THE IMPACT OF CREATIVE PROBLEM SOLVING MODEL ON STUDENT LEARNING OUTCOMES IN INFORMATION AND COMMUNICATION TECHNOLOGY (A Case Study At Public Junior High School 7 Amabi Oefeto Timur)

[1]Sarlota Uriana Babu, [2]Ellen Tantrisna, [3]Roswita Lioba Nahak

[1,2] *Informatics Education Study Program, Citra Bangsa University, Indonesia*

[3]*Elementary School Teacher Education Study Program, Citra Bangsa University, Indonesia*

[1]sarlotastkip@gmail.com, [2]ellen.tantrisna@gmail.com, [3]roswitaliobanahak@gmail.com

ABSTRACT

This study aims to determine whether the implementation of the Creative Problem Solving (CPS) model has an effect on student learning outcomes in Information and Communication Technology (ICT) with study case at Public Junior High School N 7 Amabi Oefeto Timur. The methodology consisted in a quasi-experimental design study through the comparison of results under the pedagogy model CPS, taught to an experimental group and on traditional education, implemented on control group. Results showed that the experimental group had higher post-test scores than the control group in higher order thinking skills (problem-solving abilities) and understanding of ICT concepts. This was additionally seen with classroom observations where the students in the experimental group presented greater involvement, confidence in applying concepts of ICT to practical issues and collaboration with the peers. The first thing the CPS model did was start teaching students to think critically, accept that there are always multiple solutions and that together they can solve the problem. The findings indicated that the CPS model is an appropriate pedagogy for enhancing ICT learning performance, especially in resource-poor school contexts. The study suggests that the CPS model should be more prevalent in ICT education and should also be applied in online learning settings.

Keywords : *Creative Problem Solving, Information and Communication Technology, Problem-Solving Skills, Collaboration, ICT Learning*

I. INTRODUCTION

Technology is a significant requirement in education to some extent during this era of fast-paced digital evolution we live in. The education in ICT not only prepares the students with technical knowledge to survive in technology driven society but it will also promote critical thinking, problem-solving and innovativeness. ICT literacy according to (UNESCO, 2020) is an essential element in preparing students for the 21st century, able to access, manage and make information communicative. While ICT is essential to support learning; many students, particularly in rural and under-resources areas, faced difficulties in understanding its concepts as they were rarely had an access to a technology and teaching strategies used by a teacher was characterized by the traditional teaching methods that make boring classes dominated on course-memorization (Ismail et al., 2010). In such a situation, application of the innovative pedagogical strategies will help to improve students' learning in ICT.

One promising method to foster this trait is the Creative Problem Solving (CPS) model, that focuses on creative thinking and problem-solving skills. A key element of the CPS model involves students' engaging in a systematic process to create multiple solutions for the same problem, reflect on their thinking processes, and determine which approach was most effective. Originally developed by Osborn and Parnes approaches in the 1950s (Ravenell, 2018) the model has been used extensively in many educational applications to trigger creative thinking and higher level of cognitive skills. In ICT, the CPS model Therefore, this model offers a robust platform for teaching students to acknowledge complex technical problems creatively and analytically and is formed by focusing on the logical reasoning of technology-oriented solution incorporation that reflects from Mumford et al. (2012).

Many studies have shown that the CPS model has a great potential in increasing student engagement, critical thinking, and learning outcomes in courses that require high level of problem-solving and cognitive presence. Asmidar (2019) for example, found that students in the Creative Problem Solving model got more understanding of tech subjects than conventional approaches. Despite this, evidence from Amabile (2019) indicates that the use of CPS not only increases academic performance but also fosters creativity and adaptability as well, two vital characteristics for succeeding in a high-tech world. Nevertheless, despite positive outcomes, limited evidence exists to guide application of the CPS model within rural educational contexts, specifically in schools with restricted technological access.

Therefore, this study is conducted by looking at the effect of the Creative Problem Solving (CPS) model directed to student learning results in ICT material at Public Junior High School N 7 Amabi Oefeto Timur which is located in rural areas and has limited technology infrastructure. The study seeks to find out if the introduction of CPS can enhance ICT concepts understanding among students and improve their academic performance. This is an area that this research therefore contributes some insight to, through a case study of the use of CPS in an innovative school in rural Western Cape province, and as such can inform educational practice aimed at addressing the challenge facing schools with limited access top quality human capital.

II. LITERATURE REVIEW

1. Creative Problem Solving (CPS) Model in Education

Creative Problem Solving (CPS) Model -Developed originally by Alex Osborn in the year 1953, this is one of the fundamental approaches that have been done to boost creative and problem-solving thinking across diverse settings including education. CPS is a framework that empowers people to apply both divergent as we all convergent thinking in systematic way to solve problems. Osborn's three procedures—fact-finding, idea-finding, and solution-finding—are used to help individuals understand the problem, generate multiple solutions, and select the best one (Ravenell, 2018).

The CPS model is very common in educational settings and hence is used to design courses that deliver higher-order thinking skills among students. Treffinger et al. (2006), have found that in the classroom, teachers are successfully using CPS strategies to get students to think creatively and approach problems from different perspectives than they might do on their own. CPS, by leading students in the step-wise process of problem-solving, helps enhance critical thinking and encourages innovative learning. This model is aligned primarily with subjects that, like ICT, require students to apply technology to complex problems.

The CPS model has been demonstrated by research to improve students abilities to use complex problems, develop problem-solving skills and extend their creativity (Runco, 2014). The CPS framework also supports teachers in providing student-centered learning experiences, where students take an active role in their education as they work to identify multiplepossible solutions.

2. Effectiveness of CPS in Enhancing Learning Outcomes

The Creative Problem Solving (CPS) model is proven to be effective for enhancing learning in many active and cognitive subjects like Information and Communication Technology (ICT). Asmidar, (2019) showed that there were significant differences between the students who had been taught by learning personnel using the menu model with those who had been taught by using ordinary trips, which meant that cooperation before learning activities affected achievement. This was most noticeable in technical subjects like ICT, which require problem-solving and creativity to absorb the content.

Treffinger et al. (2006) argue that Creative Problem Solving should be an essential component of students' basic education, as this technique allows pupils to fill the streets with fresh and unconventional ideas. While the divergent thinking process allows students to generate multiple possible solutions, convergent thinking lets them determine the best one from all of those options. This has been proven to solidify memory and increase comprehension as the students are actively learning.

Additionally, Pacauskas and Rajala (2017) performed a meta-analysis on the application of CPS in education, indicating that the model boosts higher-order thinking abilities (e. g., critically and creative thinking). CPS takes a step further and makes students active problem solvers by applying their skills to solve problems, which can in turn be applied in different subjects as well as real-life situations. This is especially the case in ICT where students are required to work on complex technological challenges that draw from both theoretical and practical knowledge (Nikolopoulou, 2018).

3. ICT Education and the Role of CPS

ICT is an international field that provides cognitive assistance for solving a number of problems with complex dynamic systems. The Creative Problem Solving (CPS) model is one of the most effective models for ICT education that allows students to work through difficult problems and solve them using structured thinking logic. In ICT, students often have to manage tasks that not only ask for technical knowledge but also the ability to think critically and adapt themselves with new tools and technologies.

Research conducted by Mumford et al. (2012) explains the CPS model is vital because it allows students to discover different measures towards creative solutions for technical issues. The CPS model for ICT is also available where solving the problem is needed, this helps students to apply either divergent thinking (to generate many and different possibilities) and convergent thinking (to choose a solution). The two-part process also makes students more elastic and flexible in dealing with the constant state of technological innovation.

Moreover, using CPS in ICT education aids students to acquire the necessary competences for their future life in a technology-driven world, particularly creativity, critical thinking and innovation. Wheeler et al. (2002), Wen et al. (2016) claimed that when CPS are integrated into ICT curricula, this may not simply enhance problem-solving capability but also enable students to perceive the relevance of particular notions of ICT science in the practical field.

4. Challenges in ICT Education in Rural Schools

The implementation of Information and Communication Technology (ICT) education in rural schools is fraught with challenges because the stakeholders face a number of obstacles such as lack of access to technology, outdated infrastructure and absence of resources. Although it is possible that some of these difficulties could be addressed using technological tools, the Creative Problem Solving (CPS) model offers an alternative approach focusing on the process behind solutions to overcome such challenges. UNESCO (2020), only that rural schools unfortunately struggle to do so as they have poor infrastructure and unreliable internet, little or no teacher training.

But some studies like Wang et al. (2021) have proven that in the context of a resource-poor environment, the CPS model can be optionally adopted for students to train problem-solving and creative thinking skills. CPS can give students an avenue to break through the confines of their technological constraints by forcible emphasizing cognitive engagement, and creative work-arounds. CPS is thus an attractive model for ICT education in rural schools as the focus shifts from tools to problem-solving.

III. METHODOLOGY

This research is intended to investigate the influences of creative problem solving (CPS) model on students learning achievement in Information Communication and Technology (ICT) at Public Junior High School N 7 Amabi Oefeto Timur. It uses a quasi-experimental design to compare the learning outcomes of students taught with the CPS model with those using traditional instructional strategies. This part describes the participants, research instruments, procedures and data analysis that have been conducted by the authors.

1. Participants

The participants of this study were selected from students enrolled in the 8th grade at Public Junior High School N 7 Amabi Oefeto Timur during the academic year 2023. The research included a total of 60 students, who were randomly split into an experimental group and a control group evenly. The experimental group (30 students) was taught using the CPS model, while the control group (30 students) followed the conventional lecture-based teaching method. Four ICT teachers, also participated in the study, to run the lessons with students and feedback on the instructional strategies.

We then used a purposive sampling method to select participants with similar academic backgrounds and levels of previous exposure to ICT concepts in the two groups. By doing so, we had more confidence that learning differences would be due to amembership in the instructional condition rather than other things.

2. Research Instruments

The primary tool for this study consisted of a set of ICT learning materials prepared for both the CPS-based lessons and the traditional lessons. The resources included networking, digital communication and introductory programming topics featured in the upper elementary school level curriculum.

The study was assessed by pre- and post-examination of student learning outcomes. These groups were administered the same pre-test at the commencement of the study for measuring their prior knowledge in ICT. All the participants, trained and untrained returned for a post-test session after 6 weeks of instruction to determine a possible improvement in their conceptual understanding of ICT as outlined by Savolainen et al. Test questions were in terms of problem-solving tasks, practical applications and theoretical knowledge that helped to make sure students have been looked at from all relevant perspectives of abilities.

We also distributed a student attitude survey to evaluate their experiences with the CPS model. The questions in the questionnaire were both closed and open-ended which can provide insights on how students felt about the course, their participation and any challenges they might have faced.

3. Procedures

This study was done in a period of six weeks, where the two groups, experimental and control groups were taught same topics of ICT. The main difference was in the instructional methods used:

1. Experimental Group (CPS Model).
   These students were taught employing the Creative Problem Solving (CPS) model. The class was practice-driven, with lessons developed to foster student participation in problem-solving activities and creative thinking while working together. The lessons were built using the three basic procedures of CPS: fact-finding, idea-finding and solution-funding. Children were set open-ended tasks during the lessons, for example

how to debug a network or create a basic home webpage. They were then charged with coming up with multiple potential solutions and conducting cost/benefit analyses to present to the class.

2. Control Group (Traditional Teaching).
   Students in the control group were instructed using traditional, lecture-based methods where a teacher explicitly taught concepts of ICT from textbooks while students were expected to take notes and complete exercises. This approach was driven by theoretical comprehension, and left folks with little hands on experience or collaboration work.

At the end of each lesson, teachers conducted classroom observations to document student engagement and participation. This qualitative data provided additional insights into how students in both groups responded to the different teaching methods.

4. Data Analysis

To establish a more complete view of the impact of the CPS model on the performance of K-12 students, data was both qualitatively and quantitatviely analyzed to interpret changes in student learning outcomes.

1. Quantitative Analysis.
   Paired t-tests were used for the experimental and control groups on both pre-test and post-test scores to compare student performance. The analysis is conducted to know whether significant differences are exist in learning outcomes between two groups, and the components of the CPS model are proved to enhance ICT skills.
2. Qualitative Analysis.
   Responses on student questionnaires were categorised using thematic analysis to identify common themes such as students' engagement level, difficulties faced, and explanation of the effectiveness of the CPS model. The classroom observation notes were analyzed along with the questionnaire data to provide an enriched interpretation of how the CPS model influenced classroom dynamics..

IV. RESULTS

This section presents the findings from the study, which examined the impact of the Creative Problem Solving (CPS) model on students' learning outcomes in Information and Communication Technology (ICT) at Public Junior High School N 7 Amabi Oefeto Timur. Analysis of the results is conducted in two major areas (a) quantitative findings based on pre-test and post – test scores, and (b) quality findings derived from student feedback and classroom discipline.

1. Quantitative Findings: Pre-Test and Post-Test Scores

The effectiveness of the CPS model was assessed by comparing the pre-test and post-test scores of both the experimental group (taught using the CPS model) and the control group (taught using traditional methods). The analysis reveals a significant improvement in the performance of students in the experimental group, highlighting the positive impact of the CPS model.

a. Pre-Test Scores

A pre-test was given to both groups in order for them to demonstrate prior knowledge about ICT concepts before the instructional intervention. Results exhibited similar pre-test scores for both of the above mentioned group, thus were assumed to have similar initial knowledge level:

Table 1. Pre-Test Scores

Group	Pre-Test Mean Score	Pre-Test Std Dev
Experimental Group	55.2	6.4
Control Group	54.8	6.7

These scores suggest that the students in both groups had similar levels of understanding before the intervention. The close pre-test means (55.2 for the experimental group and 54.8 for the control group) confirm that the groups were well-matched in terms of prior knowledge.

b. Post-Test Scores

Both groups completed a post-test measuring learning delivered after 6 weeks of training. The post-test scores were significantly higher for the experimental group than control group respectively:

Table 2. Post-Test Scores

Group	Post-Test Mean Score	Post-Test Std Dev	Mean Score Improvement
Experimental Group	78.4	5.8	23.2
Control Group	66.7	6.1	11.9

The experimental group (CPS model) improved their mean score by 23.2 points, whilst the control group with traditional teaching methods improved only 11.9 points. This indicates that the model of CPS has had a much greater impact on improving students' understanding of ICT concepts. A paired t-test for pre-test and post-test changes indicated that the differences in changes between-groups were statistically significant ($p < 0.05$).

2. Qualitative Findings: Student Feedback and Classroom Observations

In addition to the quantitative data, qualitative findings were gathered from student feedback and classroom observations. The students in the experimental group reported increased engagement, improved problem-solving skills, and greater collaboration with peers compared to the control group.

a) Student Engagement.

A major discovery in this study was the markedly higher percentage of student engagement in the class where they were taught using the CPS model compared with those students who took traditional call-and-response style classes. Classroom engagement is also important across all over subjects, especially in the technical subjects like ICT that consist of both cognitive and practical aspects.

The introduction of the CPS model altered the learning environment from an old-style, passive lecture hall to a dynamic space where students were inspired to engage. Such was exemplified in student feedback and classroom observations. The students told us they enjoyed the lessons, thought they were more engaging and seemed to participate in class activities more. They were no longer passive receivers, but rather active problem solvers, generating multiple solutions and discussing their work with others.

These findings were supported by classroom observations, in which students from the experimental group engaged more frequently in class discussions and tended toward being volunteers who demonstrated empathy, negotiation skills, contributed their own ideas to collaboratively solve problems. On the other hand, students in the control condition (who received traditional lecture-based teaching) displayed less participation. They tended to stay passive while doing work, and usually just took notes but did not else act on or put into practice the things they were writing down. This difference in participation had, in fact, significant effect on learning outcomes for both groups.

b) Problem-Solving Skills.

Another major finding in this study was the significantly better course adaptation of students in the experimental group related to problem-solving skills. Key Features of the CPS Model Generating Many Possible Solutions: The CPS model is intended to promote creative thinking and solutions to complex problems by teaching students how to produce multiple alternative solutions that they may assess analytically. In ICT education, students are required to engage in technical challenges that necessitate logic as well as creativity.

The earlier post-test results for the CPS group indicated that they performed better than those in the control group on questions requiring higher-order thinking and applying ICT concepts to practical situations. For instance, when solving problems in a network problem or designing a basic web page, students in the experimental group could be more creative thinking of several alternative solutions before choosing the most effective one. By comparison, the control group mostly used less flexible, unidimensional techniques and faced difficulties adapting to new situations when their first solution did not work.

c) Collaboration and Teamwork.

In addition to outside training, the collaborative process inherent in the CPS model was cited as one of the major reasons for success within the experimental group. The CPS curriculum is collaborative and kids work together in groups to problem solve and seek which of their solutions are more effective. This not only sharpened their problem solving skills but also developed the crucial aspects of social and communication skills.

Students in the experimental group solved many ICT tasks in small groups, which promoted knowledge sharing, competition and mutual support. Teachers said that as a result students were more open to other students' ideas and built upon them, often making groups come up with more inventive answers than they would have had doing the project individually. Through this the students also learnt leadership and teamwork as they had to navigate through group dynamics, segregate tasks and ensure everyone participated in finding a solution.

Meanwhile, the control group experienced limited exposure to collaboration compared with its traditional lecture peers. Alone in the work and lacking support from their peers who were instrumental in the CPS group, these students often worked individually on assignments. Therefore, they were not as well developed in solving problems and had a lower perception of their ability to implement the ICT concepts for cooperative work..

3. Classroom Observations

A distinctive result in the classroom observations was that class participation (active vs. passive) varied dramatically between those students taught through the CPS model and traditional lecture-based methods. Teachers repeatedly noted a greater sense of engagement, confidence, and problem solving from students in the experimental arm than they did from those in the control. A qualitative analysis of these observations may provide insight into how the CPS model impacted student behavior and learning outcomes in a live class environment.

a) Interactive Engagement

Teachers reported higher levels of engagement in the content and tasks by students in the experimental group. They were very present in class discussions, worked well with others during group work and problem-solving activities etc. In the CPS model, a student centric interactive learning environment allows students to be the agent of their own learning process. And not idle listeners but they were real participants., very active ones.. having an ongoing conversation with the material, each other and teacher.

Teachers reported that students from the CPS group asked questions regularly, sought clarifications, and were interested in exploring various options for solving the ICT related problems. This stood in sharp contrast to the control group who more often quietly listened while the teacher was lecturing, with less of a tendency to make deeper inquiries or engage in discussions. It was the nature of open-ended problem-solving in the CPS model that let students to think about ICT concepts from different perspectives and showed a part of intellectual curiosity and analytic thinking.

For instance, when a class was learning about how to solve network problems, students in the treatment group eagerly exchanged ideas on different solutions and then worked together to implement and measure their guesses. As a result of the active engagement, students became curious and understood that there could be more than one path to a solution and they were motivated to try find it. By contrast, the control group leveraged memorization of facts and formulas, hampering their ability to engage with the content in a substantial way.

b) Confidence in Applying ICT Concepts

Another salient reflection was in the higher confidence of students fitting ICT concepts to actual problems. The CPS model which was about exploring many solutions and constantly refining the idea assisted students to get a little less uneasy with complex, higher level tasks. All teachers noted that the experimental group were more willing to try new things, take risks in their learning and learn from those times they made mistakes.

In terms of a confidence boost, it was most obvious when students got to go hands-on with projects– for example, if they were designing a very basic website or trying to solve an issue with the computer. The students within the CPS group were just more confident in approaching these problems because they had been taught how to think critically and that failure is a part of learning. Instead of getting discouraged, students tried harder to solve the problem using other methods. For example, students were shown to adapt strategies collaboratively, meaning if they tried a strategy that didnt work they quickly came up with other strategies for logical thought and shared them with peers.

But when it came to the practical problems, students in the control group felt less confident. They were usually dependent on the teacher for taskspecific footstep instructions and they tended to be resistant in trying out new ways of taking steps. Their dependence on the direct instruction of the teacher as a crutch became an impediment to their ability to work autonomously, and form resolutions to problems that arose. Accordingly, their interaction with ICT concepts was at the superficial level and involved rote learning as compared to actual understanding of concepts and its application.

c) Critical Thinking and Multiple Solution Exploration

When discussing configuring a computer network in a lesson, students in the CPS group learned about best practices that should be followed which include ensuring optimal performance of the network by, configuring bandwidth settings, securing user accessibility and additional security configurations. They took some time with process, arguing in favor of different choices and eventually made a reasoned decision together. The reflection on this technical skill not only enhanced their analytical skills but also widened their perspective in a methodological manner.

However, we found that those in the control group were more likely to be looking for one 'correct' answer as described in their teacher's or textbook. Which intrinsically limited their capacity to engage in more depthful, analytical thinking. They lost out on the chance to exercise their critical thinking and problem-solving skills without the ability to paper test multiple solutions. The traditional method of teaching, which emphasizes correct answers over the process of exploration and discovery, did not provide students with the cognitive tools needed to tackle complex ICT challenges.

d) Hands-On Problem Solving and Engagement in the CPS Group

The teachers also found that the CPS model allowed for increased problem-solving activities. The practical implementation is particularly important for understanding and dealing with concepts in ICT education, a circumstance where the structure provided by CPS could better enable students when it comes to working on real-world problems. This enabled students to work together, put ideas into practice and explore theory through real-life application creating a learning experience via an active learning environment.

In the hands-on exercises, such as creating a website or removing code from a software program, the intervention group students were more engaged and persistent than their control cohort counterparts. They were also better at sticking with problems, iterating on their solutions and getting feedback from peers. The teacher became less of a lecturer and more of a facilitator, leading students through the problem-solving exercise. This undoubtedly helped in the development of their technical abilities as well to cultivate an independent and creative thinking.

The control group had far less chance to do any kind of hands on work. Lessons were mostly theoretical with little practical application. Consequently students in the control group were disengaged from practical work activities and regular instruction intervention was required from the teacher to complete tasks. Without access to practicum experiences, they were unable to connect ICT theory with practice.

V. DISCUSSION

The aim of this study was to determine the effect of the application of a Creative Problem Solving (CPS) model in student learning outcomes in Information and Communication Technology (ICT) subjects at Public Junior High School N 7 Amabi Oefeto Timur. The quantitative and qualitative results show positively that the CPS model has specific learning benefits ranging from increased student motivation to perform better in collaborative problem solving. The results are a discussed in greater detail later below, with topics spanning the research questions and extending to ICT education more broadly.

1. Student Engagement and Active Participation

The biggest takeaway from the study, Eisenstadt said, was that students in the experimental portion of the study saw large gains in engagement. Interactive learning and creative problem solving in the academic intervention of CPS model created a classroom where students' involvement in their learning process was vital. Similarly, these findings support earlier research positing that active learning environments facilitate greater participation, particularly in higher-order thinking domains like ICT (Treffinger et al., 2006).

Conversely, students in the control group taught through traditional lecture had lower levels of engagement. If they were present at all, they would often adopt a passive stance toward their learning—absorbers of content rather than participants in conversations or problems. The gain in post-test scores between the treatment and control groups indicates that they were more engaged in the experience, leading to improved post-test scores ever so slightly. Active engagement, promoted by the CPS model, enables students to appropriate their own learning this results in better understanding and memorization of ICT content.

This also lends credence to the work of Runco (2014) saying students will be more involved if they believe their input and ideas are valuable. CPS leverages learning as a learner-centric active process, enabling students to experience and experiment with multiple potential solutions by working together.

2. Development of Problem-Solving Skills

An important observation made during the course of this study was that that students in experimental group also exhibited positive enhancement in their ability to solve problems. Since CPS model focuses on generating an idea and critical thinking, these are key skills in ICT education. It has an iterative three-step model that is fact-finding, idea-finding and solution finding which forces the students to approach a problem from multiple angles and attempt various solutions before deciding what would be the best way to go for it.

Post-test results showed that students provided with CPS excelled in critical thinking and applying information and communications technology (ICT) knowledge to real-world problems relative to those in the control group. This is consistent with Mumford et al. (2012) argued that the CPS model could optimize critical thinking skills and innovative solutions to wicked situations. In the field of ICT education, which often requires students to solve technical problems or create new systems, creative and systematic thinking is very important.

Subsequent classroom observations similarly suggested that student those in the experimental group were more able to better link ICT concepts with practical problems. The CPS model capitalizes on both divergent thinking, exploring many possible solutions (creativity), and convergent thinking, looking for a single correct answer (critical thinking) to teach students how to be problems solvers not only in the classroom but also out of it.

3. Collaboration and Teamwork in Problem-Solving

The collaboration and team work seems to be one of the core strengths of CPS model observed in this study. Students in ICT education are often asked to solve complex problems and practised these sorts of group problem-solving activities upon which the CPS model is based. In the experiment group, students give positive feedback to each other and were more willing to share their idea openly or praise ideas of others. This system not only made them better in solving problems but also helped them develop great social and communication skills.

With the use of sharing students ideas with one another, feedback form peers in a non-judgemental setting, the CPS model generates this type of learning. This results are generally in line with the Pacauskas and Rajala (2017) paper, which finds that social problem solving improves academic performance as well as people skills. Students learned to think critically, act confidently, communicate effectively and demonstrated the leadership skills necessary not only in academia but also in future professional endeavours through collaborating together as a team to solve ICT challenges.

Instead, students in the control group participated in less frequent peer collaboration and thus came to have fewer opportunities to develop these skills. This was the more common lecture-based method that did not include much of peer interaction if there were peers doing this course and therefore a more isolated learning experience. At least part of the reason why students in the control group showed less confidence in solving complex ICT problems (hence their poorer performance) after treatment may have to do with this trend.

4. Implications for ICT Education

The results of this study suggest that these findings have important implications for ICT education - especially in contexts such as underresourced schools or rural settings. The CPS model is an excellent model to teach ICT as it provides opportunities for in depth involvement with the course work; creativity in solving a problem and cooperation between team members. And this is important in ICT where it is not just about understanding the theory but actually solving real world problems.

Furthermore, the CPS model is scalable to other educational rubrics. Considering that the school from which subjects were drawn is rural and not well equipped with modern technology modules, the findings suggest that the CPS model can be implemented in a resource starved environment as it happened in this study without advanced ICT facilities. CPS is model that is much more likely to be real world relevant when it comes to ICT teaching than just teaching the use of a suite of products, which means with some work could make significant improvements in delivering better ICT lessons.

5. Addressing the Research Questions

The results of this study address the research questions as follows:

a) How satisfied are users (teachers and students) with the CPS model in ICT education?

Qualitatively, both students and teachers express a high level of satisfaction with the CPS model through feedback. The lessons were well-received by the students and considered more engaging and interactive, as well as an improvement in some aspects of problem-solving capabilities according to teachers.

b) How effective is the CPS model in improving students' problem-solving skills in ICT?

By the quantitative data, overall and as it pertains to post-test score gains in particular, the CPS model is incredibly effective at boosting students' problem-solving skills. The experimental group demonstrated significant increases in not only theoretical knowledge scores but also awareness and operational understanding of applying ICT principles to real-world problems.

c) What aspects of the CPS model can be improved to further enhance learning outcomes?

Although the CPS model has been shown to be effective as it is, there is an opportunity for enhancement in offering increased structure around first steps and where to begin when problem-solving. A few students also struggled conceptually with the first stage of brainstorming, which signals the need for scaffolding efforts at facilitating stronger idea generation.

6. Limitations and Future Research

While the study provides important data on the effectiveness of the CPS model, there are some limitations that we should consider. First, the sample size was relatively small, and only included two groups from one school. Recommendations for future research might benefit from larger more diverse samples to improve the generalisability of results. The study is limited to only one subject (ICT), thus understanding of the effectiveness of CPS model needs to be explored in other subjects as well.

Future research may also want to explore how the CPS model could translate into a completely online educational settings, in particular within the landscape of digital literacy and distance education. The more technology is integrated into curriculum, the more important it becomes to study the ways in which problem-solving and creativity can be supported by virtual spaces.

VI. CONCLUSION

This study has shown that the Creative Problem Solving (CPS) model had a positive effect in improving student learning outcomes in Information Communication and Technology (ICT) at SMP N 7 Amabi Oefeto Timur. The results show that CPS model functions, the students have higher interest, problem solving ability increased significantly and cooperation enhanced them well which are necessary conditions for ICT education. Students of the experimental group were taught ICT concepts through CPS model which enhanced there understanding about these concepts and they had significant higher pos-test scores than the students of control group. The CPS learning context promoted active engagement with the material encouraging students to investigate multiple ways of describing particular problems and possible solutions, thus enabling them to critically consider new information in creative way.

The CPS model, in addition, was the best at improving collaborative skills. The experimental group students collaborated in solving open-ended problems and this facilitated their progressively reinforcement of cognitive and social skills 6. It improved their grade performance and helped them to face challenges in the real world where teamwork and communication skills are required. The findings of this study imply that the CPS model can be used as a reliable pedagogical tool in Information Technology education, especially for schools lacking enhanced technology resources. Since the CPS cycle can be used even without technology tools, as only drawing and simple documentation in time boxes are necessary to implement a creative problem-solving process, it makes possible to adapt to different learning environments that may or may not have technological support.

REFERENCES

Amabile, T. M. (2019). *Creativity in Context*. Routledge. https://doi.org/10.4324/9780429501234

Asmidar, A. (2019). The Effect of Creative Problem Solving Model toward Students Learning Activities and Learning Outcomes of Science Learning. *Proceedings of the 1st International Conference on Innovation in Education (ICoIE 2018)*. https://doi.org/10.2991/icoie-18.2019.22

Ismail, M. N., Ngah, N. A., & Umar, I. N. (2010). The Effects of Mind Mapping with Cooperative Learning on Programming Performance, Problem Solving Skill and Metacognitive Knowledge among Computer Science Students. *Journal of Educational Computing Research*, *42*(1), 35–61. https://doi.org/10.2190/EC.42.1.b

Mumford, M. D., Medeiros, K. E., & Partlow, P. J. (2012). Creative Thinking: Processes, Strategies, and Knowledge. *The Journal of Creative Behavior*, *46*(1), 30–47. https://doi.org/10.1002/jocb.003

Nikolopoulou, K. (2018). Creativity and ICT: Theoretical Approaches and Perspectives in School Education. In *Research on e-Learning and ICT in Education* (hal. 87–100). Springer International Publishing. https://doi.org/10.1007/978-3-319-95059-4_5

Pacauskas, D., & Rajala, R. (2017). Information system users' creativity: A meta-analysis of the link between IT use and creative performance. *Information Technology & People*, *30*(1), 81–116. https://doi.org/10.1108/ITP-04-2015-0090

Ravenell, E. (2018). *The Osborn-Parnes creative problem solving procedure*. GRIN Verlag.

Runco, M. A. (2014). Creativity: Theories and themes: Research, development, and practice, 2nd ed. In *Creativity: Theories and themes: Research, development, and practice, 2nd ed.* Elsevier Academic Press.

Treffinger, D. J., Isaksen, S. G., & Stead-Dorval, K. B. (2006). *Creative Problem Solving An Introduction 4th Edition*. Routledge. https://doi.org/10.4324/9781003419327

UNESCO. (2020). *Education in a post-COVID world: Nine ideas for public action*. https://www.unesco.org/en/articles/education-post-covid-world-nine-ideas-public-action

Wang, J., Tigelaar, D. E. H., & Admiraal, W. (2021). Rural teachers' sharing of digital educational resources: From motivation to behavior. *Computers & Education*, *161*, 104055. https://doi.org/https://doi.org/10.1016/j.compedu.2020.104055

Wen, A. S., Zaid, N. M., & Harun, J. (2016). Enhancing students' ICT problem solving skills using flipped classroom model. *2016 IEEE 8th International Conference on Engineering Education (ICEED)*, 187–192. https://doi.org/10.1109/ICEED.2016.7856069

Wheeler, S., Waite, S. J., & Bromfield, C. (2002). Promoting creative thinking through the use of ICT. *Journal of Computer Assisted Learning*, *18*(3), 367–378. https://doi.org/10.1046/j.0266-4909.2002.00247.x