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Enhancing Creative Self-Efficacy through Creative Problem-Solving-Based E-Modules: An Effectiveness Study

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ABSTRACT

Improving students' creative self-efficacy is crucial in developing creative and innovative thinking skills. This study aims to see the effectiveness of creative problem-solving-based e-modules that support students' creative self-efficacy in straight-line equation material. This research applies the research and development method, which specifically adopts the ADDIE system development model, which consists of five sequential phases: Analysis, design, development, implementation, and evaluation. The research location coincided at SMP N 5 Jambi City, with students of class VIII B SMP N 5 Jambi City utilized as research subjects, with a research sample used as many as 30 people. In collecting data, researchers utilize a series of instruments, including a learner response questionnaire and a creative self-efficacy questionnaire that experts have validated. From the data analysis, a percentage score of 82.25% of "Highly Effective" was obtained from the survey results of students' responses and the analysis results of N-Gain of the creative self-efficacy questionnaire of 0.684. In line with these results, the gain value is equivalent to 68.4% for the interpretation category of gain effectiveness, indicating that the use of e-modules is in the "Moderately Effective" category. Therefore, this N-Gain number interprets that the creative problem-solving-based e-module that supports students' creative self-efficacy can be quite effective in teaching.

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1. INTRODUCTION

Technological developments in the era of globalization have significantly impacted the educational setting [1]. The rapid advancement of digital technology has transformed the way knowledge is delivered and acquired, necessitating a shift in educational approaches. Education is required to adopt technological innovation to raise the quality of education, particularly by adjusting the use of information and communication technology (ICT) to enhance the learning process. Quality education is reflected in students' academic achievements and their attitude, behavior, speech, and actions that are pleasant, civilized,

and cultural [2]. As one of the core disciplines in education, mathematics plays a fundamental role in equipping students with logical and analytical skills essential for navigating technological advancements and innovation. Mathematics supports the development of selected competencies [3], [4].

CSE (Creative Self-Efficacy) is a person's belief in their ability to generate creative ideas and solutions in different situations [5]. It is a critical psychological construct that influences students' willingness to engage in creative problem-solving and their ability to tackle complex challenges. Creative self-efficacy is one of the most important parts of creativity that can influence one's ability to think creatively and generate innovative solutions to problems. Students with high creative self-efficacy are likelier to take risks, experiment with new ideas, and persist in solving difficult tasks. Individuals with a higher level of creative self-efficacy are most likely to believe in their ability to generate creative ideas and solutions, whereas those with low levels of creative self-efficacy may feel less confident and less capable. According to Tierney and Farmer [5] and Nuzul [6], the key indicators of creative self-efficacy include students' belief that they can generate new ideas, their ability to solve problems creatively, and their talent for developing and improving others' ideas.

Observations at SMP Negeri 5 Jambi City in July 2024 indicate that students' creative self-efficacy remains moderate at only 53.6%. This level suggests that many students struggle with confidence in their creative abilities and problem-solving skills. In addition, based on the results of interviews conducted by researchers with one of the mathematics teachers at SMP Negeri 5 Jambi City, many students still lack confidence in solving mathematical problems, especially when dealing with the material on straight-line equations. Several factors contribute to this issue: students’ limited understanding of the material due to a lack of engagement in the learning process leads to low confidence in problem-solving and idea generation. Furthermore, the teacher’s learning model is not optimized for fostering creativity, and the limited availability of instructional media hinders efforts to create an effective learning environment that supports the development of students' creative self-efficacy.

As science and technology advance, education in Indonesia continues to evolve, necessitating innovative learning strategies. One of the key approaches to addressing the challenges in fostering students’ creativity and self-efficacy is integrating digital learning materials, particularly in the form of e-modules. One important component in these efforts is teaching materials that align with students' needs and characteristics. Using this e-module, students can actively engage in learning experiences that stimulate creative thinking skills. This aligns with Ahmad and Wilujeng [7], which states that utilizing technology in the learning process can effectively develop students' problem-solving and creative thinking skills. However, a module that accommodates creative thinking skills must be designed with an appropriate pedagogical approach that ensures active engagement and meaningful learning experiences. The learning model used to support the e-module in this study is the Creative Problem-Solving (CPS) learning model.

The CPS learning model has been widely recognized as an effective approach for supporting students' creative thinking ability and self-efficacy [8]. It encourages students to

actively participate in learning by fostering collaboration, exploration, and problem-solving. The CPS model makes students more creative and active during learning because students participate in the learning process by working together to solve problems, making the class more interactive and engaging [8]. The learning process becomes more dynamic and student-centered, allowing a deeper comprehension of mathematical concepts. CPS is a problem-based learning model that promotes innovation in finding solutions, where teachers present real-world problems or phenomena to stimulate students' curiosity. This approach allows students to analyze issues, generate ideas, and develop problem-solving strategies, ultimately applying their solutions in meaningful contexts [9], [10].

CPS is a learning model that emphasizes problem-solving skills. It allows learners to independently explore different solution strategies, critically evaluate their choices, and refine their approaches to solving complex problems [11], [12]. This aligns with the thinking of Irda [13], which highlights that the CPS teaching model significantly affects students' problem-solving ability and creativity. According to Anggraini et al. [14], the CPS model follows a structured six-stage process: (a) Objective Finding, where students define learning goals; (b) Fact-Finding, where they gather relevant information; (c) Problem Finding, where they identify the core issue; (d) Idea Finding, where they brainstorm potential solutions; (e) Solution Finding, where they evaluate and refine their ideas; and (f) Acceptance Finding, where they implement and assess the effectiveness of their solution. The advantages of the CPS learning model are as follows: (a) students are trained to formulate problems, (b) develop creative and innovative thinking skills, (c) apply realistic and practical problem-solving approaches, (d) engage in analytical and investigative activities, (e) assess and evaluate findings systematically, (f) enhance cognitive flexibility in overcoming challenges, and (g) increase the relevance of education to real-life applications, particularly in preparing students for the workforce [15].

Based on the issues discussed above, the researchers are motivated to examine the effectiveness of Creative Problem-Solving-Based E-Modules as a pedagogical tool for enhancing students' creative self-efficacy. This study aims to contribute to developing innovative learning strategies that can bridge the gap between technological advancements and effective mathematics education.

2. METHOD

The research was conducted using the research and development (R&D) method. This method is widely used in educational research to develop and validate learning products. Research and development (R&D) are processes or methods used for product validation and development [16]. In this study, the primary objective is to develop a creative problem-solving-based e-module that enhances students' creative self-efficacy. To achieve this, a well-structured development design is essential to produce an effective product. Therefore, the development procedure in this study follows the steps of the ADDIE development model. The stages of the ADDIE development model, according to Sugiyono [17], are the analysis stage, design stage, development stage, implementation stage, and evaluation stage. Each stage plays a crucial role in ensuring the quality and effectiveness of the developed e-module. Although the one-group pretest-posttest design provides insights

into students' improvement, it lacks a control group, which limits the ability to establish a causal relationship. Thus, while this design is useful for preliminary evaluation, further experimental studies with a control group are recommended for stronger causal inferences. The effectiveness of the developed product can be seen from the students' responses and the results of data analysis of the pretest and posttest creative skills and creative self-efficacy of students.

Table 1. One Group Pretest-Posttest Research Design

Pretest	Treatment	*Posttest*
To	Use of creative problem-solving-based e-modules that support creative self-efficacy	*Ti*

The product effectiveness test was carried out by (1) assessing students' responses and (2) assessing creative self-efficacy skills. The evaluation process aims to determine the level of acceptance and impact of the developed e-module on students' learning experiences. The effectiveness test is seen from students' responses using a Likert scale score of 1 to 5, with aspects of the assessment that the researcher has modified from Branch [18], namely the feasibility of content, language, and function of the e-module. Furthermore, the percentage is calculated and converted into the parameters presented in Table 2.

Table 2. Learner Response Questionnaire Parameters

Percentage	Categories
0-39.99	Very Ineffective
40-55.99	Not Effective
60-79.99	Moderately Effective
80-100	Very Effective

Source [19]

Assessment of the effectiveness test of e-modules in terms of students' creative self-efficacy skills is also conducted to measure students' confidence and ability in creative problem-solving. This assessment uses a Likert scale score of 1 to 4, with creative self-efficacy indicators that have been modified from Safitri [20]**.** The indicators include students' belief in their ability to generate new ideas, confidence in solving problems creatively, and talent in developing ideas from others. Then, the percentage is converted into parameters, as shown in Table 3.

Table 3. Creative Self-Efficacy Skill Parameter

Percentage	Categories
< 40	Low
$40 \leq x < 80$	Medium
≥ 80	High

Source [21]

The assessment of students' improvement in CSE skills (Creative Self-Efficacy skills) is conducted using the N-Gain test, which evaluates learning gains before and after treatment. The N-Gain test uses parameters such as those presented in Table 4.

Table 4. N-gain parameter

N-gain	Categories
< 0.3	Low
0.3 – 0.7	Medium
> 0.7	High

Source [22]

Through these assessment methods, this study aims to provide empirical evidence regarding the effectiveness of the creative problem-solving-based e-module in enhancing students' creative self-efficacy.

3. RESULTS

This research and development process applies the ADDIE instructional design model, which consists of five sequential stages: Analysis, Design, Development, Implementation, and Evaluation [18]. Through the structured application of this model, a creative problem-solving-based e-module (CPS-based e-module) was developed to support the creative self-efficacy of junior high school students in learning straight-line equations.

The research and development process began with the analysis stage, which involved identifying educational needs through observations and interviews at SMP N 5 Jambi City. The school curriculum was also analyzed to ensure alignment with instructional objectives. The primary goal was to design a CPS-based e-module that enhances students' creative self-efficacy in learning straight-line equations. Furthermore, student capabilities and learning characteristics were analyzed in class VIII, focusing on their initial levels of creative self-efficacy and the resources necessary for effective implementation. After obtaining the required information, a structured development plan was formulated to guide subsequent research phases. The findings of this study align with previous research by Rahmatin et al. [23], which demonstrated that the development of mathematics learning modules using the CPS learning model significantly enhances students' creativity in problem-solving. Although Rahmatin et al. primarily focused on the "Define" stage of instructional design, their results support the effectiveness of CPS-based learning materials, reinforcing the relevance of this study.

The second stage, the design phase, involved conceptualizing and developing the CPS-based e-module to support creative self-efficacy. Researchers formed a development team during this stage, established a project timeline, and created a storyboard as a blueprint for the module's content and instructional flow. Based on this structured design, an initial prototype of the CPS-based e-module was created and subsequently tested for quality. These steps are consistent with findings from Chairani and Nurfajriani [24], highlighting the importance of rigorous design validation in educational module development. The development stage followed, during which the CPS-based e-module underwent further

refinement and enhancement. The final product was packaged in an interactive format, specifically a flipbook, to improve accessibility and engagement for students.

The third stage, the development phase, focused on validating and refining the e-module to ensure it met quality standards regarding validity, practicality, and effectiveness. According to Nieveen [25], high-quality teaching materials must fulfill these three criteria to be considered effective instructional tools. Before validating the e-module, researchers first conducted an expert review of the research instruments used in the study. A team of specialists in educational technology, instructional design, and mathematics education evaluated the module's content, structure, and usability. The validation process yielded constructive feedback, which was incorporated into the revision process to enhance the overall quality of the e-module.

After the validation and revision stages, a comprehensive trial phase was conducted at SMP N 5 Jambi City. This trial process was structured into three stages: (1) an individual trial, where a mathematics teacher evaluated the module; (2) a small-group trial involving nine students with varying academic abilities; and (3) a field trial with 30 students from class VIII B. The results of these trials provided insights into the practicality and effectiveness of the developed e-module, ensuring that it met the intended learning objectives before full-scale implementation.

The fourth stage, the implementation phase, involved integrating the CPS-based e-module into real classroom settings. In this study, the module was applied in class VIII B at SMP N 5 Jambi City over six instructional sessions. During the implementation, researchers observed classroom interactions, monitored student engagement, and collected feedback on the usability and effectiveness of the e-module. Additionally, questionnaires were administered to evaluate students' experiences and the module's impact on their creative self-efficacy. This stage was essential in determining the practical application of the e-module and its potential for wider adoption in mathematics education.

The research and development process culminated in the evaluation stage, which was integrated throughout each phase of the ADDIE model. The ongoing assessment at each stage was critical in refining the e-module to align with educational objectives. After the study, a final evaluation was conducted to analyze the overall effectiveness of the CPS-based e-module in enhancing students' creative self-efficacy. The collected data were used to assess the module's validity, practicality, and effectiveness, ensuring that it met the required educational standards and was suitable for classroom implementation.

The effectiveness of the CPS-based e-module was ultimately determined through field trials. The final trial was conducted in class VIII B with 30 students, comprising 14 female and 16 male participants. The implementation process consisted of six instructional sessions: (1) the first session was dedicated to measuring students' baseline creative self-efficacy skills before exposure to the e-module, (2) sessions four and five involved active learning using the e-module to explore straight-line equations, and (3) the final session assessed post-learning creative self-efficacy and gathered student feedback on the e-module's usability and impact.

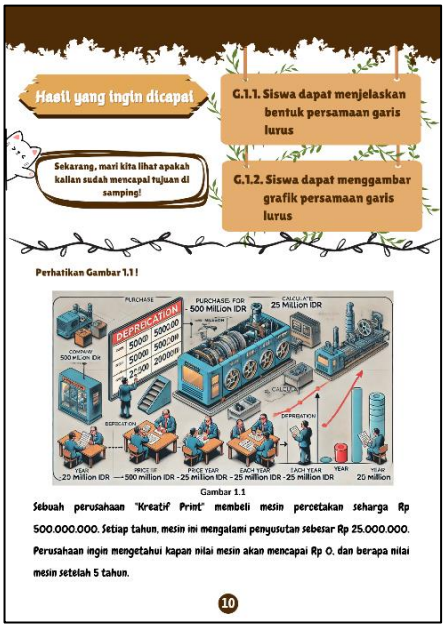

Figure 1. Learning Activity Page on E-Module

3.1 Learner Response

The results of the learner response questionnaire are seen from three indicators: the feasibility of content, language, and function of the e-module. The results of students' responses to the effectiveness of e-modules are listed in Table 5.

Table 5. E-Module Effectiveness Based on Learner Response

Indicator	%	Categories
Content Appropriateness	82,22%	Highly Effective
Language	84,66%	Highly Effective
E-Module Function	80,66%	Highly Effective
Average	81,11%	Highly Effective

Table 5 shows that the effectiveness of e-modules based on student responses has an average value of 81.11% with the criteria “Very Effective”. CPS-based e-modules are effective in learning and supporting students' creative self-efficacy.

3.2 Creative Self-Efficacy

Table 6 provides the pretest results of students' creative self-efficacy skills, showing that 21 students fall into the medium category, while 9 students are in the low category.

Table 6. Creative Self-Efficacy Skill Pretest Results

Categories	Number of Learners
High	0
Medium	21
Low	9

Table 7 presents the posttest results, indicating that 20 students reached the high category, while 10 students were in the medium category. Notably, no students remained in the low category after the intervention.

Table 7. Creative Self-Efficacy Skills Posttest Results

Categories	Number of Learners
High	20
Medium	10
Low	0

Furthermore, to evaluate the increase in creative self-efficacy skills, the N-Gain value was calculated. The results are displayed in Table 8

.

Table 8. N-Gain Value

Categories	Number of Learners
High	18
Medium	12
Low	0

Based on the N-Gain analysis, 18 students experienced a high level of improvement in their creative self-efficacy skills, while 12 students showed a medium level of improvement. The N-Gain value of 0.684 indicates the moderate effectiveness of the e-module in enhancing students' creative self-efficacy. Through these assessment methods, this study aims to provide empirical evidence regarding the effectiveness of the creative problem-solving-based e-module in enhancing students' creative self-efficacy.

4. DISCUSSION

E-modules can be effective, as seen from the results of student response questionnaires and creative self-efficacy questionnaires. Research instruments in the form of student response questionnaires are used to assess the effectiveness of creative problem-solving-based e-module products that support students' creative self-efficacy during field trials. Based on the student response questionnaire is assessed from the aspects of content feasibility, language, and function of the e-module. From the questionnaire results, it can also be seen that students mostly fill in the question points on scores 3, 4, and 5. In addition, during learning, students also seem enthusiastic and excited about learning using this e-module through group discussions and technology assistance. This e-module contains material content and is presented in steps of the CPS learning model and the integration of CSE indicators in the learning process. The students' response questionnaire results obtained a score of 82.25% with very effective criteria. This proves that the use of e-modules can be declared effective for students in supporting the learning process. Through creative problem-solving-based e-modules that support creative self-efficacy, learning is carried out that supports students in improving creative self-efficacy skills. These results align with the research by Pertiwi [26], which states that e-modules based on creative problem-solving are very effective to use, with a percentage of 86.79%.

In addition to the students' response questionnaire, the results of the creative self-efficacy questionnaire can also measure aspects of the module's effectiveness. This questionnaire was given twice during the field trial: a pretest before learning activities and a posttest after learning activities using creative problem-solving-based e-modules that support students' creative self-efficacy. Assessment indicators that are reviewed on creative self-efficacy skills are (1) Learners feel they will generate new ideas, (2) Learners feel confident in their ability to solve problems creatively, and (3) Learners are talented at developing ideas that come from others. After carrying out the pretest and posttest, the results of the initial and final test scores will be processed and compared to see the improvement in students' creative self-efficacy skills.

Based on the results of the pretest questionnaire, it can be seen from the indicators that students are not confident in conveying their ideas, are not confident in their ability to solve problems, and have not been able to develop ideas from others. Based on the overall data from the pretest results, it was found that the creative self-efficacy skills of students were still relatively low, with an average pretest score of 39.7.

After the implementation of creative problem-solving-based e-modules that support the creative self-efficacy of junior high school students on the material of straight-line equations, based on the results of the posttest questionnaire, it can be seen from the indicators that students dare to express their ideas or opinions, students are confident to solve problems creatively, and students are brave and can develop and respond to other people's ideas or opinions. This can be seen from the creative problem-solving syntax; pay attention to Figure 1.

In the first stage of the CPS model, the objective-finding step, students must determine clear, specific, and measurable learning goals. This initial phase is crucial as it allows students to develop the ability to identify well-defined objectives and fosters the capacity to generate creative and innovative ideas. The importance of this step is supported by research findings from Nieveen [25], which indicate that establishing clear goals enhances students' ability to generate novel and innovative solutions. Furthermore, this research aligns with the study conducted by Pertiwi [26], which emphasizes that strengthening CSE skills contributes significantly to students' creative thinking processes and problem-solving capabilities.

Furthermore, in fact-finding, students must collect relevant, accurate, and comprehensive information. This stage is the foundation for effective problem-solving, as students are trained to develop ideas by critically analyzing data and information. Through this process, their CSE skills improve, enabling them to tackle more complex and abstract challenges. As supported by previous research [26], engaging in creative problem-solving significantly enhances students' confidence in their ability to generate solutions independently.

In the third stage, problem-finding, students are guided to identify complex problems and understand their root causes. Students develop critical thinking skills by engaging in this process, allowing them to assess various potential issues and consider underlying factors contributing to these challenges. This step also strengthens students' ability to handle uncertainties and make informed decisions. The significance of problem-finding is

highlighted in Nieveen [25], which demonstrates that problem identification plays a crucial role in enhancing creative self-efficacy and innovative thinking.

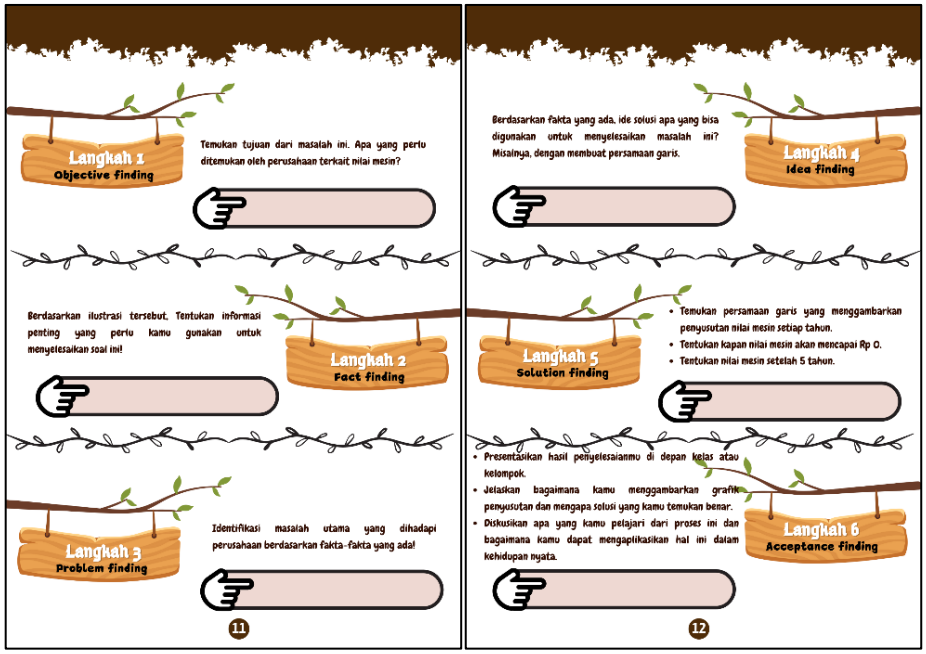

Figure 2. Learning Activity Steps with CPS Model Page

In the idea-finding step, students are directed to explore creative and innovative ideas as potential solutions. This stage encourages students to think divergently, generating unique and diverse ideas rather than settling on conventional responses. Developing such skills is essential, as students who can explore multiple solutions are more likely to become confident problem-solvers. This research aligns with Capron Puozzo and Audrin [27], which indicate that students who consider multiple possibilities and risks in problem-solving tend to have higher creative self-efficacy levels.

Following idea generation, students move to the solution-finding step, where they are directed to refine, evaluate, and select the most effective and efficient solutions. During this phase, students critically analyze their proposed ideas, ensuring their solutions are practical and applicable. This step reinforces their analytical skills and fosters resilience in overcoming complex challenges. Consistent with prior studies [27], [28], the findings suggest that participation in creative problem-solving activities significantly improves students' creative self-efficacy, particularly in their ability to assess and refine ideas systematically.

In the final stage, acceptance-finding, students must review and implement the most viable solution. This stage emphasizes decision-making and encourages students to evaluate the feasibility of their selected solution within real-world contexts. As a result, students become more adept at making strategic choices, enhancing their ability to navigate uncertain or ambiguous situations. This conclusion is supported by Bandura [29], highlighting that developing CSE skills directly influences students' capacity to generate and apply innovative ideas effectively. Based on the overall data from the pretest results, it was found that students' creative self-efficacy significantly improved, with an average posttest score of 81.1.

Based on the results of the N-Gain analysis of creative self-efficacy scores, implementing CPS-based e-modules has demonstrated a substantial positive impact on students' learning outcomes. Using e-modules based on creative problem-solving led to a measurable increase in students' creative self-efficacy, reinforcing their confidence in tackling complex problems. The calculation of the N-Gain score resulted in a value of 0.684, classifying the effectiveness as "Moderate." This finding indicates that the CPS-based e-module is a highly beneficial instructional tool, supporting students in their cognitive and creative development. In line with this result, the gain value corresponds to 68.4%, placing it within the "Quite Effective" category for improving creative self-efficacy. Therefore, this N-Gain metric confirms that the CPS-based e-module can be effectively utilized in mathematics education to foster creativity and problem-solving abilities among students. Furthermore, the findings of this study align with prior research [8], which demonstrates that applying CPS learning models in scientific subjects, such as colloidal system material, improves teacher effectiveness, student engagement, creative thinking skills, self-efficacy, and overall learning performance.

5. CONCLUSION

This study demonstrates the effectiveness of Creative Problem-Solving (CPS)-based e-modules in enhancing students' creative self-efficacy (CSE) in learning straight-line equations. The results from student response questionnaires indicate a high level of acceptance, with an effectiveness rating of 82.25% in the "Highly Effective" category. Additionally, the N-Gain analysis yielded a score of 0.684, indicating a "Moderate" level of effectiveness in improving students' CSE.

These findings suggest that CPS-based e-modules can be a valuable instructional tool in mathematics education, promoting students' confidence in generating creative ideas and solving problems innovatively. By integrating structured problem-solving approaches with interactive learning materials, the e-module facilitates an engaging and supportive learning environment.

Future research should explore the long-term impact of CPS-based e-modules across different mathematical topics and student demographics. Further comparative studies with conventional learning methods and control groups will provide deeper insights into the effectiveness and scalability of CPS-based e-modules in various educational contexts.

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