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The Structural Relationship between Secondary School Teachers' Level of Computational Thinking Skills and Organizational Agility

Garry Vanz V. Blancia[1,2] and Philip R. Baldera[2]

ABSTRACT

With the various problems encountered by secondary school teachers, the skills to adapt to the evolving educational landscape is imperative. In this study, secondary school teachers' level of Computational Thinking Skills (CTS) and Organizational Agility (OA) was assessed, as well as the structural relationship of the two variables. Standardized CTS test and OA Test were adapted and revised based on the Philippines' secondary school setting. Convenience sampling was done among 305 secondary school teachers in the division of Romblon. The sampling size was calculated using Raosoft software. SPSS v. 25 was used to calculate the descriptive statistics. The structural relationship between variables was modelled using Smart PLS software. Results revealed that secondary school teachers CTS and OA were high and very high, respectively. It was also found out that CTS significantly predicts secondary school teachers' OA. It was recommended that activities such as problem-solving simulations be integrated in every school's in-service training program for secondary school teachers' sustained level of CTS and OA.

Keywords: *structural relationship, computational thinking skills, organizational agility, secondary school teachers*

INTRODUCTION

In the age of the Fourth Industrial Revolution, education is rapidly evolving alongside other industries and sectors. Global education demands have led countries to introduce numerous changes and innovations, requiring schools to develop adaptive skills for teachers (Miller et al., 2022). The COVID-19 pandemic further disrupted the learning process, posing unprecedented challenges for both students and teachers. The abrupt changes in teaching strategies and school operations caught everyone off guard, necessitating quick adaptation to new measures (Gross & Opalka, 2020).

In the Philippines, the Department of Education reported that 425 schools have permanently closed since 2020 (Chanco, 2023) Greater organizational agility might have prevented these closures and ensured the continuation of quality education for more Filipino learners.

As critical problems arise in education, a vital skill for school organization members is the ability to swiftly respond to challenges and adapt to changes. This skill, known as organizational agility, highlights an organization's capacity to overcome educational sector demands and innovations (Zeb-Obipi et al., 2020). Organizational agility is crucial for educational institutions to remain relevant and competitive in today's dynamic environment, enabling quick adaptation to student needs, technological advancements, and regulatory requirements (Pouravid et al., 2019). By fostering organizational agility, educational institutions can enhance their responsiveness, creativity, and resilience, improving their ability to achieve goals and fulfill missions.

Additionally, educators need strong problem-solving skills to meet global demands. Computational thinking (CT), a foundational skill, involves breaking down complex problems and creating algorithms to solve them (Martínez et al., 2023). Recognized as essential for teachers, computational thinking promotes problem-solving, logical reasoning, and creativity. This skill is increasingly important in education, where assessing secondary teachers' computational thinking

✉: garryvanzblancia@gmail.com
[1]College of Education, Romblon State University, Odiongan, Romblon, Philippines
[2]Graduate Education and Professional Studies, Romblon State University, Odiongan, Romblon, Philippines
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skills is crucial for planning and implementing necessary interventions.

Studies have explored the relationship between computational thinking and organizational agility (Cutumisu et al., 2022; Li, 2022; Veiseh & Eghbali, 2015). However, there is limited literature on this relationship among secondary teachers in the Philippines, highlighting the need for further exploration.

Senin et al. (2019) discussed in their study that although teachers tend to be computational thinkers, their becoming agile in the sense of being proactive is deeply associated. Meanwhile, Bakhshi et al. (2017) revealed in their investigation that one of the key determinants of organizational agility is computational thinking skills. Grześ (2023) further supported their claim in his study about managing organizational agility which he revealed that organizational agility could be achieved through harnessing computational thinking skills. Moreover, he concluded in his investigation that organizations should provide strong grounds to harness the ability for the survival and development of an organization.

Meanwhile, in a study by Catumisu et al. (2022), the relationship between pre-service teachers' computational thinking and organizational agility was explored within the dimensions of attitudes and skills. Path analysis revealed that higher levels of computational thinking skills among pre-service teachers are associated with greater organizational agility. This suggests that as pre-service teachers develop stronger computational thinking abilities, they become better equipped to adapt and respond effectively to changes and challenges within educational organizations. Presser et al. (2023) support this finding, emphasizing the importance of integrating computational thinking into teacher training programs to create a more agile and adaptable workforce.

Yeh and Chu (2017) explored computational thinking, creativity, and organizational agility in large Chinese organizations. Their study revealed a significant relationship between computational thinking skills and organizational agility. They found that problem-solving techniques, abstraction, and algorithmic thinking foster innovation and maintain a competitive edge. Amenyo & Kpo (2023) emphasized the importance of managers investing in CT training to cultivate a more creative and agile workforce, driving sustained innovation and flexibility. Integrating CT into organizational practices is seen as pivotal for achieving long-term success and resilience in the face of digital transformation.

Further, Veiseh et al. (2015) studied the structural relationship between computational thinking, creativity, and organizational agility. Their findings showed a significant relationship between these constructs. This suggests that as employees develop their computational thinking abilities, they become more adept at problem-solving, adapting to change, and innovating. Amenyo & Kpo (2023) discussed that these skills enable organizations to design and implement interventions and simulations to anticipate challenges and identify opportunities for improvement or innovation.

In this investigation, secondary school teachers' computational thinking skills and organizational agility were assessed. Further, this analyzed if computational thinking skills predict organizational agility among secondary school teachers.

METHODOLOGY

This study employed a descriptive-correlational research design. This study was conducted among 305 secondary school teachers (Male=92, and Female=213) in the Division of Romblon, Philippines using convenience sampling. The sampling size was calculated using Raosoft software (Adekunle & Dakare, 2020).

The standardized Computational Thinking Skills test (Gurbuz & Hatunoglu, 2022) and Organizational Agility Test (Korkmaz et al., 2017) were adapted and revised based on the Philippines' secondary school setting. In the data gathering, the instruments were distributed using printed copies and Google forms (for far-flung areas) throughout Romblon province. Using SPSS v.25, descriptive statistics such as mean, percentage, and standard deviation were used. In testing the structural relationship as to how computational thinking skills predict organizational agility, Smart PLS was used.

RESULTS AND DISCUSSION

Table 1 presents the levels of creativity, algorithmic thinking, cooperativity, critical thinking, and problem-solving skills among secondary school teachers in Romblon. Teachers demonstrated high levels of creativity, as indicated by their belief in solving problems with sufficient time and effort (M = 4.33, SD = 0.81). They also showed strong algorithmic thinking, with the ability to mathematically express solutions to daily life problems (M = 3.85, SD = 0.88).

Additionally, the teachers exhibited high cooperativity, enjoying cooperative learning and believing it leads to more successful results (M = 3.71, SD = 0.85). In terms of critical thinking, teachers expressed a willingness to learn challenging things (M = 3.67, SD = 0.84). Lastly, teachers demonstrated strong problem-solving skills, producing multiple options for solving problems (M = 4.51, SD = 0.99).

Table 1. Level of Computational Thinking Skills Among Secondary School Teachers in Romblon

Component	Mean	SD	DI
Creativity			
1. I like the people who are sure of most of their decisions	3.75	0.88	M
2. I like the people who are realistic and neutral	3.58	0.84	H
3. I believe that I can solve most of the problems I face if I have sufficient amount of time and if I show effort.	4.33	0.81	VH
4. I have a belief that I can solve the problems possible to occur when I encounter with a new situation.	3.83	0.82	H
5. I trust that I can apply the plan while making it to solve a problem of mine.	3.83	0.80	H
6. Dreaming causes my most important projects to come to light.	3.67	0.85	H
7. I trust my intuitions and feelings of "trueness" and "wrongness" when I approach the solution of a problem	3.67	0.86	H
8. When I encounter with a problem, I stop before proceeding to another subject and think over that problem.	4.33	0.83	VH
Composite Mean	3.67	0.85	H
Algorithmic Thinking			
9. I can immediately establish the equity that will give the solution of a problem.	3.67	0.87	H
10. I think that I have a special interest in the mathematical processes	3.58	0.91	H
11. I think that I learn better the instructions made with the help of mathematical symbols and concepts.	3.75	0.89	H
12. I believe that I can easily catch the relation between the figures	3.75	0.87	H
13. I can mathematically express the solution ways of the problems I face in the daily life.	4.17	0.88	H
14. I can digitize a mathematical problem expressed verbally.	4.17	0.88	H
Composite Mean	**3.85**	**0.88**	**H**
Cooperativity			
15. I like experiencing cooperative learning together with my group friends.	3.92	0.85	H
16. In the cooperative learning, I think that I attain/will attain more successful results because I am working in a group.	3.92	0.82	H
17. I like solving problems related to group project together with my friends in cooperative learning.	3.50	0.88	H
18. More ideas occur in cooperative learning	3.50	0.86	H
Composite Mean	**3.71**	**0.85**	**H**
Critical Thinking	**Mean**	**SD**	**DI**
19. I am good at preparing regular plans regarding the solution of the complex problems.	3.67	0.80	H
20. It is fun to try to solve the complex problems.	4.00	0.79	H
21. I am willing to learn challenging things.	3.67	0.84	H
22. I am proud of being able to think with a great precision.	3.83	0.78	H
23. I make use of a systematic method while comparing the options at my hand and while reaching a decision.	3.75	0.82	H
Composite Mean	**3.67**	**0.91**	**H**
Problem-solving	**Mean**	**SD**	**DI**
24. I have problems in the demonstration of the solution in my mind.	3.67	0.97	H
25. I have problems in the issue of where and how I should use the variables such as X and Y in the solution of a problem.	3.42	0.96	H
26. I cannot apply the solution/ways I plan respectively and gradually.	3.33	0.99	M
27. I can produce so many options while thinking of the possible solution/ways regarding a problem.	3.67	1.03	H
28. I can develop my own ideas in the environment of cooperative learning	3.50	1.00	H
29. I try to learn something together with my group friends in group learning.	3.52	0.99	H
Composite Mean	**4.51**	**0.99**	**H**

Legend **Descriptive Interpretation (DI)**
1.00 - 1.80 Very Low **(VL)**; 1.81 - 2.60 Low **(L)**; 2.61 - 3.40 Moderate **(M)**; 3.41 - 4.20 High **(H)**; 4.21 - 5.00 Very High **(VH)**

These findings suggest that secondary school teachers in Romblon possess high levels of key skills necessary for effective teaching and student engagement. These skills can enhance classroom activities, promote student learning, and contribute to a more dynamic educational environment.

The results suggest that teachers in Romblon possess a strong sense of creativity and confidence in their problem-solving abilities, as discussed in the study of Catumisu et al. (2022). This bodes well for their potential to integrate computational thinking skills into their teaching, facilitating the development of creativity and problem-solving skills in their students which is also aligned with the study of Presser et al. (2023). These findings further suggest that teachers in Romblon exhibit a strong proficiency in algorithmic thinking. Their comfort with mathematical processes and ability to apply mathematical concepts to problem-solving are indicators of their readiness to integrate computational thinking skills into their teaching practices, fostering algorithmic thinking skills among students which was profoundly stressed in the study of Li (2022) and Alvarado et al. (2023)

Results further indicate that teachers in Romblon have a strong preference for and belief in the effectiveness of cooperative learning. This is a positive indicator of their potential to integrate cooperative learning strategies into their teaching practices, fostering collaboration and teamwork skills among students (Veiseh & Eghbali, 2015). They further stressed that teachers' confidence in problem-solving, enjoyment of challenging tasks, and systematic approach to decision-making are positive indicators of their ability to integrate critical thinking into their teaching practices, potentially enhancing students' critical thinking skills as well.

On the other hand, Table 2 presents the levels of organizational agility among secondary school teachers in Romblon, focusing on proactiveness, radicalness, responsiveness, and adaptiveness. Teachers perceived their organization as highly proactive, anticipating new opportunities and seeking novel approaches to future market needs (M = 4.33, SD = 0.67, VH). They also viewed their organization as moderately radical, supporting high-risk plans and projects with uncertain returns and committing resources to radical changes (M = 4.19, SD = 0.76, H). Furthermore, teachers perceived their organization as highly responsive, rapidly reacting to emerging opportunities in customer needs, markets, and environmental factors (M = 4.28, SD = 0.71, VH).

Lastly, teachers perceived their organization as highly adaptive, adapting existing business and educational models and processes and quickly adopting best practices used by others (M = 4.28, SD = 0.72, VH). These findings suggest that teachers perceived their organization as highly agile, with a strong ability to anticipate, respond to, and adapt to change, which is

Table 2. Level of Organizational Agility Among Secondary School Teachers in Romblon

Component	Mean	SD	DI
Proactiveness			
1. Our organization anticipates new opportunities	4.42	0.67	VH
2. Our organization seeks new possible opportunities	4.33	0.68	VH
3. Our organization seeks novel approaches to future market needs	4.25	0.67	VH
Composite Mean	**4.33**	**0.67**	**VH**
Radicalness			
4. Our organization seeks high-risk plans and projects with chances of high return.	4.17	0.72	H
5. Our school supports organizational experimentation despite uncertain returns	4.33	0.78	VH
6. Our organization commits resources to radical changes that can potentially transform markets and competition.	4.08	0.76	H
Composite Mean	**4.19**	**0.76**	**H**
Responsiveness			
7. Our organization rapidly reacts to emerging opportunities in customer needs.	4.25	0.72	VH
8. Our organization rapidly reacts to emerging opportunities in markets.	4.33	0.74	VH
9. Our organization rapidly reacts to emerging environmental opportunities (e.g., new regulations, globalization)	4.25	0.67	VH
Composite Mean	**4.28**	**0.71**	**VH**
Adaptiveness			
10. Our organization adapts existing business and educational models.	4.25	0.72	VH
11. Our organization adapts the existing educational/business process.	4.25	0.71	VH
12. Our organization quickly adopts best practices used by others	4.33	0.75	VH
Composite Mean	**4.28**	**0.72**	**VH**

Legend Descriptive Interpretation (DI)
1.00 - 1.80 Very Low **(VL)**; 1.81 - 2.60 Low **(L)**; 2.61 - 3.40 Moderate **(M)**; 3.41 - 4.20 High **(H)**; 4.21 - 5.00 Very High **(VH)**

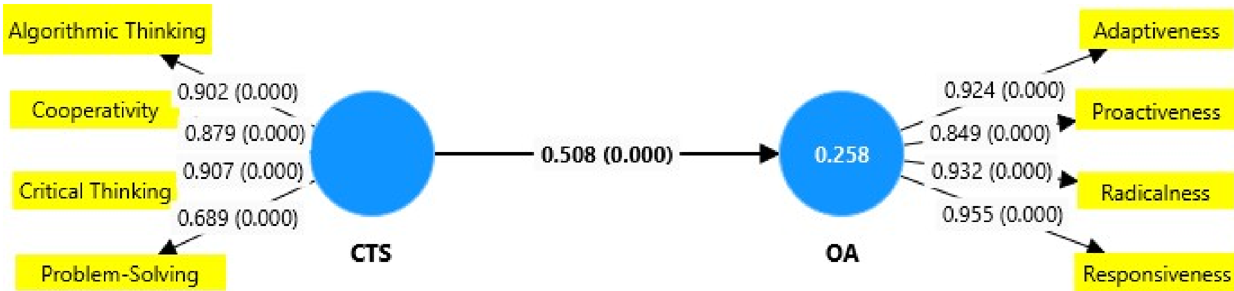

Figure 1. Structural Relationship Between Computational Thinking Skills and Organizational Agility Among Secondary School Teachers

essential for organizational success and effectiveness in a dynamic environment. These findings could imply that teachers in Romblon perceive their organization as highly proactive and agile. This high level of proactiveness is a positive indicator of the organization's ability to adapt to change, seize opportunities, and effectively respond to challenges in the education sector as also explained by Marhraoui et al. (2022). These findings further suggest that teachers in Romblon perceive their organization as agile and willing to take risks and pursue radical changes. Chen and Lin (2014) argued that a high level of radicalness is a positive indicator of the organization's ability to innovate and adapt to new challenges and opportunities in the education sector. Grzes (2023), and Bai and Li (2019) opined that teachers who perceived their organization as highly responsive to various opportunities are crucial for adapting to the dynamic educational landscape and meeting the evolving needs of students and stakeholders, which is also consistent with the arguments raised by Grześ (2023).

The structural model above shows the relationship between the two variables, computational thinking skills predicting organizational agility. The means of the components of computational thinking skills such as algorithmic thinking, cooperativity, critical thinking, and problem-solving loaded significantly to CTS (0.689-0.907). Meanwhile, the means of the components of the construct on the right, which is organizational agility (adaptiveness, proactiveness, radicalness, responsiveness) is significantly loaded to OA (0.849-0.955). The solid arrow from CTS to OA represents the relationship between computational thinking skills and organizational agility suggesting a significantly positive beta coefficient (β=0.508, p=0.00) thereby predicting 25.8% of the variance in OA.

This implies that CTS plays a crucial role in enhancing teachers' ability to adapt and respond to new challenges and opportunities within their organizational context. These findings underscore the importance of fostering CTS among teachers to enhance OA within educational institutions as suggested by Catumisu et al., (2022). Li (2022) further discussed that by developing CTS, schools can empower teachers to effectively navigate complex problems, embrace innovative solutions, and drive positive change in their organizations.

The findings supported the investigation of Veiseh and Eghbali (2015), who studied the structural relationship between computational thinking, creativity, and organizational agility. Educators need to become more adept at problem-solving, adapting to change, and innovating as they develop their computational thinking abilities better with these competencies. Amenyo and Kpo (2023) claimed that these skills should be developed among organizations to plan and execute interventions and simulations to anticipate challenges and identify opportunities for improvement or innovations within organizations. They further opined that Integrating CT into organizational practices is seen as pivotal for achieving long-term success and resilience in the face of digital transformation.

CONCLUSION

As educational organizations tend to evolve due to the challenging demands of time, educators must develop computational thinking skills for sustained organizational agility. In this investigation, findings suggest that secondary school teachers in Romblon possess high levels of creativity, algorithmic thinking, cooperativity, critical thinking, and problem-solving skills. These competencies are essential for effective teaching and fostering a dynamic learning environment. Additionally, the teachers perceive their organization as highly agile, and capable of anticipating and responding to new opportunities and challenges.

Based on these findings, it is recommended that educational institutions in Romblon continue to foster and enhance these key skills among teachers through professional development programs focused on creativity, algorithmic thinking, cooperativity, critical thinking, and problem-solving. These skills could be enhanced by integrating problem-solving scenario simulations in their respective schools' in-service training programs. Emphasizing these skills will further strengthen teachers' abilities to integrate computational thinking into their teaching practices, benefiting student learning and engagement.

Moreover, schools should leverage the high organizational agility perceived by teachers to implement innovative educational practices and policies. By maintaining a proactive, radical, responsive, and adaptive organizational culture, schools can better navigate the dynamic educational landscape and effectively meet the evolving needs of students and stakeholders.

Future research could explore the direct impact of these skills on student outcomes and further investigate the relationship between computational thinking and organizational agility in different educational contexts such as in private schools. This would provide deeper insights into how these competencies can be effectively developed and utilized to enhance educational practices and organizational effectiveness.

AUTHORS' CONTRIBUTIONS

G.V.B. is the main researcher and statistician of the study, while P.B. gave advice and implications of the results.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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