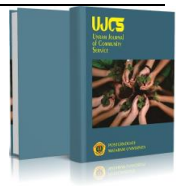
UJCS 5(4) (2024)

Unram Journal of Community Service

https://jurnalpasca.unram.ac.id/index.php/UJCS



Developing Teachers Digital Competence Through International STEM Coding Training

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Received: October 14, 2024
Revised: November 24, 2024
Accepted: December 25, 2024
Published: December 31, 2024

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DOI: 10.29303/ujcs.v5i4.746

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Abstract: The purpose of this Community Service is to enhance the digital skill of teachers with coding training in STEM in the city of Palembang. Sriwijaya University is organizing this community service in collaboration with ARtec Japan and Indonesian STEM Association for the benefit of. There are 46 participating teachers attending this event, coming from different levels of education: SD, SMP, dan SMA (primary and secondary school). After the community service activities, a significant improvement was noted in the participants' understanding and technical skills on how to use coding in the classroom. This is evidenced by increased posttest scores across all elements in the provided evaluation instrument with a mean increase of 28 points. The approaches used in this training are lectures, practical training, and mentoring. In conclusion, what can be done from this training is that well-organized STEM Coding Training has boosted digital literacy, technical skills, and the confidence of instructors themselves.

Keywords: Training; STEM; Coding

Introduction

The decline in performance in mathematics and science, reflective of the sustained decline in test results among children from the United States in these subjects, has prompted the United States to create a STEM-based system of education in these sciences with the goal of improving academic performance (Emalia et al., 2023). Companies like Onetwocode Indonesia, which offers comprehensive training in web design, augmented reality, and programming skills, are presenting a variety of programming courses, both physically and virtually (Alexandra et al., 2022). These courses are made to fit different learners' needs-from novice to professional (Sahir et al., 2023). Many graduates in information technology prefer career positions like project managers, technical consultants, or business analysts over direct careers as programmers (Maesaroh et al., 2022). Such drift indicates that the information technology sector indeed requires sound analytical and managerial skills (Noerbella, 2022).

The Indonesian government also struggles to manage information technology; for example, the Bjorka data breach shows the need to increase the level of training in IT management among government employees. Fundamental programming skills are thus a must to meet the demands of the IT industry. Many IT graduates have entered into successful programming careers too, having no formal degree in this discipline but by undergoing extensive training programs and self-learning processes. Besides, programming skills, there are a considerable number of job opportunities which require analyst and managerial aptitude. Different types of IT graduates are being recruited for jobs in industries which require very high levels of analytical and managerial acumen irrespective of whether the job involves direct programming activities or not. The coding curriculum in STEM should be all-inclusive,

How to Cite:
Maharani, S. D., Hartono, H., Syarifuddin, S., Inderawati, R., & Santri, D. J. (2024). Developing Teachers Digital Competence Through International STEM Coding Training. *Unram Journal of Community Service*, *5*(4), 330–334. https://doi.org/10.29303/ujcs.v5i4.746

right from augmented reality, web development to mere programming. Customizing such programs to each learner's learning style can enhance the learning outcomes. Such industry collaboration will align the training modules to the market's needs. For example, Udacity Indonesia collaborates with Google in training in Android development.

The situational analysis reveals that an intensive training module must meet the skills demand in the digital era by collaborating with the industry and tailoring modules to individual learning preferences. As part of holistic education, especially regarding digital literacy based on STEM, this approach allows children not only to understand the concept of science and technology but also to develop creative and literacy skills. That goes to support the notion that all educational experiences must be interactive and engaging for diverse age groups (Yulian & Maulidha Eka Putri, 2024).

The study showed that educators face a problem in practicing instruction and evaluative techniques that improve literacy and numeracy (Noerbella, 2022). Based on this, it is necessary to enhance knowledge of reading and numeracy through a collaborative learning environment for elementary, middle school, and high school teachers in Palembang City. STEM coding workshops are the activities teachers can attend to improve science-oriented literacy and numeracy.

Method

In this community service educators from elementary, middle, and high schools in Palembang City were targeted, specifically for competence enhancement through the implementation of STEM-Coding. This program will be supported with counseling, training, and mentoring to improve science-based literacy and numeracy skills and integrate information and communication technology to enhance coding skills and the concept of STEM. It is also expected that, through this activity, the quality of education in Palembang City will increase and educators will be prepared to face challenges in an advanced digital era ((Mustofiyah et al., 2024).

The community service activities proposed cover counseling, training, and mentoring in building the competencies in the necessary coding for STEM. One of the foundation aspects pointed out in the program in chemical sciences is literacy and numeracy skills development and, along with ICT, builds better skills in the coding to conceptual understandings in the context of STEM. This may involve outreach activities, training that involves practical experience with actual coding practices, tool usage, and project development in STEM.

Lectures: dissemination of information with regard to the value of STEM-Coding and its potential to improve educational outcomes. This method was chosen because it is very effective in conveying information directly and systematically to respondents, especially in explaining basic concepts (Rahmawati & Lutfi, 2024)

Training: practical experience that includes coding practices, tool usage, and project development related to STEM.

Mentorship: This involves the personal or collective guidance needed to increase the application of knowledge and skills learned in daily practices.Therefore, prepares and equips the participants' understanding and skills in the level best position in STEM-Coding for solving problems in the advanced digital era.

Result and Discussion

The targeted group for this community service activity includes educators in elementary, middle, and high schools within Palembang City to enhance their competencies in STEM-Coding implementation. This activity was held at the KM5 FKIP Campus, Sriwijaya University, from 07.00 WIB until 16.00 WIB.

Figure 1. Sriwijaya University Facilitator Dr. Didi Jaya Santri, M.Sc.

The Palembang STEM Coding Training for Teachers took part in the attendance of 46 participants from all levels within Palembang City. Hybrid training activities were conducted in conjunction with ARTec Japan and Indonesian STEM Association, while facilitators from Sriwijaya University were present at the location.

Dr. Hartono, M.A., opened the STEM Coding Training Service Activity, Dean of the Faculty of Teacher Training and Education, Sriwijaya University. At the beginning of the delivery of the material, participants were given a pre-test in the form of a perception

questionnaire with 15 statements. This test is conducted at the beginning to determine the preliminary understanding of the participants concerning STEM Coding.

The first core material was presented by Dr. Arif Hidayat, M.Sc., Ph.D. Edu, who is the Indonesian STEM Association chairman. The theme of this session was an introduction to STEM education. A big emphasis taken during this session was on opening up the opportunity to integrate STEM in learning at every level of education. The training material was delivered by Mr. Teawook Im. The participants at the venue were accompanied by a facilitator: Dr. Hartono, M.A., Dr. Rita Inderawati, M.Pd., Dr. Didi Jaya Santri, M.Si., and Dr. Syarifuddin, M.Pd. This presentation of material includes an introduction to Studuino equipment and software components with an outline of the basic, middle, and upper programming blocks. The material is delivered directly by participants in assembling the robot. Besides, after the participants practised assembling the robot with various challenges from the trainer Mr Teawook Im.

Figure 2. Mr Teawook Im gave a challenge to the participants

Participants carry out a post test which gives an overview of the influence of the training material compared to pretest activities. The results of pretest and posttest are described as follows:

Table 1. Pretest and Postest Score

No Statement	Pretest Score	Posttest Score
1	86.27	100.00
2	92.16	100.00
3	68.63	96.97
4	68.63	100.00
5	66.67	93.94
6	68.63	96.97
7	68.63	96.97
8	68.63	96.97
9	68.63	96.97
10	68.63	96.97
11	66.67	96.97
12	66.67	96.97
13	68.63	96.97
14	66.67	96.97
15	68.63	96.97

Results in both the pre-test and posttest, as shown on the table above, clearly indicate great improvement in the knowledge, skills, and confidence of teachers in STEM Coding instructions after their participation in the workshop. This is more evident in a number of areas, especially in the better presentation of positive responses regarding the teaching of STEM Coding. The pretest indicated that the majority of the respondents had a background on the importance of STEM Coding, which it showed through the pretest percentage scores that fluctuated between 66% and 92% for the various survey questions. However, this increased significantly in the posttest, where many of the respondents scored 95% and above, while in some questions they attained full scores of 100%. This significant increase in scores underlines a tremendous improvement in the understanding of their concepts on STEM Coding.

Another domain where considerable development occurred was the participants' confidence in integrating STEM Coding into their teaching practices. During the pretest, it was noted that 68% of the teachers believed that they were confident in teaching STEM Coding. Meaning, although many realized its importance, they were yet to be very sure about how they would actually do the implementation in the classroom. After the training, however, this number increased as all the teachers claimed that they feel more confident and ready to integrate STEM Coding into their pedagogy at school. This means that the training not only provided them with the knowledge but also carried out the task of instilling in them the confidence to apply this knowledge in a teaching situation.

The workshop also yielded a high increase in the technical skills required for the successful integration of coding devices in the classroom. For example, before training, approximately 69 percent of the teachers believed they had adequate technical skills to manage coding equipment and tools. After the workshop, over

96% demonstrated a significant gain in their competencies with these devices, which significantly increased their level of preparedness to instruct students in STEM Coding. The skill sets will further empower teachers to create engaging and interactive lessons in coding to afford students the opportunity for hands-on, practical experiences. Moreover, it was also observed that the teachers showed significant enhancement in understanding how to integrate STEM Coding into project-based learning. Most of the teachers were struggling pre-workshop on this very aspect, when only 66%-69% agreed upon central items of integrating STEM Coding. However, the outcome from the training showed that almost all participants had a more profound understanding of how to incorporate STEM coding into their lesson plans and correlated those activities with the curriculum by about 96%-100%. This novated clarity also extended to include their understanding of the benefits, considerations, and most effective ways of embedding STEM Coding into other subject areas to enable them to approach STEM education with a more holistic and practical view.

These extraordinary gains in knowledge, skill, and confidence were evident not only in the test scores but also in the training sessions themselves. Many of the teachers who had shown some uncertainty or doubt as to their ability to teach coding became very involved and proactive during the workshop. At the end of the program, they were even more confident but also showed enthusiasm for integrating STEM Coding into their classrooms. This change of outlook, combined with increased competence, means that the workshop has had a strong and positive impact on their overall teaching competencies.

The results presented here strongly indicate that the training program significantly enhances the capacities of teachers to instruct in STEM Coding. This will not only improve the standards of coding at schools and colleges but will also bring a sea change in the students who develop some very important skills, including problem-solving, critical thinking, and digital literacy, which are some of the key 21st-century competencies that have been clearly recommended (Irfan Saninur Azis et al., 2023).

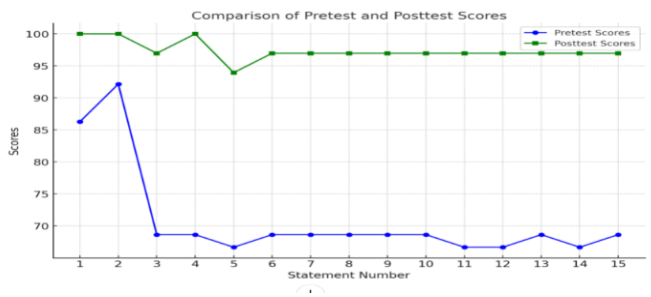

Figure 3. Graf of the difference between pretest and posttest scores

These are precariously gaining importance in a technological environment that changes by the day. In addition, STEM Coding educators, with proper training to teach the skills, may play an important role in helping students prepare for challenges ahead. Finally, evidence from this training program underlines its importance to teachers who are trying to push forward with STEM Coding in their classrooms. The program indeed equipped the teachers with competencies on literacy and numeracy skills on a STEM-Coding framework, with particular emphasis on Chemical Science concepts integrated with information and communication technology. Further interventions in terms of technological resources, infrastructure, and access to relevant application platforms should be made certain for its success to be sustained. In this way, educational institutions may provide the conditions that would result in a learning environment where coding in STEM is continuously accommodated into the school curriculum for the benefit of future teachers and students alike.

Conclusion

These findings reveal that the overall competencies of the teachers in digital literacy, technical skills, and instructional confidence were significantly and positively influenced by the intervention of the STEM Coding training program. This could be seen in the significant increase in the pretest and posttest scores, showing how such targeted training can enhance the educators' understanding of the concepts of STEM Coding and their ability to embed these skills into their teaching practices. Educators not only developed a deeper understanding of concepts but also showed significant improvements in their technical skills, both on the management of coding devices and on how to effectively organize project-based learning activities. In addition, the training fostered a higher level of confidence among educators, thus enabling them to be more involved in the delivery of STEM education in the classroom.

This is highly significant development because it aligns with the increasing requirements of the 21st-century education setup, where digital literacy and proficiency in STEM subjects become crucial. The ability to teach in STEM Coding enables educators to better equip students for their future and imbibe the necessary skills among them for problem-solving, critical thinking, and digital fluency. These are basic skills that would help students cope with the rapidly changing technologically engaging environment and prepare them for careers in the digital economy. Besides the direct benefits this would have on the teaching

fraternity, the program points to the broader prospects for integrating STEM Coding in schools. Indeed, by improving the quality of coding instruction, educational institutions stand to foster learning environments characterized by creativity, innovation, and interdisciplinary thinking among learners. The implications of such efforts go beyond the classroom level and contribute significantly to the overall progress of the education system in building STEM competencies at a tender age.

This training program points out that continuous professional development of educators working in digital and STEM-related disciplines is very essential. The fact that the program was successful shows that, for effective integration of the STEM Coding in educational institutions, sustained support will be required to provide continuous access to technology and infrastructure, as well as collaborative learning platforms. The findings from this study underline the importance of creating a culture of lifelong learning for educators to ensure they will be suitably prepared to meet the changing needs within the educational system, and concurrently enable students to prepare for future challenges.

Acknowledgments

A special thank you to the Faculty of Teacher Training and Education, Sriwijaya University which has provided funding for this service activity through the grant allocated for Professional Teacher Education (PPG) activities for the year 2024 with a grant scheme for community service. We would like to appreciate also all the facilitators, trainers and participants who helped in the successful conduct of this workshop on STEM Coding. We also extend our gratitude to the Indonesian STEM Association and ARtec Japan for their partnership and support. The publication of this article was funded by DIPA of Public Service Agency of Universitas Sriwijaya 2024. SP DIPA-023.17.2.677515/2024, On November 26, 2024. In accordance with the Dean's Decree 23675/UN9 FKIP/TUSK 2024, On Oktober 30, 2024

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