS-Tiongkok* , *11* (10), 831–838. https://doi.org/10.17265/1548-6591/2014.10.003

Becker, K., & Taman, K. (2011). Pengaruh Pendekatan Integratif Antara Mata Pelajaran Sains, Teknologi, Teknik, dan Matematika (STEM) terhadap Pembelajaran Siswa: Analisis Meta Awal. *Jurnal Pendidikan STEM* , *12* (5), 23–38. https://eric.ed.gov/?id=EJ943196

Fathoni, A., Muslim, S., Ismayati, E., Rijanto, T., Munoto, & Nurlaela, L. (2020). TANGKAI : Inovasi dalam Pembelajaran Vokasi. *Jurnal Pendidikan Teknologi Dan Kejuruan* , *17* (1), 33–42. https://doi.org/https://doi.org/10.23887/jptk-undiksha.v17i1.22832

Febriana, F., & Cecep Anwar. (2022). Manajemen Pendidikan dalam Perspektif Al-Qur'an dan As-Sunnah. *Konferensi Kajian Ushuluddin ke-2* (hlm. 396-403). Bandung: Rangkaian Konferensi Gunung Djati .

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). Mempersiapkan Hidup di Era Digital. Dalam *Mempersiapkan Hidup di Era Digital* . https://doi.org/10.1007/978-3-319-14222-7

Hatip, M., Sanosra, A., & Qomariah, N. (2018). Kompetensi Dosen, Profesionalisme Dosen, dan Kecerdasan Spritual Dampaknya Terhadap Motivasi Belajar Mahasiswa Kompetensi Dosen, Profesionalisme Dosen, dan Kecerdasan Spiritual Dampaknya Terhadap Motivasi Belajar Mahasiswa. *Jurnal Sains Manajemen Dan Bisnis Indonesia* , *8* (1), 112–130. https://doi.org/https://doi.org/10.32528/smbi.v8i1.1770

Havice, W., Havice, P., Waugaman, C., & Walker, K. (2018). Mengevaluasi Efektivitas Pendidikan STEM Integratif: Pengembangan Profesional Guru dan Administrator. *Jurnal Pendidikan Teknologi* , *29* (2), 73–90. https://doi.org/10.21061/jte.v29i2.a.5

Ishak, AMF, Israwaty, I., & Halik, A. (2021). Penerapan Pendekatan STEM untuk Meningkatkan Hasil Belajar Siswa Sekolah Dasar Kelas Lima di Kabupaten Barru. *Jurnal Pendidikan Pinisi* , *1* (3), 38–58. https://ojs.unm.ac.id/PJE/article/view/26603/13495

Khairani, Mukhni, & Aini, FQ (2018). Pembelajaran Berbasis STEM dalam Perkuliahan Kalkulus di Perguruan Tinggi. *UJMES (Jurnal Pendidikan Matematika dan Sains Uninus)* , *3* (2), 104–111. https://doi.org/https://doi.org/10.30999/ujmes.v3i2.544

Milner-Bolotin, M. (2018). Penelitian Berbasis Bukti dalam Pendidikan Guru STEM: Dari Teori ke Praktek. *Perbatasan dalam Pendidikan* , *3* (November), 1–9. https://doi.org/10.3389/feduc.2018.00092

Nasional, DP (2018). *Kamus Besar Bahasa Indonesia* (hlm. 1–1701). Jakarta: Gramedia Pustaka Utama.

Nuragnia, B., Nadiroh, & Usman, H. (2021). Pembelajaran STEAM di Sekolah Dasar: Implementasi dan Tantangan. *Jurnal Pendidikan Dan Kebudayaan* , *6* (2), 187–197. https://doi.org/https://doi.org/10.24832/jpnk.v6i2.2388

Nurwahyunani, A. (2021). Tinjauan Pustaka: Pendekatan STEM untuk Meningkatkan Kualitas Pembelajaran IPA di Indonesia. *Jurnal Pendidikan Ilmuwan Muda Berbakat* , *9* (5), 11–17. https://doi.org/https://doi.org/10.17478/jegys.853203

Permanasari, A. (2016). Pendidikan STEM : Inovasi dalam Pembelajaran Sains. *Seminar Nasional Pendidikan Sains "Peningkatan Kualitas Pembelajaran Sains Dan Kompetensi Guru Melalui Penelitian & Pengembangan Dalam Menghadapi Tantangan Abad-21" Surakarta, 22 Oktober* , 23–34. https://jurnal.fkip.uns.ac.id/index.php/snps/article/view/9810

Pramudiyani, A., & Indratno, TK (2021). Peningkatan kompetensi profesional guru dalam penerapan

STEAM pada PAUD. *Prosiding Seminar Nasional Hasil Pengabdian Kepada Masyarakat Universitas Ahmad Dahlan* , *000* (Agustus), 623–629.

Sa'ida, N. (2021). Implementasi Model Pembelajaran STEAM pada Pembelajaran Daring. *Jurnal Review Pendidikan Dasar : Jurnal Kajian Pendidikan Dan Hasil Penelitian* , *7* (2), 123–128. https://doi.org/10.26740/jrpd.v7n2.p123-128

Sakti, I., Nirwana, & Defianti, A. (2022). Implementasi Pembelajaran Berbasis STEM pada Mata Kuliah Kajian IPA-1 Materi Suhu dan Kalor untuk Meningkatkan Literasi Sains Mahasiswa. *Jurnal Kumparan Fisika* , *5* (2), 131–140. https://doi.org/https://doi.org/10.33369/jkf.5.2.131-140

Setyaningsih, E., Adnan, M., Ahmad, CNC, & Anif, S. (2021). Tinjauan Pustaka: Perkembangan Pembelajaran STEM di Indonesia Berdasarkan Variasi Mata Pelajaran, Media, dan Strategi Pembelajaran Tahun 2015 hingga 2019. *Review International Geographical Education Online* , *11* (4), 1023–1033. https://doi.org/10.33403/rigeo.8006816

Shernoff, DJ, Sinha, S., Bressler, DM, & Ginsburg, L. (2017). Menilai Kebutuhan Pendidikan Guru dan Pengembangan Profesi untuk Penerapan Pendekatan Terpadu Pendidikan STEM. *Jurnal Internasional Pendidikan STEM* , *4* (1), 1–16. https://doi.org/10.1186/s40594-017-0068-1

Sinambela, LP (2017). Profesionalisme Dosis dan Kualitas Pendidikan Tinggi. *populis : Jurnal Sosial Dan Humaniora* , *2* (2), 579–596. https://doi.org/http://dx.doi.org/10.47313/pjsh.v2i2.347

Siron, Y., Nuryanah, AI, Huraerah, H., & Rahmani, NF (2020). Wajah TK Berbasis Islam: Kesiapan Guru dalam Penerapan Pembelajaran STEM. *Al-Hikmah: Jurnal Pendidikan Anak Usia Dini Indonesia* , *4* (2), 171–192. https://doi.org/https://doi.org/10.35896/ijecie.v4i2.146

Stohlmann, M., Moore, T., & Roehrig, G. (2012). Pertimbangan untuk Pengajaran Pendidikan STEM Terpadu. *Jurnal Penelitian Pendidikan Teknik Pra-Perguruan Tinggi* , *2* (1), 28–34. https://doi.org/https://doi.org/10.5703/1288284314653

Sunaryati, T. (2022). *(Ketua Prodi PGSD), Wawancara, 28 Juni* .

Supyani, Y., & F, DF (2021). Klasifikasi Kompetensi Digital Dosen Bahasa Inggris di Era Pandemi. *Sebatik* , *25* (2), 460–467. https://doi.org/10.46984/sebatik.v25i2.1524

Sutisna, D., & Widodo, A. (2020). Peran Kompetensi Guru Sekolah Dasar dalam Meningkatkan Efektivitas Pembelajaran Daring. *Jurnal Bahana Manajemen Pendidikan* , *9* (2), 58–64. https://doi.org/https://doi.org/10.24036/jbmp.v9i2.110927

Sutrisno, RR, & Hamdu, G. (2020). Aplikasi Mobile Learning Model Pembelajaran STEM untuk Guru Sekolah Dasar. *JKTP: Jurnal Kajian Teknologi Pendidikan* , *3* (3), 227–238. https://doi.org/10.17977/um038v3i32020p227

Torlakson, T., & Bonilla, Susan A. (2014). Inovasi Cetak Biru untuk Pendidikan STEM - Sains (Departemen Pendidikan CA). *Warga California Berdedikasi untuk Yayasan Pendidikan* , *Mei* , 52.

Uğraş, M., & Genç, Z. (2018). Menyelidiki Niat Mengajar STEM Calon Guru Prasekolah dan pandangan tentang Pendidikan STEM. *Jurnal Fakultas Pendidikan Universitas Bartin* , *7* (2), 724–744. https://doi.org/https://doi.org/10.14686/buefad.408150

Wahyuni, S., Reswita, & Afidah, M. (2020). Pengembangan Model Pembelajaran Sains, Teknologi, Seni, Teknik Dan Matematika Pada Kurikulum PAUD. *Jurnal Zaman Keemasan* , *4* (02), 297–309. https://doi.org/https://doi.org/10.29408/goldenage.v4i02.2441