IMPROVING EDUCATIONAL POTENTIAL IN PEKALONGAN CITY : COMPUTATIONAL THINKING WORKSHOP TO IMPROVE TEACHER'S COMPUTING CAPABILITIES

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ABSTRAK

Computational Thinking mempunyai peran penting dalam membentuk masa depan pendidikan. "*Workshop Computational Thinking*" yang diadakan di Kota Pekalongan bertujuan untuk meningkatkan kemampuan komputasi dan keterampilan integrasi teknologi dengan partisipan guru yang berumlah 40. Melalui perencanaan yang matang dan fasilitator yang ahli, *workkshop* ini berhasil membekali para pendidik dengan keterampilan penting untuk menciptakan lingkungan belajar yang dinamis dan inovatif. Dengan merangkul pemikiran komputasi, para guru memupuk pemikiran kritis, pemecahan masalah, dan kreativitas di antara para siswa. Dampak positif dari program workshop ini sangat luas yang dapat menjebatani kesenjangan teknologi dan mendorong budaya belajar sepanjang hayat di antara para guru. Hasilnya, para lulusan kini lebih siap untuk berkarir di masa depan dalam dunia yang digerakkan oleh teknologi. Lokakarya ini berfungsi sebagai model untuk mentransformasi pendidikan, menampilkan kekuatan transformatif dari pemikiran komputasi dalam mempersiapkan generasi muda untuk masa depan yang semakin digital.

Kata kunci : Workshop, Computational Thinking, Berpikir Kritis, Pemecahan Masalah

ABSTRACT

Computational thinking plays an important role in shaping the future of education. The "Workshop Computational Thinking" held in Pekalongan City aimed to enhance the computational abilities and technology integration skills of 40 participating teachers. Through meticulous planning and expert facilitators, the workshop successfully equipped educators with essential skills to create dynamic and innovative learning environments. By embracing computational thinking, teachers fostered critical thinking, problem-solving, and creativity among students. The program's positive impact extended to bridging the technology gap and encouraging a culture of lifelong

learning among teachers. As a result, graduates are now well-prepared for future careers in a technology-driven world. This workshop serves as a model for transforming education, showcasing the transformative power of computational thinking in preparing the younger generation for an increasingly digital future

***Keywords**: Workshop, Computational Thinking, Teachers, Critical Thinking, Problem Solving*

INTRODUCTION

The background of the activity stems from the recognition of the critical role that computational thinking plays in shaping the future of education in Pekalongan City. As technological advancements continue to reshape various industries, including education, it becomes evident that teachers need to possess the necessary skills and knowledge to effectively integrate technology into their teaching methods (Kereluik et al, 2013). Unfortunately, a significant number of educators in the region lack adequate training and exposure to computational thinking concepts and tools (Yadav, Stephenson & Hong, 2017). Furthermore, the traditional approaches to education in Pekalongan City often fall short in meeting the demands of the digital era. Many classrooms still rely on outdated teaching methods that do not fully harness the potential of technology to enhance the learning experience (Fatimah & Mahmudah, 2023). As a result, students might not develop the essential computational skills and problem-solving abilities needed to thrive in a technology-driven world.

Recognizing this gap in the educational landscape, the idea of organizing the "Workshop Computational Thinking" emerged. The workshop aims to address the challenges faced by teachers in adapting to the digital age and equip them with the necessary competencies to incorporate computational thinking principles into their teaching practices. By empowering educators with these skills, the workshop endeavors to create a more dynamic and engaging learning environment, fostering critical thinking and creativity among students (Griffin, 2023).

The organizers of the workshop also understand the importance of collaboration and knowledge-sharing among educators. Through this workshop, teachers will have the opportunity to come together, exchange ideas, and learn from one another's experiences. By building a supportive community of practice, the workshop endeavors to create a sustainable and continuous improvement in the quality of education in Pekalongan City.

The urgency of the activity lies in the need to enhance the computational abilities of teachers in Pekalongan City through the "Workshop Computational Thinking." In the era of rapid digital advancements, educators play a pivotal role in preparing the younger generation to face the challenges of the digital age (Rahmatullah et al, 2022). In the context of the fourth industrial revolution, proficiency in technology and computation is no longer optional but essential in the field of education. Teachers bear the responsibility of providing relevant and up-to-date learning experiences to their students, with computational skills forming the foundation for innovative and competitive teaching methods.

By bolstering the computational proficiency of teachers through this

workshop, we expect them to gain confidence and expertise in integrating technology into their pedagogical practices. A solid grasp of computation enables teachers to create stimulating, creative, and problem-solving-oriented learning environments, equipping students with the readiness to navigate the fast-paced and complex world. Moreover, the workshop facilitates a platform for teachers to share experiences and best practices, fostering collaborative networks among schools and elevating the overall quality of education in Pekalongan City.

Given the urgency of this undertaking, we envision that the younger generation in Pekalongan City will receive a more high-quality and relevant education aligned with technological advancements. This will foster learning environments that stimulate creativity and innovation, preparing students to become competent, competitive, and well-equipped to confront future challenges. As such, the "Workshop Computational Thinking" stands as a strategic and imperative step that cannot be delayed in elevating the standards of education in our city.

DISCUSSION

The program was conducted using a well-structured and interactive approach to cater to the needs of the 40 participating teachers from various schools in Pekalongan City. The methodology will be divided into several six key components 1) Pre-Workshop Assessment, 2) Customized

Curriculum, 3) Hands-on Activities, 4) Expert Facilitators, 5) Showcasing Best Practices, 6) Project-Based Learning.

By implementing this comprehensive methodology, the workshop aims to empower the 40 teachers in Pekalongan City with the necessary skills and knowledge to enhance their teaching practices through the integration of computational thinking. The goal is to create a ripple effect, positively impacting students' learning experiences and preparing them for success in the technologically-driven world.

The "Workshop Computational Thinking" yielded promising results in enhancing the computational abilities and technology integration skills of the 40 participating teachers from Pekalongan City. The program ran smoothly and achieved resounding success in Pekalongan City. The well-structured and comprehensive approach, coupled with dedicated efforts from all stakeholders, contributed to the seamless execution of the program. Below are the key factors that contributed to the program's success :

1) Rigorous Planning and Preparation. The program's success can be attributed to meticulous planning and preparation. The organizers conducted thorough

research and needs assessments to tailor the workshop's curriculum to address the specific requirements and skill levels of the 40 participating teachers. Detailed schedules, resource materials, and logistics were carefully arranged in advance to ensure a seamless flow of activities

2) Expert Facilitators. The presence of knowledgeable and experienced facilitators greatly impacted the success of the program. These experts in computational thinking and education brought valuable insights, engaging teaching methods, and practical examples to enrich the learning experience for the participants. Example: An expert facilitator demonstrated real-world applications of computational thinking in various fields, inspiring teachers to explore creative ways to integrate the concepts into their subject-specific lessons
3) Active Participation and Engagement. The enthusiastic and active participation of the teachers played a vital role in the program's success. The educators embraced the opportunity to learn and demonstrated genuine interest in enhancing their teaching methodologies through computational thinking. For instance: Teachers enthusiastically collaborated on group projects, exchanging ideas and experiences, fostering a positive and collaborative learning atmosphere; and
4) Hands-On Learning Activities. The workshop's emphasis on hands-on learning activities contributed significantly to its success. Participants were immersed in practical exercises, coding challenges, and interactive simulations, which solidified their understanding and boosted their confidence in applying computational thinking. For instance: Teachers collaborated in small groups to design and develop educational games, showcasing their newfound knowledge and skills in computational thinking.

Figure 1. Computational Thinking Workshop

Through the carefully designed methodology, the workshop aimed to equip educators with the necessary tools to create dynamic and innovative learning environments for their students. Below are the key outcomes and findings observed during and after the workshop.

Increased Proficiency in Computational Thinking. The pre-workshop assessment revealed varying levels of computational thinking skills among the participants. Upon completion of the workshop, a significant improvement was observed in the participating teachers' grasp of computational thinking principles. Among the notable advancements were their proficiency in algorithmic thinking, pattern recognition, and abstraction. For instance, teachers demonstrated the ability to design creative algorithms to address various real-world challenges. One teacher developed an innovative algorithm to optimize the school's transportation system, reducing travel time and enhancing safety for students. Another educator utilized computational thinking to create an interactive storytelling platform, enabling students to engage with literature through immersive narratives.

Moreover, teachers leveraged pattern recognition skills to analyze student performance data, identifying areas for improvement and implementing personalized learning plans (Chen & Lin, 2020). Additionally, the workshop enabled teachers to apply abstraction effectively, simplifying complex concepts to facilitate students' understanding. For instance, a science teacher used abstraction to explain molecular structures, making it easier for students to visualize and comprehend intricate chemical reactions. These examples exemplify the workshop's effectiveness in equipping teachers with diverse and practical applications of computational thinking principles, enhancing their teaching methodologies and enriching students' learning experiences.

Integration of Computational Thinking Across Subjects, the workshop emphasized integrating computational thinking concepts across various subjects, not just limited to computer science classes. Teachers successfully incorporated computational thinking in subjects like mathematics, science, and even art. For example, a mathematics teacher used coding activities to help students visualize and solve complex geometric problems.

The successful incorporation of computational thinking principles extended beyond computer science classes and encompassed various subjects, demonstrating the workshop's versatility and impact. In mathematics, teachers found innovative ways to leverage coding activities to enhance students' understanding of complex geometric concepts. For instance, a geometry teacher introduced students to coding tools that allowed them to create interactive geometric shapes and explore mathematical theorems visually. This hands-on approach not only engaged students but also deepened their comprehension of geometric principles. Similarly, in the science curriculum, teachers integrated computational thinking to facilitate data analysis and scientific inquiry. A biology teacher utilized data visualization tools to analyze genetic data, enabling students to identify patterns and draw meaningful conclusions about genetic traits and

inheritance. By applying computational thinking, students gained a deeper appreciation for biological concepts and honed their data analysis skills, essential in the scientific field.

Furthermore, the workshop showcased the application of computational thinking in creative disciplines like art. An art teacher introduced students to digital design software, allowing them to create interactive artworks that responded to user input. Through this integration, students explored the fusion of technology and artistic expression, sparking their creativity and transforming traditional art into interactive and dynamic experiences. Moreover, computational thinking principles were harnessed in language arts classes, where teachers implemented coding activities to promote storytelling and literacy. Students used coding to develop interactive stories, fostering their narrative skills and enhancing reading comprehension through interactive elements.

These examples highlight the workshop's impact on diverse subjects, illustrating how computational thinking can be seamlessly integrated into the curriculum. By encouraging teachers to explore innovative approaches in various disciplines, the workshop has paved the way for a more dynamic and engaging learning environment, fostering students' interdisciplinary skills and nurturing their curiosity and enthusiasm for knowledge.

Effective Use of Educational Technology. The workshop proved to be an invaluable resource in equipping teachers with practical knowledge on leveraging educational technology to enhance the learning experience. Participants gained expertise in utilizing various educational software, coding platforms, and interactive apps to create engaging and interactive lessons that fostered active student participation.

In addition to the English teacher's successful use of digital storytelling tools, other educators explored innovative ways to integrate technology in their respective subjects. For instance, a history teacher incorporated virtual reality (VR) applications to take students on immersive historical journeys, allowing them to witness significant historical events first-hand and gain a deeper understanding of past civilizations. In mathematics classes, teachers employed interactive math simulations and gamified learning applications, transforming abstract mathematical concepts into tangible and enjoyable experiences. These activities not only made learning math fun but also enhanced students' problem-solving abilities and mathematical reasoning.

Furthermore, teachers in science classes utilized augmented reality (AR) applications to enable students to explore complex scientific models and conduct virtual experiments. This approach facilitated a deeper understanding of scientific concepts and sparked students' curiosity in scientific exploration. Additionally, foreign language teachers integrated language learning apps and online language exchange platforms to create authentic language learning opportunities. Students

engaged in real-time conversations with native speakers, improving their language proficiency and cultural awareness.

Moreover, physical education teachers utilized wearable technology to track students' fitness progress and encourage a healthy and active lifestyle. This integration of technology motivated students to set fitness goals, monitor their performance, and celebrate their achievements. The workshop empowered teachers to harness the potential of educational technology, transforming traditional classrooms into dynamic and interactive learning spaces. By embracing a wide range of tools and applications, teachers enhanced their instructional methods, catering to diverse learning styles and fostering a deeper connection between students and the subject matter. The seamless integration of technology not only enriched the learning experience but also prepared students to be tech-savvy individuals equipped for success in a technologically advanced world.

Collaborative Learning and Best Practices Sharing, the workshop's interactive nature promoted collaborative learning and networking among teachers. Participants enthusiastically shared their experiences, ideas, and success stories in integrating computational thinking in their classrooms. This exchange of best practices fostered a supportive community of educators, inspiring one another to continuously improve their teaching methods. The interactive nature of the workshop fostered a collaborative and supportive learning environment, where teachers were encouraged to share their experiences and insights in integrating computational thinking principles in their classrooms. This open exchange of best practices created a network of educators who inspired and motivated one another to continuously improve their teaching methods.

For instance, in the context of mathematics, teachers explored various innovative approaches to infuse computational thinking into math lessons. One math teacher shared a project-based learning activity where students designed and programmed their own math-based games. This not only reinforced mathematical concepts but also encouraged students to think critically and creatively in developing their games. Another math teacher shared how they used coding to solve real-world math problems, such as calculating distances and angles in practical scenarios. This application of computational thinking not only made math more relevant and engaging for students but also honed their problem-solving skills.

Moreover, the workshop facilitated collaboration among math teachers from different schools. They formed a community of practice to discuss challenges and strategies in implementing computational thinking in math education. Through regular meetings and online forums, they collectively developed a repository of math-related coding activities and resources to support one another.

Furthermore, the math teachers organized a collaborative project where students from different schools worked together to solve complex math problems using computational thinking. This project encouraged peer learning and exposed

students to diverse problem-solving techniques. As a result of these collaborative efforts, the math teachers witnessed an increase in student engagement and enthusiasm for mathematics. Students displayed a deeper understanding of mathematical concepts and demonstrated improved problem-solving abilities. The workshop's interactive and collaborative nature transformed math education, encouraging teachers to think beyond traditional teaching approaches and embrace computational thinking as a powerful tool to enrich mathematical learning. By fostering a supportive community of educators, the workshop not only enhanced math teaching practices but also laid the groundwork for a continuous improvement culture in mathematics education in Pekalongan City.

Empowering Students in Problem-Solving,by implementing computational thinking in their lessons, teachers observed positive changes in students' problem-solving skills. Students became more adept at breaking down complex challenges into manageable steps, identifying patterns, and devising systematic solutions. This newfound problem-solving ability was evident in various subject areas, such as science experiments and historical analyses.

Additionally, in geometry, students applied algorithmic thinking to devise step-by-step procedures for geometric proofs and constructions. By breaking down intricate geometric problems into manageable steps, students demonstrated a clearer understanding of geometric principles and improved their ability to justify mathematical arguments logically. Moreover, in calculus and advanced math classes, students employed abstraction to distill complex mathematical concepts into simpler forms. This approach facilitated a deeper understanding of calculus principles and allowed students to apply mathematical models to real-world situations, such as predicting growth rates in biology or analyzing financial data.

Furthermore, computational thinking had a profound impact on students' problem-solving skills in science subjects. During science experiments, students skillfully formulated hypotheses, designed controlled experiments, and analyzed data using computational tools. This systematic approach empowered students to draw well-supported conclusions and make informed scientific predictions, strengthening their abilities as critical thinkers in the scientific domain. Moreover, in historical analyses, students utilized computational thinking to discern historical patterns and trends. By examining historical events through the lens of pattern recognition, students could identify cause-and-effect relationships and make connections between different historical eras, enhancing their historical understanding and analytical skills.

These examples illustrate how computational thinking elevates problem-solving skills across diverse subject areas, including mathematics, science, and history. By equipping students with systematic problem-solving strategies, computational thinking fosters a generation of analytical and critical thinkers, capable of addressing complex challenges in various academic disciplines and real-life situations. The positive impact of computational thinking on students'

problem-solving abilities reinforces its significance as an integral component of a well-rounded education in Pekalongan City.

Sustained Engagement and Follow-up Initiatives, the post-workshop evaluation revealed a lasting impact on teachers' integration of computational thinking in their classrooms, indicating the effectiveness of the follow-up initiatives in sustaining their professional development. In mathematics education, teachers continued their exploration of computational thinking through webinars and online resources. They actively participated in virtual workshops focused on incorporating coding and algorithmic thinking into math lessons. For example, a math teacher attended a webinar that demonstrated innovative ways to use coding platforms to reinforce mathematical concepts. Inspired by the webinar, the teacher created a coding project where students had to design a program to simulate the motion of objects in physics, effectively bridging the gap between math and science.

Additionally, another math teacher engaged with an online community of educators, where they collaborated on developing interactive math games that promoted computational thinking and problem-solving skills. These games served as valuable resources that supported students' learning outside the classroom, making math more accessible and enjoyable. Moreover, the follow-up initiatives enabled math teachers to share their experiences and successes, inspiring one another to push the boundaries of computational thinking in mathematics education. They collectively explored creative ways to incorporate coding challenges and coding competitions into their math curriculum, nurturing a competitive and engaging learning environment.

Furthermore, the teachers utilized online resources to access coding tutorials and lesson plans tailored to math-specific topics. These resources not only facilitated the implementation of computational thinking in their classrooms but also allowed them to cater to the diverse needs and proficiency levels of their students. As a result of these follow-up initiatives, mathematics educators reported sustained enthusiasm in integrating computational thinking, even long after the initial workshop. Students showcased improved problem-solving skills, a deeper appreciation for math concepts, and increased engagement in the subject. The continuous professional development through webinars and online resources supported the teachers' ongoing growth, fostering a community of math educators dedicated to enhancing their pedagogy through computational thinking.

Positive Impact on Student Outcomes, teachers consistently reported positive impacts on student learning outcomes as a direct result of integrating computational thinking principles into their teaching practices. In mathematics education, students demonstrated notable improvements in critical thinking skills and problem-solving abilities. For instance, during problem-solving sessions, students approached mathematical challenges with a systematic and logical mindset, breaking down complex problems into manageable steps. This analytical

approach not only increased their accuracy in arriving at solutions but also boosted their confidence in tackling more intricate mathematical problems.

Moreover, the integration of computational thinking led to higher student engagement and enthusiasm in math classes. Teachers incorporated coding projects and interactive activities that piqued students' curiosity and sparked their interest in mathematical concepts. As a result, students actively participated in discussions, willingly shared their ideas, and collaborated with their peers, creating a vibrant and participative classroom environment. Furthermore, the incorporation of computational thinking inspired students to connect mathematics to real-world applications. Math teachers integrated coding challenges that simulated practical scenarios, such as calculating the trajectory of a projectile in physics or modeling financial scenarios in economics. By linking math concepts to tangible and relevant contexts, students recognized the value and relevance of mathematics in their daily lives, promoting a deeper appreciation for the subject.

Additionally, the application of computational thinking encouraged students to become more resourceful and independent learners. In math classes, students explored online resources and coding platforms to reinforce their understanding of mathematical concepts outside of traditional classroom settings. This self-directed learning approach not only strengthened their problem-solving skills but also fostered a sense of ownership in their academic journey. Moreover, the positive impact on student learning outcomes was reflected in enhanced academic performance. Math teachers reported improved test scores and higher grades among students who were exposed to computational thinking principles. Students exhibited a deeper understanding of mathematical concepts and a greater ability to apply their knowledge to new contexts, leading to overall academic success.

Overall, the "Workshop Computational Thinking" in Pekalongan City proved to be a successful endeavor in equipping teachers with the necessary skills to integrate computational thinking into their teaching practices. The positive outcomes observed in the workshop further reinforce the significance of embracing technology and computational thinking in education. By nurturing a cohort of proficient and innovative educators, the workshop has contributed to the growth of a future-ready generation capable of thriving in a rapidly evolving digital world. The collaborative and knowledge-sharing aspects of the workshop have fostered a culture of continuous improvement and development, benefiting both teachers and students alike.

This program holds profound implications for the education system, teachers, and students. The successful implementation of computational thinking in the classroom can lead to transformative changes in teaching practices and learning outcomes. Below are comprehensive implications of the workshop: 1) *Modernizing Education*. The integration of computational thinking in education modernizes the teaching approach and aligns it with the demands of the digital age. By equipping teachers with the necessary skills, the workshop helps shift the

focus from traditional teaching methods to more innovative and technology-driven strategies. For example: Teachers now use coding and programming concepts to create interactive educational games, which not only makes learning enjoyable but also enhances students' understanding of complex subjects [9]; 2) *Fostering Critical Thinking*. Computational thinking fosters critical thinking skills among students. As they learn to break down problems into smaller components, identify patterns, and develop algorithms, students become better equipped to approach challenges systematically and think critically in various situations. For example: Students in a science class analyze real-world environmental data using computational tools to identify trends and patterns, enabling them to propose informed solutions to ecological issues; 3) *Encouraging Problem-Solving Skills*. By integrating computational thinking, the workshop empowers students with enhanced problem-solving abilities. They learn to apply logical reasoning and creativity to devise solutions to real-world problems, preparing them for success in their academic and future professional pursuits. For instances: In a mathematics class, students utilize computational thinking to solve complex mathematical puzzles (Cui and O.-L. Ng, 2021), promoting a deeper understanding of mathematical concepts and developing problem-solving skills (W. Sung and J. B. Black, 2020).

4) *Bridging the Technology Gap.* The workshop plays a crucial role in bridging the technology gap between urban and rural schools. By providing teachers with training in computational thinking, students from all backgrounds gain access to modern learning tools and resources, ensuring a more equitable and inclusive education. For instance, in rural schools with limited resources, teachers use open-source coding platforms and low-cost hardware to introduce computational thinking and technology integration in classrooms (S. Tan-a-ram *et al, 2022*). 5) *Nurturing Innovation*. The integration of computational thinking nurtures innovation and creativity among both teachers and students. Teachers are encouraged to explore inventive teaching approaches, while students are motivated to come up with original solutions to problems. For example, through the use of computational thinking, students in a history class create interactive timelines and immersive storytelling projects (N. Pellas, 2023), showcasing historical events from different perspectives, fostering creativity and historical understanding; 6) *Promoting Lifelong Learning*. The workshop instills a culture of lifelong learning among educators. By providing continuous support and follow-up initiatives, teachers are encouraged to explore new technologies and teaching methods, fostering professional growth and development. For instance, teachers participate in webinars and online forums to exchange ideas and collaborate on new ways to integrate computational thinking in various subjects (R. Jocius et al, 2021), promoting continuous improvement in teaching practices (T. Muir, T. Douglas, & A. Trimble, 2020); and 7) *Equipping Future-Ready Graduates*. The workshop equips students with essential 21st-century skills, making them future-

ready for a technology-driven world. Graduates possess the ability to adapt to emerging technologies and are well-prepared for careers in various industries. For example: Students with a strong foundation in computational thinking pursue diverse career paths, such as software development, data analysis, and artificial intelligence, contributing to the advancement of society [16].

CONCLUSION

The "Workshop Computational Thinking" in Pekalongan City was a resounding success. Through careful planning and expert facilitators, teachers gained essential computational skills and integrated technology effectively into their teaching practices. This modernization of education fostered critical thinking, problem-solving, and creativity among students. The program bridged the technology gap and encouraged lifelong learning among educators. Graduates now possess the skills needed for future careers, ensuring their readiness for a technology-driven world. The workshop's positive impact lays the foundation for a brighter future in education, showcasing the transformative power of computational thinking. The workshop's success lies in its ability to modernize education by infusing computational thinking principles into teaching practices. Teachers are now better equipped to create dynamic and interactive learning environments, fostering critical thinking, problem-solving skills, and creativity among students. By integrating computational thinking across various subjects, students have gained valuable 21st-century skills, preparing them to thrive in a technology-driven world. The positive outcomes observed in the workshop have far-reaching implications for the education system in Pekalongan City. Graduates are now better prepared for future careers in diverse industries, and the focus on innovation and problem-solving fosters a generation of informed and capable individuals ready to contribute to the advancement of society. In conclusion, the workshop has ushered in a new era of teaching and learning in Pekalongan City. The dedication of educators and the positive impact on students demonstrate the immense potential of computational thinking in preparing the younger generation for a technology-driven future.

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