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Complex Problem-Solving Assessment: Key Benefits for Education System

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Abstract

Complex Problem Solving (CPS) skills are essential in the 21st century, as they encompass critical thinking, creativity, and decision-making capabilities. In the context of education in Malaysia, there is a growing need to develop and assess competencies in CPS among students, as these skills are highly valued by employers and are essential for facing complex and dynamic challenges in various fields. However, researchers have not treated CPS in much detail especially in strategy-based framework context. This study discusses the potential of CPS instrument within the educational system, based on the SCORE model—a strategy-based framework. The methodology used for this concept paper is the general analysis of CPS using SCORE model that measured among five elements such as Strengths (S), Challenges (C), Options (O), Responses (R) and Effectiveness (E). By using CPS instruments validated through psychometric methods, this model helps in creating a comprehensive assessment strategy to measure higher-order thinking skills and adaptability in students. The findings of this study highlight the potential and importance of developing reliable and culturally relevant CPS instruments tailored to the Malaysian educational context. The implications of this research are significant for educational policymakers, institutions, and stakeholders, as it provides a strategic holistic framework for improving problem-solving competencies. Future studies are recommended to explore the application of CPS instruments across various domains such as business, crisis management, and leadership, especially in evaluating their effectiveness in different cultural and settings.

Keywords: Complex Problem Solving, CPS, SCORE Model, Instrumentation, 21st Century Skills.

Introduction

Complex problem solving (CPS) is a critical skill required by workers in the 21st century to face challenges in the workplace (Alrababah et al., 2024). Prospective employees, particularly students in educational institutions, who lack complex problem-solving skills will inevitably struggle to adapt to the challenges of addressing complex problems (Ong et al., 2022). To

explain CPS, it can be classified as a topic within the fields of cognitive psychology, focusing on how humans solve complex and dynamic problems (Batchelder & Alexander, 2012). In the context of global education, CPS has gained increasing attention as it is considered crucial in addressing the challenges of the 21st century. The Programme for International Student Assessment (PISA), conducted by the OECD, has emphasized the importance of CPS by evaluating students' abilities in reading, mathematics, scientific knowledge, and skills in solving complex, unstructured problems encountered in real-life situations. Complex problems involve multiple interrelated variables, are dynamic in nature, and require deep thinking, adaptation, and consideration of various factors.

To understand what is meant by complex problems, it is important to first understand their characteristics. The first characteristic is multidimensionality, meaning it involves many interacting variables. Each element in the problem system may influence one another, making the entire system difficult to comprehend at a glance. For example, in organizational or corporate management, there are numerous variables such as employee productivity, customer satisfaction, operational costs, and profits, which interact with each other. It is easy to understand that every decision made will impact other aspects in unpredictable ways. Another characteristic of complex problems is their dynamic nature, meaning they change or evolve over time. This implies that a solution effective at one point may no longer be relevant later (Kipman et al., 2022).

Uncertainty of information is another key characteristic of complex problems. Not all the information required for decision-making is usually available immediately, forcing individuals to make decisions based on limited or speculative data. In such situations, problem-solving requires not only logical reasoning but also the ability to think critically and adapt to the circumstances. For example, during the Covid-19 pandemic, world leaders were unsure of the evolving situation and the availability of clear information. Decisions had to be made despite the prevailing uncertainties, and the full impact of these decisions could not be fully determined until time passed.

Additionally, complex problems are often unstructured, meaning there are no clear procedures or steps to follow in order to reach a solution. Individuals must find their own way to overcome obstacles and achieve goals. A real-life example of complex problems includes business challenges that involve long-term strategies and high-risk decision-making (Kunze et al., 2018). Complex problem solving involves several key components that help individuals navigate the complexities of the situations they face. Each of these components plays a critical role in the problem-solving process, providing guidance and structure for addressing the various challenging aspects. In studies on complex problem solving, several main components have been identified as key factors in understanding and overcoming such problems.

Addressing complex problems requires essential components to assist individuals in tackling these situations effectively. First, the availability of information is crucial, as sufficient information enables more accurate decision-making. Second, clear goals must be established, whether there are one or multiple conflicting goals. Third, the complexity of the situation is determined by the number of variables involved, where the more variables, the more challenging the problem becomes.

Furthermore, the interconnectedness of variables is critical, as changes in one element can affect many others. The dynamic aspect of the system indicates that problems often change over time, requiring problem-solvers to act swiftly and adapt. Additionally, the ability to control the system is important in identifying which elements can be influenced. Finally, cognitive load must be managed well, as the complexity of the problem can be mentally exhausting.

Overall, these components contribute to a deeper understanding of how complex problems can be solved. An organized and systematic approach that considers each of these factors is key to success in addressing layered and challenging problems. The ability to manage and solve complex problems is crucial in various fields such as business, public policy, and crisis management. Understanding and mastering CPS can help individuals and organizations navigate larger challenges more strategically and effectively (Funke, 2012).

However, the SCORE model has the advantage of a more positive and action-oriented approach compared to SWOT. Due to its relative lack of popularity in comparison to other problem-solving methods, the possible benefits of CPS is rarely discussed in Malaysia. Planning will become more methodical and deliberate if the potential of CPS in kids is positively explored using an action-oriented approach. The SCORE Model is one of the often-utilized strategic planning tools. SWOT, TOWS, NOISE, SOAR, and numerous additional tools are available as alternatives to the SCORE model (Neal, 2023). However, compared to SWOT, SCORE has an edge due to its more optimistic and proactive approach.

The motivation for addressing CPS through the SCORE model arises from the need to equip students with critical thinking, creativity, and strategic problem-solving skills essential for tackling 21st-century challenges. This model serves as a structured and practical framework for assessing and enhancing students' problem-solving abilities, particularly within educational systems designed to produce a highly skilled and competitive workforce.

Moreover, the findings of this study contribute to the advancement of an effective education system by offering a systematic approach to assessing students' competencies in addressing complex problems. This includes essential skills such as adaptability, creativity, and strategic thinking, which are crucial for preparing students to enter a modern workforce that operates in dynamic global and economic environments. This research aims to provide readers with insights into how frameworks like the SCORE model can support the development of students capable of meeting the demands of future industries and employment markets.

Thus, the objective of this concept paper is to introduce and elaborate on the strategy-based assessment of complex problem-solving using the SCORE model. The study focuses on how this model can empower educational systems to produce students with strong problem-solving capabilities, ultimately contributing to the creation of a highly skilled workforce aligned with the needs of the 21st century.

The rationale for presenting this research through the SCORE model is to demonstrate its effectiveness as a proactive, measurable, and contextually relevant framework for assessing CPS. This approach emphasizes the importance of aligning educational outcomes with

industry demands, ensuring students not only excel academically but also acquire competencies that meet global workforce requirements.

The integration of the SCORE model with CPS is illustrated through its ability to enhance the effectiveness of education systems by helping students master problem-solving skills in real-world contexts. Through its application, this concept paper seeks to engage readers with innovative methodologies that strengthen the link between education, students, and the evolving needs of the 21st-century workforce. It highlights the vital role of education in producing a workforce equipped to navigate complex challenges and dynamic global transformations.

SCORE Model-Strategy Based Assessment

The SCORE Analysis Model emerges as a vital framework for evaluating and developing strategy-based assessment tools, particularly in the domain of (CPS) within educational contexts. This model delineates five critical dimensions: Strengths, Challenges, Options, Responses, and Efficiency. By systematically exploring these dimensions, the SCORE Model ensures that assessment tools are not only effective and reliable but also aligned with contemporary educational objectives (Neal, 2023).

Strengths

At its core, the Strengths of a strategy-based assessment tool lie in its ability to measure higher-order thinking skills essential for navigating the complexities of the modern world. These skills include critical thinking, creativity, and problem-solving, which are increasingly recognized as fundamental competencies in educational frameworks. The SCORE Model facilitates a departure from traditional rote memorization, advocating for an emphasis on the application of knowledge to real-world scenarios. This aligns with progressive educational philosophies that promote active learning and the cultivation of transferable skills, ultimately preparing students to adapt to diverse challenges in their future careers. Furthermore, the adaptability of these assessment tools allows for personalized evaluations that cater to individual student capabilities, generating rich data on student performance and enabling targeted instructional interventions (Mudhol, 2024). Strengths for this paper will discussed on how the research on Complex Problem Solving (CPS) in Malaysia contributes to the development of 21st-century skills such as critical thinking, creativity, and decision-making, emphasizing the need for CPS instruments that not only measure problem-solving abilities but also encourage students to adopt the mindset required to tackle global challenges.

Challenges

However, the journey towards implementing effective strategy-based assessment tools is fraught with Challenges. One significant obstacle is the substantial time and resources required to design valid and reliable assessment tasks that accurately capture the nuances of CPS skills. Educators may require extensive professional development to adequately interpret and utilize these assessments, adding to their existing workloads and potentially leading to resistance from those accustomed to traditional evaluation methods (Kılıç, 2017). Financial constraints often hinder the integration of technology, particularly in underfunded educational environments, complicating efforts to provide equitable access to these innovative assessment methods (Bishop et al., 2020). Challenges for this paper will be discussed in the context of the evolving demands of the 21st century, driven by technological

advancements and the Fourth Industrial Revolution, which underscore the importance of bridging the gap between educational outcomes and industry needs.

Options

Despite these challenges, the landscape is rich with Opportunities for leveraging strategy-based assessments. The increasing global emphasis on 21st-century skills has created a strong demand for assessment tools that measure competencies such as collaboration, innovation, and critical thinking. Additionally, advancements in technology, including artificial intelligence and adaptive learning platforms, offer the potential for dynamic, real-time feedback mechanisms that enhance the learning experience for both students and educators. Collaborations across sectors can further enrich the development of these tools, ensuring alignment between educational outcomes and the evolving demands of the workforce (Ültay et al. 2021). Opportunities here on this paper will be discussed with a focus on strategies for integrating these advancements into the development of complex problem-solving (CPS) instruments in Malaysia, ensuring that educational tools align with global standards and prepare students effectively for the demands of the 21st-century workforce.

Responses

Moreover, understanding the Responses from various stakeholders—students, educators, parents, and industry representatives—is crucial for the successful implementation of strategy-based assessments. Students may exhibit enthusiasm for engaging with practical projects that enhance their interest in the subject matter; however, some may feel anxious about new assessment methods. Teachers may welcome professional development opportunities that equip them with the skills necessary to teach CPS effectively, while also expressing concerns about increased workloads. Parents often support initiatives that promote critical thinking, but they may have questions about how these new assessment methods will affect their children's education (İzoğlu-Tok, 2024). Industry representatives may show interest in collaboration with educational institutions to ensure alignment between educational content and workforce needs. Engaging these diverse responses will be critical to fostering acceptance and successful integration of new assessment practices (Sadovska et al., 2024). Responses for this paper will be discussed in terms of how various stakeholders' perspectives—ranging from the enthusiasm and concerns of students to the practical and strategic insights of educators, parents, industry representatives, and policymakers—impact the development and integration of complex problem-solving (CPS) instruments in education.

Efficiency

Efficiency stands as a critical consideration for the successful adoption and sustained use of strategy-based assessment tools. Achieving efficiency requires a careful balance between providing comprehensive feedback and maintaining practicality in implementation. The integration of automation can significantly streamline grading processes and deliver immediate, actionable insights to educators and learners alike. Developing user-friendly platforms that facilitate seamless data collection and analysis is essential, yet it is equally important that these tools remain adaptable and scalable across diverse educational environments to uphold assessment quality. Efficiency on this paper will cater to ensuring that the initiative for developing complex problem-solving (CPS) instruments is structured strategically, incorporating clear goal-setting, active stakeholder engagement, pilot testing,

ongoing teacher support, and continuous data-driven refinements to optimize practical implementation and relevance to workforce needs.

In conclusion, the SCORE Analysis Model presents a comprehensive and balanced framework for evaluating the feasibility and impact of strategy-based assessment tools in the context of CPS. By rigorously examining strengths, addressing challenges, capitalizing on opportunities, mitigating risks, and enhancing efficiency, educational institutions can foster robust and sustainable assessment practices. This structured approach ensures that assessments remain relevant, reliable, and responsive to the evolving demands of both educational systems and industry expectations, ultimately equipping students with the necessary skills to thrive in an increasingly complex world. One of the most significant current discussions on the CPS to SCORE model is how to effectively integrate real-world problem-solving scenarios into assessments while balancing educational outcomes with practical workforce skills.

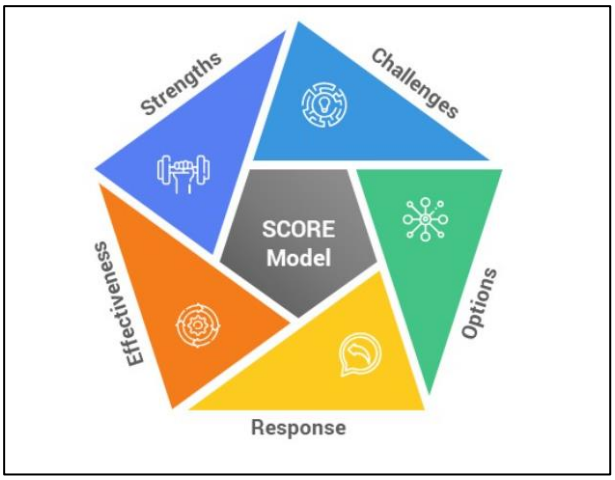

Figure 1: SCORE Analysis Model

The Stregnth of CPS

CPS is considered a core skill for the 21st century as it involves critical thinking, creativity, and the ability to work in unstructured, complex situations. Global research on CPS focuses on honing these skills among students, as employers worldwide highly value the ability to solve complex problems (Guo et al., 2023). The strength research on CPS in Malaysia helps to develop 21st-century skills such as critical thinking, creativity, and decision-making. The highly needs of instruments CPS is not only measure problem-solving abilities but also encourage students to adapt the necessary mindset to tackle global challenges.

The strength of CPS instrument in Malaysia is widely applied across diverse fields, including science, mathematics, technology, engineering, business, and management. It allows for assessing students' problem-solving abilities in multiple contexts. For example, in science and mathematics, CPS helps evaluate how students tackle complex experimental problems or equations with multiple variables. In technology and engineering, the instrument assesses how students manage dynamic technical problems, such as system design or process optimization. In business and management, CPS is used to test students' strategic decision-making skills in uncertain scenarios, reflecting real-world challenges. This broad application ensures that the CPS instrument helps students develop transferable skills relevant to various disciplines and professional fields. It prepares students to face real-world problems that

require critical, creative, and innovative thinking (Mohamad et al., 2023). By bridging theory with practice, CPS enhances students' readiness for complex challenges, making it a flexible and valuable tool in modern education.

One of the key strengths of the CPS instrument in Malaysia is its ability to be adapted to the local cultural and educational context. This is crucial because Malaysian students have diverse backgrounds in terms of language, culture, and learning systems. These adaptations ensure that the CPS instrument is more relevant and effective in assessing complex problem-solving skills among local students. By considering the unique needs and challenges faced by Malaysian students, the instrument provides a more accurate and realistic measure of their ability to solve dynamic and multifaceted problems (Yusop et al., 2024). For example, the CPS instrument used in Malaysia is modified not only in terms of language but also in question design, scenario content, and problem-solving approaches. The scenarios and situations included in the instrument often reflect everyday life or issues commonly encountered within the Malaysian context, such as economic, social, or environmental challenges specific to the country. This helps students better understand and relate to the problems presented, thus enhancing their ability to apply their knowledge in solving real-world issues. These adaptations also encourage students to think critically and contextually, which is an essential requirement for developing 21st-century skills in Malaysia.

A significant strength of CPS research lies in the continuous development and refinement of instruments and methodologies designed to accurately measure and assess CPS skills. Globally, researchers and educators are making substantial efforts to establish robust and comprehensive assessment frameworks that provide a detailed evaluation of students' abilities in CPS. These frameworks are not just tools for measurement but are also carefully designed to reflect the complexities of real-world problem-solving situations, ensuring that assessments are aligned with the kinds of multifaceted, dynamic challenges that students are likely to encounter in both academic and professional environments (Azmin et al., 2023).
The validity and reliability of these CPS instruments are of paramount importance. This is achieved through rigorous psychometric validation processes, where various statistical techniques are employed to test the exaggerate of instruments. For instance, factor analysis is used to determine whether the test items accurately represent the underlying constructs of CPS, ensuring that the instrument measures different dimensions of problem-solving, such as knowledge acquisition and knowledge application. Additionally, correlation analysis is applied to verify the consistency of results across different populations, thereby ensuring that the instrument can reliably measure CPS across diverse groups of students.

Moreover, the development of these instruments involves iterative cycles of refinement. Researchers must engage in continuous testing, piloting, and recalibration of assessment tools to ensure that they not only capture the nuances of problem-solving behaviors but also adapt to cultural and contextual variations in how students approach problems. This level of rigor ensures that CPS instruments are scalable and can be applied in various educational contexts globally, while still maintaining high standards of psychometric integrity (Azmin et al., 2023).

The use of longitudinal studies and multidimensional assessments further enhances the robustness of CPS instruments. Longitudinal research allows scholars to track the

development of CPS skills over time, providing insights into how students' problem-solving abilities evolve with different educational interventions (Greiff et al., 2015). This is complemented by multidimensional assessments that capture both cognitive and behavioral aspects of problem-solving, offering a more holistic view of students' CPS capabilities. Ultimately, the strength of CPS research lies in its ability to not only measure current abilities but also to provide a foundation for educational innovation. The insights gained from these assessments can guide curriculum development, inform teaching strategies, and shape educational policies aimed at enhancing problem-solving skills, making CPS instruments a powerful tool in shaping future educational practices.

Challenges on CPS

In the 21st century and in the context of research, CPS has become increasingly important due to the rapidly changing job landscape driven by the Fourth Industrial Revolution and technological advancements such as artificial intelligence (AI), big data, and automation. According to the Future of Jobs Report in 2023 by the World Economic Forum, skills like analytical and creative thinking, including CPS, are now top priorities for employers. One major issue identified is the gap between the problem-solving abilities of students or workers and the demands of industries. Workers lacking these skills often struggle to adapt to the dynamic and complex challenges posed by new technologies and fast-paced changes in the workplace (World Economic Forum, 2023). Additionally, research highlights the need for enhanced education and training efforts to build stronger CPS capabilities that align with future job requirements. At the educational level, curricula and teaching strategies frequently fail to focus adequately on the mastery of CPS, leaving students underprepared for real-world challenges.

In the context of Malaysia, several key challenge gaps exist in the assessment of CPS, which present significant challenges to the educational landscape. One of the main issues is the lack of standardized tools to effectively measure CPS among students across different levels of education. Currently, assessments are largely dependent on knowledge-based exams that emphasize rote learning, making it difficult to evaluate students’ abilities to handle unstructured and complex problems. This is further compounded by an overemphasis on knowledge-oriented examinations, which focus heavily on memorization and factual recall, rather than critical and creative thinking. Consequently, this fails to measure students' true problem-solving abilities in real-world scenarios (Loh et al., 2017).

Additionally, the absence of a holistic assessment approach exacerbates the issue, as current evaluations do not comprehensively cover various aspects of CPS, such as logical reasoning, adaptability, creativity, and the ability to work under pressure. This limits the extent to which students are assessed in different contexts, which are crucial for solving complex, real-life problems. Another critical gap lies in the misalignment between formal assessments and industry needs. While industries require workers, who can swiftly adapt to changes and tackle dynamic problems, educational assessments in Malaysia do not adequately reflect these needs, leaving students underprepared for the workforce (Loh et al., 2017).

Furthermore, challenges in implementing alternative assessments also hinder progress. Despite the recognition of the importance of more comprehensive and innovative CPS assessments, schools face significant barriers such as a lack of training and resources among

teachers and administrators. The high workload and limited time further restrict the adoption of such assessments. These gaps highlight the need for reform in the assessment of CPS in Malaysia to better equip students with the critical skills required for the 21st-century workforce (Herde, Wüstenberg, & Greiff, 2016). In addressing the challenges of CPS in the 21st century, education in Malaysia must adapt a scientific and critical approach, in line with the National Philosophy of Education. One of the primary challenges faced is the lack of emphasis on critical and creative thinking skills in the existing curriculum, which leads to students struggling to evaluate and analyze problems from multiple perspectives. To overcome this challenge, capabilities such as critical thinking need to be developed, where students should be trained to make decisions based on evidence and connect various elements in complex situations (Ab.Wahid, 2022).

Additionally, education should emphasize creativity and innovation, as these abilities are essential for generating new solutions to unconventional problems. In this context, students need to be exposed to real-world situations that require out-of-the-box thinking. Furthermore, adaptability becomes increasingly important, especially in a rapidly changing world where students must be able to adjust to unforeseen changes and respond quickly (Yuan et al., 2024).

Moreover, effective communication skills and teamwork are crucial aspects that need attention, as complex problem-solving often requires collaboration among various parties. Time management and prioritization are also vital in ensuring that the problem-solving process can be carried out efficiently without compromising the quality of the outcomes. Lastly, leadership and social influence should be highlighted, where students must be trained to lead and inspire their peers in problem-solving efforts (Yuan et al., 2024). By developing these capabilities, education in Malaysia can produce individuals who are not only capable of overcoming CPS challenges but also act as agents of change in the industry. This aligns with the goals of the National Philosophy of Education to cultivate human capital that is balanced in intellectual, emotional, and social aspects, thus contributing to the development of a competitive nation on the global stage.

Options on CPS

In the context of research on the development of CPS instruments in Malaysia, there are various options and opportunities that can be explored to enhance students' capabilities in facing the challenges of the 21st century. One primary option is the integration of project-based learning into the curriculum, which aligns with the constructivist approach in education. This approach allows students to engage in real-world projects where they can apply CPS skills and learn through practical experience. Not only does this strengthen collaboration between students and industry, but it also ensures that the developed instruments are relevant to market needs.

Additionally, utilizing technology in CPS assessment opens opportunities to enhance interactivity and flexibility in the learning process. By leveraging online platforms to deliver tests or simulations of complex situations, students can refine their critical and creative thinking skills. This aligns with active learning theory, which emphasizes the role of students in the learning process. Collaboration between higher education institutions and industry is also a strategic step that can strengthen the development of CPS instruments. Through this

partnership, precise assessment criteria can be formulated, ensuring that the developed instruments are not only effective but also meet the actual needs of the industry. Furthermore, the opportunity to develop learning and training resources for educators is crucial, as this empowers them to teach CPS skills more effectively, in line with the principles of continuous education that emphasize professional development among educators(AlAli, 2024).

Researching best practices in the development of CPS instruments in other countries can also provide valuable guidance. By adapting proven assessment models to the Malaysian context, we can avoid common pitfalls and accelerate the innovation process. Involving students in the instrument development process is essential, as it ensures that the instruments are relevant and meet their needs, referring to the student-centered learning theory that emphasizes student voice and engagement in education.

Additionally, research conducted in different cultural and social contexts provides valuable perspectives on how diverse student populations tackle complex problems. By learning from how students in other countries approach CPS, Malaysian researchers can gain insights to tailor their instruments to better fit local needs and challenges. Furthermore, international research often offers training and guidance for educators on teaching CPS skills. Through the sharing of best practices and the latest findings, Malaysian educators can enhance their instructional methods, ultimately improving students' capabilities in complex problem-solving.

Moreover, many foreign studies adopt multidisciplinary approaches in the development of CPS instruments, incorporating aspects of psychology, education, and technology. This multidisciplinary perspective can inspire Malaysian researchers to fuse various disciplines into their instrument development processes, resulting in more holistic and effective tools. Finally, international research frequently produces resources and tools for measuring CPS, such as rubrics, assessment guidelines, and other measurement instruments. The development and adaptation of these resources can save time and effort in creating new instruments in Malaysia (Patah et al., 2023).

Finally, developing clear and detailed assessment criteria for CPS will provide consistent guidance to educators and program managers. With this approach, research on the development of CPS instruments in Malaysia can not only produce more competitive students but also contribute to strengthening problem-solving skills among students, in line with the National Philosophy of Education's goal of producing balanced human capital in intellectual, emotional, and social dimensions.

Responses

When developing instruments for CPS in education, it is essential to anticipate a range of responses from various stakeholders, including students, teachers, parents, industry representatives, and educational authorities. Students may express enthusiasm for engaging with practical, real-world projects that enhance their interest in the subject matter; however, some may also feel anxious about new assessment methods, especially if they are accustomed to traditional forms of testing. This may lead them to seek clarity on evaluation criteria and request additional resources or support, such as workshops, to develop the

necessary skills for effective problem-solving. Teachers are likely to welcome professional development opportunities that equip them with the skills to teach CPS effectively, providing valuable insights into how the new instruments align with existing curricula. However, they may also voice concerns about the increased workload associated with developing and accessing these new methods, particularly if they feel unprepared or unsupported.

Parents generally express support for initiatives that promote critical thinking and problem-solving skills, recognizing their importance for their children's future success. Yet, they may have questions regarding the implementation of CPS assessment methods and how these changes will affect their children's overall education. Additionally, some parents might express concerns about equitable access to the necessary resources and support for all students. Industry representatives often show interest in collaborating with educational institutions to ensure that the skills being taught align with workforce needs, offering partnerships for internships or real-world projects. They may provide feedback on the relevance of specific problem-solving skills and raise concerns about whether students are adequately prepared for the complexities of modern work environments (Santana et al., 2024).

Furthermore, educational authorities and policymakers tend to support innovative approaches to assessment and curriculum development that align with national education goals. They emphasize the need for effective monitoring and evaluation frameworks to assess the impact of CPS instruments on student learning outcomes while discussing the importance of resource allocation to support teacher training and the development of necessary materials. Finally, community organizations and NGOs often advocate for inclusive practices, ensuring all students have access to quality CPS education. They may also offer resources or programs that support educators in promoting critical thinking skills within their communities. By understanding and addressing the concerns and needs of these diverse stakeholders, educational leaders can create a more collaborative and effective approach to implementing CPS instruments, ultimately enhancing students' problem-solving capabilities and preparing them for future challenges (Akanbi et al., 2024).

The development of CPS instruments in education presents both opportunities and risks that carry significant business value. On the opportunity side, engaging students through real-world, practical learning can boost academic performance and motivation (Sonnleitneret al., 2017) . Institutions that foster such engagement stand to benefit from higher student success rates, which can, in turn, attract more students, thereby increasing enrolment and revenue. Furthermore, investing in the professional development of teachers to enhance their ability to teach CPS not only improves the quality of education but also bolsters the institution's reputation for academic excellence (Siklander et al., 2023). This can result in better staff retention and increased attractiveness to potential students and partners. Collaboration with industry is another opportunity that offers immense business value, as it aligns educational content with the needs of the job market. Such partnerships can lead to sponsorships, internships, and better job placement for graduates, strengthening the institution's appeal and opening up new revenue streams (Siklander et al., 2023). Additionally, research into CPS and the adaptation of global best practices can position the institution as a leader in educational innovation, increasing its global recognition and competitiveness. The use of technology in CPS assessments further enhances flexibility in educational delivery, allowing

institutions to tap into new markets, such as remote learners, while reducing operational costs (Fonseca et al., 2019).

However, these opportunities come with associated risks. Resistance from students and parents, particularly toward unfamiliar assessment methods, could result in lower satisfaction and retention rates, negatively impacting the institution's reputation and enrolment. Teachers may also face increased workloads due to the demands of implementing CPS, leading to burnout and reduced teaching quality, which in turn could harm institutional performance. Additionally, the issue of unequal access to resources poses a significant risk, as students from disadvantaged backgrounds may struggle to benefit from CPS initiatives, potentially resulting in academic disparities and reputational damage. A mismatch between CPS instruments and industry expectations could undermine the institution's efforts to prepare students for the workforce, weakening partnerships and employment outcomes for graduates. Moreover, the high initial investment required for developing and implementing CPS instruments poses a financial risk, especially if the return on investment is delayed or insufficient (Siklander et al., 2023). Finally, without effective monitoring and evaluation frameworks, the institution risks deploying ineffective programs that do not achieve educational objectives, wasting resources and damaging credibility (Sonnleitner et al., 2017).

In conclusion, the business value of developing CPS instruments in education lies in enhancing the quality of learning, increasing institutional competitiveness, and fostering valuable industry partnerships. These opportunities can drive higher enrolment and improve graduate outcomes. However, the risks must be carefully managed to prevent financial inefficiencies, reputational damage, and inequitable access to resources. A balanced approach that incorporates stakeholder needs, financial sustainability, and effective monitoring is essential for the successful implementation of CPS instruments in educational institutions.

Effectiveness

To ensure that the initiative for developing CPS instruments works efficiently and reliably, a structured and strategic approach must be adopted. First, it is critical to define a clear vision and specific goals that align with educational objectives. Setting SMART (Specific, Measurable, Attainable, Relevant, Time-bound) goals ensures clarity and direction throughout the project, which will help align the efforts of all stakeholders (Widaningrum et al., 2023). Stakeholder engagement is another crucial component. Involving students, teachers, industry partners, and policymakers early in the process fosters collaboration and ensures buy-in, which is essential for overcoming potential challenges. Collaboration with industry also helps ensure that the CPS instruments remain relevant to workforce needs (Siklander et al., 2023).

Moreover, pilot testing is necessary to identify potential issues and refine the instruments before full-scale implementation. This iterative process helps in gathering real-world feedback and making improvements. Teachers play a pivotal role in implementing CPS, so providing ongoing professional development through workshops, online courses, and peer learning communities is essential. Educators need both the theoretical understanding of CPS and practical skills to assess problem-solving effectively. Allocating sufficient resources, such as financial, technological, and human support, is key to maintaining the efficiency of the

initiative. Establishing a support system for teachers can also help to troubleshoot issues and ensure a smooth implementation process (Zhang et al., 2023).

Further, data-driven decision-making ensures that the initiative remains on track and effective. By collecting and analyzing data on student performance and teacher feedback, the development process can be continuously refined for better results. Scalability and flexibility should also be considered during the design phase, allowing the initiative to expand to different educational settings without significant loss in quality. Flexibility will enable the CPS instruments to be adapted to various contexts, including different educational levels and cultural backgrounds. Clear communication and feedback loops should be established to ensure that stakeholders stay informed about the progress and that any concerns are addressed promptly (Aburizaizah, 2021).

Finally, the initiative should include a robust monitoring and evaluation framework to regularly assess the impact on student learning outcomes. Technology can play a key role in improving efficiency, with digital platforms facilitating CPS assessments, providing real-time feedback, and aiding teachers in managing the evaluation process. With these strategic measures in place, the CPS initiative will have a stronger foundation for success, ensuring that it operates efficiently and delivers reliable outcomes that prepare students for complex challenges in the modern world.

Summary

Overall, these results indicate the application of the SCORE model in assessing and addressing complex problem solving through CPS instruments in Malaysia. The model's strategic and action-oriented approach offers a clear advantage in addressing complex, changing, and unpredictable problems. Due to practical constraints, this paper cannot provide a comprehensive review of SCORE. This study only discusses the application of the SCORE model within the context of complex problem solving, while also integrating CPS instruments and methods, such as assessments, self-evaluations, and peer reviews, in Malaysia to measure and enhance students' competencies in solving complex problems. This study highlights key components such as interconnected variables, availability of information, goal clarity, critical and analytical thinking, adaptability, collaboration, emotional management, creativity, and context awareness.

This finding has important implications for educational institutions, organizations, and policymakers in developing CPS instruments that are more structured and strategically aligned with Malaysia's educational context. Ultimately, this alignment aims to exaggerate problem-solving capabilities. Besides that, this finding could help in improving decision-making processes across various fields by enhancing complex problem solving, providing a more structured and strategic approach to identifying key variables, clarifying goals, and making more informed decisions. By understanding the components of complex problem solving through the SCORE model and CPS instruments, we can properly identify critical factors influencing successful problem-solving, allowing us to address underlying issues more effectively and align strategies accordingly.

Future studies on the current topic are therefore recommended. Further study could extend to exploring the application of CPS instruments across various other fields, such as crisis

management or organizational leadership, as well as examining how they exaggerate problem-solving potential within different cultural and contextual settings in Malaysia. Applying CPS instruments across different domains is valuable as it highlights their versatility in addressing complex problems, providing insight into their generalizability and how they can exaggerate problem-solving capabilities in diverse settings. Figure 2 provides a concise summary of how SCORE Analysis Model applies specifically to the development of CPS assessment: key benefits for Malaysia education system in this concept paper.

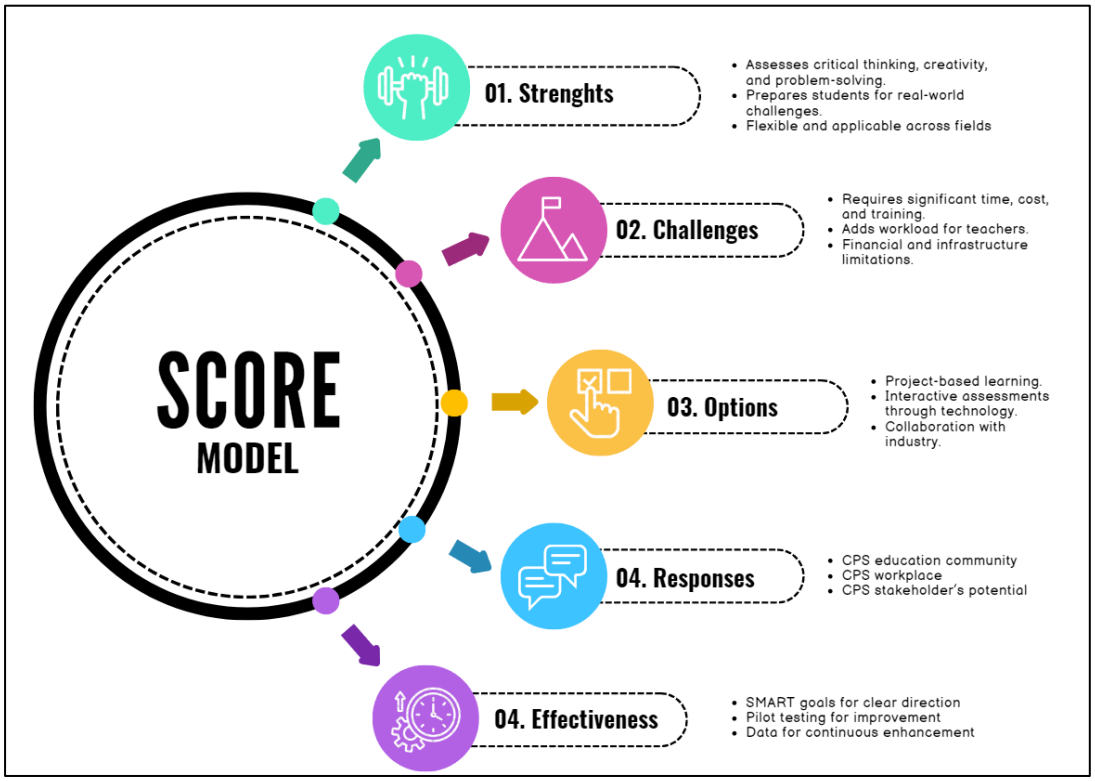

Figure 2: SCORE Analysis Model for Complex Problem-Solving assessment

References

Ab.Wahid, N. T. (2022). Developing Critical Thinking Skills in Secondary School Students: The Potential for Strategic Management through Problem-Posing Instructional Strategy. International Journal of Academic Research in Progressive Education and Development, 11(3), 1327–1335. https://doi.org/10.6007/ijarped/v11-i3/15505

Aburizaizah, S. J. (2021). Data-Informed Educational Decision Making to Improve Teaching and Learning Outcomes of EFL. Journal of Education and Learning, 10(5), 17–29. https://doi.org/10.5539/jel.v10n5p17

Akanbi, G., & Adesina, A. E. (2024, February 5). Fostering Sustainable Development Goal-4 Through Culturo-Techno-Contextual-Approach in Innovative Steam Education: A Policy Assessment. https://doi.org/10.32388/OC6BA0

AlAli, R. (2024). Enhancing 21St Century Skills Through Integrated Stem Education Using Project-Oriented Problem-Based Learning. Geojournal of Tourism and Geosites , 53(2), 421–430. https://doi.org/10.30892/gtg.53205-1217

Alrababah, S. A., Wu, H., & Molnár, G. (2024). A Pilot Study for Measuring Complex Problem-Solving in Jordan: Feasibility, Construct Validity, and Behavior Pattern Analyses. SAGE Open, 14(2). https://doi.org/10.1177/21582440241249884

Azmin, N. F. M., Mat Isa, C. M., Lee, W. K., Ibrahim, S. N., & Lian, O. C. (2023). Implementation of Complex Engineering Problem Solving (CEP) and Complex Engineering Activities (CEA) in Malaysian Engineering Curriculum: A Pilot Study. 2023 International Conference on University Teaching and Learning, InCULT 2023, 1–6. https://doi.org/10.1109/InCULT59088.2023.10482478

Batchelder, W. H., & Alexander, G. E. (2012). Insight Problem Solving: A Critical Examination of the Possibility of Formal Theory. The Journal of Problem Solving, 5(1), 56–100. https://doi.org/10.7771/1932-6246.1143

Bishop, M. J., Boling, E., Elen, J., & Svihla, V. (2020). Handbook of Research in Educational Communications and Technology: Learning Design: Fifth Edition. Handbook of Research in Educational Communications and Technology: Learning Design: Fifth Edition, (September 2020), 1–897. https://doi.org/10.1007/978-3-030-36119-8

Fonseca, D., & García-Peñalvo, F. J. (2019). Interactive and collaborative technological ecosystems for improving academic motivation and engagement. Universal Access in the Information Society, 18(3), 423–430. https://doi.org/10.1007/s10209-019-00669-8

Greiff, S., Wüstenberg, S., Goetz, T., Vainikainen, M. P., Hautamäki, J., & Bornstein, M. H. (2015). A longitudinal study of higher-order thinking skills: working memory and fluid reasoning in childhood enhance complex problem solving in adolescence. Frontiers in Psychology, 6(July), 1–9. https://doi.org/10.3389/fpsyg.2015.01060

Guo, J. W., She, H. C., Chen, M. J., & Tsai, P. Y. (2023). Can CPS better prepare 8th graders for problem-solving in electromagnetism and bridging the gap between high- and low-achievers than IPS? International Journal of Computer-Supported Collaborative Learning, 18(4), 489–512. https://doi.org/10.1007/s11412-023-09407-y

Herde, C. N., Wüstenberg, S., & Greiff, S. (2016). Assessment of Complex Problem Solving: What We Know and What We Don't Know. Applied Measurement in Education, 29(4), 265–277. https://doi.org/10.1080/08957347.2016.1209208

İzoğlu-Tok, A., & Doğan, Ö. (2024). Preliminary developmental challenges of children at risk for specific learning disabilities: Insights from parents and teachers—a qualitative study. Current Psychology, 43(31), 25551–25567. https://doi.org/10.1007/s12144-024-06231-x

Kipman, U., Bartholdy, S., Weiss, M., Aichhorn, W., & Schiepek, G. (2022). Personality traits and complex problem solving: Personality disorders and their effects on complex problem-solving ability. Frontiers in Psychology, 13(August), 1–10. https://doi.org/10.3389/fpsyg.2022.788402

Kılıç, Ç. (2017). A new problem-posing approach based on problem-solving strategy: Analyzing pre-service primary school teachers' performance. Kuram ve Uygulamada Egitim Bilimleri, 17(3), 771–789. https://doi.org/10.12738/estp.2017.3.0017

Kunze, T., Stadler, M., & Greiff, S. (2018). A Look at Complex Problem Solving in the 21st Century. NSW Department of Education, 11, 1–11.

Loh, S. C., Loo, C. K., Mamauag, M. F. M., & Arosh, S. G. (2017). Development of an assessment toolkit to measure higher order thinking skills among secondary school learners. Retrieved from http://eprints.um.edu.my/18971/%0Ahttps://eprints.um.edu.my/18971/1/Development_of_an_assessment_toolkit_to_measure_higher_order_thinking_skills.pdf

Mohamad, A., Sulaiman, T., & Mohd, A. F. (2023). Factors Influencing 21st Century Teaching among Secondary School Teachers in Selangor , Malaysia. International Journal of Academic Research in Business and Social Sciences, 13(12), 401–417. https://doi.org/10.6007/IJARBSS/v13-i12/19805

Mudhol, A. C. (2024). Innovative Assessment Methods for Measuring Practical Skills in Higher Education. Atlantis Press International BV. https://doi.org/10.2991/978-94-6463-374-0_8

Neal, M. (2023). SCORE, an Alternative to SWOT. Retrieved from https://medium.com/@marcneal/score-an-alternative-to-swot-64bcf5fc740a

Ong, T. W. S., Ting, S.-H., Raslie, H., Marzuki, E., Chuah, K.-M., & Jerome, C. (2022). University Students' Communication and Employability Skills: Mismatch Perspectives of Students, Lecturers, and Employers in Sarawak, Malaysia. NOTION: Journal of Linguistics, Literature, and Culture, 4(2), 93–103. https://doi.org/10.12928/notion.v4i2.6003

Patah, S. A., Boon, Y. (2023). Reliability of a Best Practice Instrument for Beginning Teacher Professionalism Development in High-Performing Primary Schools in Malaysia: A Rasch Measurement Model. Asian Journal of Research in Education and Social Sciences, Vol. 5(3), 252–258. https://doi.org/10.55057/ajress.2023.5.3.26

Sadovska, V., Rastorgueva, N., Migliorini, P., Melin, M., Sadovska, V., & Migliorini, P. (2024). Engagement of stakeholders in action-oriented education for sustainability : a study of motivations and benefits and development of a process model development of a process model. The Journal of Agricultural Education and Extension, 1–23. https://doi.org/10.1080/1389224X.2024.2415607

Santana, A. L. M., & de Deus Lopes, R. (2024). Using Real-World Problems and Project-Based Learning for Future Skill Development: An Approach to Connect Higher Education Students and Society Through User-Centered Design (pp. 393–417). https://doi.org/10.1007/978-3-658-42948-5_20

Siklander, S. P., Impio, N., & Celik, I. (2023). Development and Application of Collaborative Problem-Solving Design (CPS) in Higher Education: Perspectives from International Students, 1–59.

Sonnleitner, P., Keller, U., Martin, R., Latour, T., & Brunner, M. (2017). Assessing complex problem solving in the classroom: Meeting challenges and opportunities (pp. 159–173). https://doi.org/10.1787/9789264273955-12-en

Ültay, N., Dönmez Usta, N., & Ültay, E. (2021). Descriptive Content Analysis of Studies on 21st Century Skills. SDU International Journal of Educational Studies, 8(2), 85–101. https://doi.org/10.33710/sduijes.895160

Widaningrum, D., Mindyarto, B. N., & Aji, M. P. (2023). Development of an Assessment as Learning Based on an ISCACoRe Metacognitive Strategy to Improve Problem-Solving Skills. Jurnal Penelitian Pendidikan IPA, 9(5), 2548–2555. https://doi.org/10.29303/jppipa.v9i5.2441

World Economic Forum. (2023). Future of Jobs Report 2023: Insight Report. World Economic Forum. Retrieved from https://www.weforum.org/reports/the-future-of- jobs-report-2023/

Shuang, Y., Karabalaeva, G., Karabalaev, S. N. A. (2024). Pedagogical conditions of organisation of development of creative abilities of college students in educational activity. Scientific Herald of Uzhhorod University Series Physics, 56, 1109–1117. https://doi.org/10.54919/physics/56.2024.110kf9

Yusop, S. R. M., Rasul, M. S., & Yasin, R. M. (2024). The Vocational Skills Integration in TVET Classroom Assessment Practices Instrument : The Validity and Reliability Analysis. International Journal of Future Education and Advances (IJFEA), 1(1), 348–357. Retrieved from https://www.masree.info/wp-content/uploads/2024/03/IJFEA-Article-45.pdf

Zhang, M., & Andersson, B. (2023). Identifying Problem-Solving Solution Patterns Using Network Analysis of Operation Sequences and Response Times. Educational Assessment, 28(3), 172–189. https://doi.org/10.1080/10627197.2023.2222585