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An Investigation on Coding Educational Management for Small-sized Elementary Schools in Northeastern of Thailand

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Abstract

The purpose of this research was to investigate the strategies used to practice six components of coding educational management from 10 experts' views followed by their heuristic evaluation. A mixed-mode research design was employed, namely focus group interviews and heuristic evaluation. The results of the focus group discussion revealed that school administrators should apply the strategies of collaboration, networking, support, flexibility, and diversity to create digital learning communities. A learning ecosystem can be designed to stipulate students with contact to diverse opportunities and resources. Conducting research in curriculum development, teaching and learning strategies, professional development and evaluation with equity and access would promote coding educational management. Digital learning has the potential to transform education and provide opportunities for students to access high-quality educational content and resources. The results of the heuristic evaluation showed that the quality of strategies used is applicable in terms of their consistency, usefulness, suitability, and feasibility.

Keywords: *Coding Management; Computational Thinking; Focus Group Discussion; Heuristic Evaluation; Small-sized Elementary Schools.*

Introduction

The International Society for Technology in Education Standards for Administrators has established an instrument to investigate the association between technology leadership and school effectiveness including teaching, learning, and administration (Zhong, 2017).

At this moment, we cannot deny that digital technology has convert a public need to warrant education as a prime human right, particularly in a realm undergoing more regular emergencies and conflicts, as informed by United Nations Educational, Scientific and Cultural Organization (UNESCO, February 2, 2023).

This issue has been proven during the coronavirus 2019 (COVID-19) pandemic. Those nations exclusive of adequate ICT setup and sound-resourced digital learning structures grieved the extreme education interruptions and learning losses. Hence, the COVID-19 education disturbance obviously exposed the crucial necessity to support technologies and human resources to renovate

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teaching models and shape comprehensive, vulnerable, and robust learning structures (UNESCO, February 2, 2023).

According to Antonopoulou et al. (2021), coding educational management has the potential to transform the mode that education is delivered and managed, constructing it more resourceful, effective, and accessible to students of all backgrounds. They defined coding educational management as the practice of digital technologies to manage and improve educational systems. This incorporates the practice of various tools and software to manage student records, track progress, and rationalize administrative tasks.

Therefore, a coding educational administrator supports the use of digital innovation in escalating the significance and excellence of learning, constructing ICT-enhanced lifelong learning trails, consolidating education, and learning management structures, and supervising learning procedures (Gill, 2020).

The COVID-19 pandemic has accelerated the adoption of coding educational management systems and emphasized the importance of technology in education. As schools around the world including Thailand were forced to switch to remote and online learning in response to the pandemic, coding educational management of school administrators became important for ensuring continuity of learning and maintaining student engagement (Musikanon, 2022). Even though we are currently moving to endemic, it is likely that coding educational management will continue to play a significant role in education.

Musikanon (2022) explained that coding educational management can provide several advantages such as increased flexibility, improved data analysis, enhanced collaboration, and cost savings. Coding educational management can provide students with more flexibility in how they learn, allowing them to access course constituents and comprehensive tasks at their own pace and on their own plan. Besides, coding educational management can provide teachers with real-time data and analytics on student progress, permitting them to identify parts where students may be struggling and provide targeted interventions. Moreover, coding educational management can ease alliance among students and teachers, permitting them to collaborate on developments and tasks regardless of their physical location.

Finally, coding educational management can help schools save money by reducing the necessity for physical infrastructure and resources, such as textbooks and paper-based materials (Musikanon, 2022).

Computational thinking is a fundamental skill that is essential for the development and implementation of artificial intelligence systems. In addition, artificial intelligence has the potential to report numerous vast challenges in education along with bring revolution to teaching and learning practices. Nevertheless, the request of these technologies must be steered by the ideologies of enclosure and fairness (Payne et al., 2022). Payne et al. refer to computational thinking as a problem-solving methodology that comprises breaking down multifaceted problems into minor,

more controllable fragments, recognizing outlines and associations, and developing procedures and models to solve them. As a result, computational thinking is a way of thinking that is closely related to computer science and programming, but it can also be applied to a wide range of other arenas, including educational management (Payne et al., 2022).

In contrast, artificial intelligence denotes to the development of machines and software organizations that can accomplish responsibilities that stereotypically entail human intellect, such as learning, perception, reasoning, and problem-solving. Artificial intelligence systems are built using a range of techniques and technologies, comprising machine learning, deep learning, natural language processing, and robotics (Li et al., 2020). Computational thinking is an important skill for school administrators in the field of artificial intelligence, as it provides a structured and systematic approach to problem-solving that is important for the design, development, and implementation of artificial intelligence systems (Li et al., 2020).

In Thailand, there are four types of school sizes, namely extra-large, large, medium, and small sizes. Small-sized schools in Thailand can offer a unique learning experience for students and provide a more personalized approach to education. However, these schools may also face some challenges, such as limited resources and a smaller pool of teachers. A small size elementary school in Thailand has a relatively low number of students enrolled and thus serves a small local community from grades 1 to 6. Generally, small-sized elementary schools in Thailand are often located in rural areas or small towns, where the population density is lower and there is less demand compared to larger size schools.

However, small-sized elementary school administrators may face several challenges and problems including limited resources, recruiting and retaining teachers, meeting curriculum standards, providing specialized services, managing finances, dealing with emergencies, and managing relationships with the community (Peangchan, 2020). Peangchan explained that small-sized elementary school administrators often have limited resources both human and material resources making them difficult to provide a high-quality education as well as meet the needs of all students. Besides, they have to struggle to attract and retain quality teachers, especially in rural areas. Owing to small-sized elementary schools are having limited resources to implement curriculum standards and provide students with a well-rounded education, this can cause their students hard to compete with their peers in larger schools (Peangchan, 2020).

Report of Preliminary Results and Research Aims

In the preliminary research, the researchers conducted a need assessment of a total of 740 school administrators and teachers from 370 small-sized elementary schools in the northeastern region of Thailand. The preliminary results of this research indicated that there are six components of coding educational management for small-sized elementary schools, namely curriculum development, digital literacy skills, digital learning, learning ecosystem, coding research and evaluation, and coding learning community. Curriculum development of coding education management was found related

to computational thinking. Computational thinking involves integrating computational thinking principles into the design and delivery of education programs (Payne et al., 2022). Therefore, the researchers defined curriculum development of coding education in this research as teaching elementary students how to apply computational thinking to solve complex problems, analyze data, and develop innovative solutions. The second component of coding education was found to be digital literacy skills. The initial result of digital literacy skills refers to the ability to use digital technologies effectively and responsibly. In other words, developing digital literacy skills is important in current educational conditions, where technology plays an increasing significant role in many aspects of our personal and professional lives. This result was in line with Audrin and Audrin's (2022) reviews of 1037 research articles published on digital literacy skills between 2000 and 2020.

The third component of coding educational management was identified as digital learning. Digital learning, also known as e-learning, refers to the use of digital technologies to deliver educational content and facilitate learning. Digital learning can take many forms, such as online courses, virtual classrooms, mobile learning, and blended learning, which combines face-to-face instruction with online components (UNESCO, February 2, 2023).

The preliminary results showed that a learning ecosystem was found to be the fourth component of coding educational management. A learning ecosystem refers to the interconnected network of people, resources, and technologies that support and facilitate learning.

This ecosystem can include formal educational institutions such as schools, informal learning spaces such as libraries and museums as well as online platforms and resources. The result was found consistent with the result of Nguyen and Tuamsuk (2022) who explored the characteristics of the digital learning ecosystem in educational institutions based on the analysis of English scholarly from various sources between 2002 and 2021.

The fifth component of coding educational management was found as research and evaluation in computational thinking which can help to better understand how to effectively teach and assess computational thinking skills. This definition corresponds to Li et al.'s (2020) practical implications of computational thinking in education. The final component of coding educational management was the digital learning community.

A digital learning community means a virtual space where learners, educators, and other stakeholders can connect, collaborate, and share knowledge and resources related to digital learning. Digital learning communities can take many forms, such as online discussion forums, social media groups, and virtual learning networks.

Thus, Georgarakou (February 8, 2023) highlighted the importance of a digital learning community through productive conversations and collaborative learning to continually shape our understanding of any topic at hand and even co-create knowledge. The need assessment results indicated that the digital learning communities were the most vital component of coding

educational management ($PNI_{modified}$ = 0.250) according to 740 respondents' perceptions. This was followed by components of coding educational management in descending order such as learning ecosystem ($PNI_{modified}$ = 0.226), research and evaluation ($PNI_{modified}$ = 0.185), digital learning ($PNI_{modified}$ = 0.093), and digital literacy skills ($PNI_{modified}$ = 0.062). The narrowest gap between the current condition and desired condition was the component of curriculum development ($PNI_{modified}$ = 0.055). Based on the preliminary results above, the researchers aimed to investigate the effective strategies of practicing the six components of coding educational management from the 10 experts' perspectives. After the researchers drafted an instrument including all the strategies proposed by the 10 experts in the first phase, the researchers continued to investigate the feasibility, suitability, consistency, and usefulness of the instrument according to the 10 experts' heuristic evaluations as the final phase of this research.

Materials and Methods

Research design

The researchers employed a mixed-mode research design that associated two different data collection methods, namely focus group interviews and surveys. The rationale for employing this research design was to obtain a more comprehensive and nuanced understanding of the research problems as discussed above.

According to Creswell and Plano Clark (2011), each data collection method has its own strengths and weaknesses, and by using multiple methods, researchers can offset the limitation of each method and enhance the overall quality of the data. The researchers used focus group interviews in the first phase to gather data on the phenomenon of coding educational management strategies used by school administrators in two small-sized elementary schools and then used surveys to validate or supplement those results in terms of feasibility, suitability, consistency, and usefulness. This mixed-mode research design is particularly useful in this research where the researchers want to obtain both qualitative and quantitative data to triangulate both sources of data to enhance the validity of our results. A focus group interview was employed involving a moderated discussion with seven experts who shared a common set of experiences on the strategies to practice the six components of coding educational management. During the focus group interview, the 10 experts were asked six open-ended questions about strategies to practice the six components of coding educational management, and they were encouraged to discuss their opinions, beliefs, attitudes, and experiences related to the proposed strategies.

The aim of the first phase was to obtain in-depth information about the issue of strategies in practicing the six components of coding educational management, as well as to gain insights into the perspectives of the 10 experts. The data collected from focus group interviews could be analyzed to identify common themes, patterns, and trends, which could inform decision-making and guide further research. In the final phase, the researchers utilized heuristic evaluation as a quantitative method of evaluating the user interface design of an application of strategies in

practicing the six components of coding educational management. It involves having a small group of evaluators inspect the user interface based on a set of usability principles, called heuristics. The goal of the heuristic evaluation was to identify usability problems that users might encounter while using the application of proposed strategies and to provide recommendations for improvement. Therefore, the researchers employed the heuristic evaluation ideas of Stufflebeam (in Kanjanawasi, 2011) to evaluate the overall quality of proposed strategies for practicing components of coding educational management by elementary small-sized elementary school administrators in four aspects, namely feasibility, suitability, consistency, and usefulness. This evaluation process was conducted with the 10 experts. A five-point Likert scale assessment instrument was employed as a tool to assess the 10 experts' interpretation of the strategies in practicing the six components of coding educational management, ranging from minimal to most applications.

Population and samples

The total of small-sized elementary schools in the north-eastern region of Thailand was 1,345 with a total population of 7,203 students, according to the record from the Office of the Basic Education Commission for the academic year 2021. These research schools are under the administration of Elementary Educational Service Area 10 to 14 (refer to Table 1).

Table 1. Distribution of small-sized elementary schools in north-eastern Thailand

Regional Basic Education Commission	Elementary Educational Service Area	Population of Small-sized Schools
Region 10	Udon Thani	114
Region 10	Nong Khai	101
Region 11	Sakon Nakhon	139
Region 11	Nakhon Phanom	167
Region 12	Roi Et	141
Region 12	Maha Sarakham	161
Region 13	Nakhon Ratchasima	123
Region 13	Surin	131
Region 14	Ubon Ratchathani	176
Region 14	Sisaket	92
Total		**1,345**

The researchers employed purposive sampling to select the seven and 10 experts to participate in the first and final phases, respectively. The purposive sampling technique was suitable to use in this research in order to select those experts based on specific characteristics, expertise, and experiences.

One of the advantages of purposive sampling is that it allows researchers to select participants who are most likely to provide valuable insights related to the research aim. In this line of reasoning, the researchers considered their expertise, credibility, availability, diversity, and relevance to coding education. Table 2 demonstrates the specific criteria that the researchers considered when selecting the 10 experts for focus group interviews and heuristic evaluation.

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Table 2. Distribution of 10 experts and the specific criteria

Experts	Specific Criteria	Quantity
E1	A professor who is specialized in educational administration from Kasetsart University.	1
E2	Director from Institute for the Promotion of Teaching Science and Technology.	1
E3	Recipient of Princess Maha Chakri Award Teacher.	1
E4	Educational scholar is responsible for coding educational management.	1
E5 E6 E7	School directors who are the recipients of the National Award for Coding Educational Management.	3
E8 E9	Qualified educational supervisors who are responsible for coding educational management, doctoral degree holders, and have working experience not less than three years.	2
E10	A qualified teacher who is responsible for coding education, a doctoral degree holder, has working experience not less than three years, and recipient of the National Award for Coding Education.	1
Total		**10**

Research instruments

The researchers employed two types of research instruments, namely a discussion guide and a heuristic evaluation questionnaire to collect qualitative and quantitative data. The focus group interview protocol consists of 10 interview questions mainly encompassing experts' initial thoughts, sharing of their related experiences, their opinion on the current state, sharing any positive or negative experiences, how the six identified components affect different groups of people in small-sized elementary schools, some possible solutions to the challenges, potential risks or challenges associated with implementing these solutions, and how the coding educational management will evolve in the future.

Moreover, the researchers used probes or follow-up questions to gain more detailed and nuanced responses from the 10 experts, specifically on those strategies in practicing the six factors of coding educational management in small-sized elementary schools. A heuristic evaluation questionnaire is a usability evaluation technique that involves having 10 experts evaluate an interface according to a set of usability principles.

A heuristic evaluation questionnaire was another research instrument used by the 10 experts who came together to discuss their findings after they evaluated an interface of the drafted strategies in practicing the six components of coding educational management in small-sized elementary schools independently. This heuristic evaluation questionnaire includes opportunities for the 10 experts to provide comments and suggestions for improvement. The researchers created the questionnaire with questions that correspond to each heuristic. Questions were clear and concise and asked the 10 experts to evaluate whether or not the interface met each heuristic. Pilot test the

questionnaire with a small group of experts who were excluded from the actual research to ensure that the questions are clear, and that the questionnaire is effective in evaluating the usability of the interface.

Data Collection and Data Analysis

In the first phase, qualitative data collection for a focus group discussion involved careful planning and execution to ensure that the researchers gathered high-quality that could be used to generate valuable insights into the 10 experts' attitudes, perceptions, and experiences related to the strategies in practicing the six components of coding educational management in small-sized elementary schools. A discussion guide was a list of questions and prompts that would guide the conversation during the focus group.

The discussion guide was developed based on the preliminary research results and designed to elicit in-depth responses from the 10 experts. The focus group interview was conducted in a comfortable and neutral environment. The researchers acted as moderators introduced the research topic and facilitate the discussion according to the discussion guide. The discussion was recorded so that the researchers could analyze the data later. The researchers recorded the discussion using audio and video equipment and took notes as well. Once the focus group was complete, the researchers transcribed the audio and video recording and analyzed the notes. The researchers looked for themes and patterns in the data that related to the research aim. The researchers used NVivo software tools to analyze the data. Finally, the researchers reported the results of the focus group.

The report summarized the key themes and patterns that emerged from the discussion and provided insights into experts' attitudes, perceptions, and experiences related to the research aim. In the final phase, quantitative data collection for heuristic evaluation with 10 experts involved careful planning and execution to ensure that the researchers gathered high-quality data that could be used to identify usability issues and improved the user experience of an interface. After the researchers recruited 10 experts who have strong backgrounds in usability and user experience design. Then, the researchers defined the evaluation criteria by choosing a set of usability heuristics encompassing feasibility, suitability, consistency, and usefulness that were appropriate for the interface the researchers wanted to evaluate.

Before conducting the heuristic evaluation, the researchers had a meeting with the 10 experts on the evaluation criteria and process. This could ensure that all experts have a consistent understanding of the heuristics and how to apply them. The 10 experts evaluated the interface independently based on the evaluation criteria. Once the evaluation was complete, the researchers collected notes and feedback from each expert. The researchers could analyze the data to identify common issues and areas for improvement. Finally, the researchers reported the results of the heuristic evaluation. The quantitative results summarized the key issues identified by the experts and provided recommendations for improving the usability of the interface.

Results and Discussions

This research was conducted in two phases, with the first phase entailing focus group interviews and the final phase involving heuristic evaluation with 10 experts in the area of coding educational management in small-sized schools.

In the first phase, the main aim of the focus group interview with the 10 experts was to explore the strategies for practicing components of coding educational management. In the final phase, the researchers aimed to conduct a heuristic evaluation to identify areas where an interface might have usability issues and provide guidance for further improvement so that the strategies in practicing the six components of coding educational management could be a useful reference for small-sized elementary school administrators.

First Phase: Focus Group Interview Results

The preliminary research with 740 respondents found six essential components that contribute to coding educational management from the greatest to the narrowest gap between the desired condition and current condition are digital learning communities, learning ecosystem, research and evaluation, digital learning, digital literacy skills, and curriculum development, in that order. The 10 experts were identified as E1 to E10.

Digital learning communities

The quantitative results of need assessment in preliminary research revealed that the component of digital learning communities was the most needed component of coding educational management, as perceived by 740 respondents consisting of 370 school directors and 370 teachers. This implies that digital learning communities can be an effective strategy to enhance the digital learning experience and support students in achieving their learning goals. The followings are the verbatim discussion records from the 10 experts who supported the importance of the digital learning communities in practicing coding educational management for small-sized elementary school administrators:

"Digital learning communities are a very important strategy to practice coding education because digital learning communities provide opportunities for students and teachers to collaborate and share ideas, resources, and best practices related to digital learning." (E1)

"Digital learning communities can assist students and teachers to expand their professional networks and connect with others who share similar interests and goals. Therefore, I feel that digital learning communities is an effective strategy to implement coding education successfully." (E2)

"Digital learning communities can provide students with support and guidance, as well as access to a range of resources to help them succeed in their learning goals. This can be a good strategy for us to upgrade coding education." (E3)

"Digital learning communities are often available 24/7, providing students with the flexibility to

engage in learning activities and discussions on their own schedule. This is a strategy in practicing coding education." (E4)

"Digital learning communities can bring together students and teachers from diverse backgrounds, creating opportunities for cross-cultural and cross-disciplinary learning." (E9)

The above results revealed that the component of digital learning communities is one of the key components of coding educational management. School administrators should apply the strategies of collaboration, networking, support, flexibility, and diversity to create digital learning communities. Therefore, forming digital learning communities for a wide range of educational settings, especially for small-sized elementary schools, can be used to support both formal and informal learning. On top of that, digital learning communities are suggested by the 10 experts to support professional development for teachers, allowing them to share and learn from one another's experiences.

Learning ecosystem

Qualitative discussion group results revealed that school administrators should utilize the learning ecosystem as a strategy to improve coding educational management. According to the 10 experts, a learning ecosystem can be designed to provide students with access to diverse opportunities and resources.

This can be done by connecting students with different types of learning experiences to form a learning ecosystem. Hence, a learning ecosystem can be a strategy to support a holistic and well-rounded approach to learning. The verbatim responses are explicitly demonstrated how to utilize the learning ecosystem in practicing coding educational management:

"In my view, the individual students who seek to learn and develop their skills and knowledge is an important element in the learning ecosystem." (E5)

"I think the individual teachers who facilitate learning and provide guidance and support to students is a vital element in learning ecosystem." (E6)

"Another important element of the learning ecosystem is institutions. The formal organizations that provide educational programs and resources, such as schools, universities, and training centers." (E7)

"The informal settings where learning can occur, such as libraries, museums, and community centers. This provides informal learning space for learning ecosystem." (E10)

"The digital tools and resources that support and enhance learning, such as online platforms, educational apps, and simulations are technologies needed to promote the learning ecosystem." (E8)

"The methods used to measure learning outcomes and provide feedback to students and teachers

to upgrade learning ecosystem." (E1). The results could be concluded that a learning ecosystem in small-sized elementary school management, consists of the following elements, namely students, teachers, institutions, informal learning spaces, technologies, and assessment and evaluation. By creating a robust learning ecosystem that leverages the strengths of each of these elements, students can access a wide range of educational opportunities that can help them to achieve their learning goals and develop the skills and knowledge they need to succeed in their personal and professional lives.

Research and evaluation

The focus group discussion with the 10 experts revealed teachers can better understand how to effectively teach and assess their students' computational thinking and develop evidence-based practices to support student learning and success in their teaching by conducting research and evaluation in the area of coding education. According to the 10 experts' views, the component of research and evaluation can help to prepare students for the challenges of the 21st century, where computational thinking is becoming an increasingly essential skill in many specializations. Some key elements of research and evaluation related to coding education in small-sized school management were proposed by the 10 experts as follows:

"In my opinion, research can be conducted to develop computational thinking curricula that are appropriate for different age groups and educational settings, and that align with national and international computational thinking standards." (E2)

"I would like to suggest that research can be done to explore teaching and learning strategies for computational thinking, including methods for integrating computational thinking across different subject areas and for teaching computational thinking to students with different learning styles and abilities." (E3)

"Other than research, the evaluation methods are also important for us to manage coding education. School administrators should develop evaluation methods to assess computational thinking skills, such as using performance-based assessments and rubrics to measure students' problem-solving skills and ability to apply computational tools and techniques." (E4)

"Based on my experience, I found that research should be conducted to identify effective professional development programs for teachers to assist them develop the skills and knowledge needed to effectively teach computational thinking." (E5)

"My suggestion is research can explore the role of computational thinking in promoting equity and access in education, particularly in underserved communities and for students from diverse backgrounds. This issue is quite obvious in small-sized elementary schools in remote areas." (E6)

The results of the focus group discussion revealed that the component of research and evaluation play essential strategies in promoting coding education practices by conducting research in curriculum development, teaching and learning strategies, and professional development. In

addition, assessment and evaluation as well as equity and access should be given sufficient attention by school administrators in small-sized elementary schools. The results of research and evaluation of computational thinking have become increasingly important in today's educational management, where technology is pervasive and plays a role in almost every aspect of our lives.

Digital learning

The fourth component of coding education is digital learning. The results indicated that digital learning has the potential to transform education and provide more opportunities for students to access high-quality educational content and resources. The verbatim responses are explicitly demonstrated digital learning offers several advantages as follows:

"I agree that digital learning provides flexibility in terms of time and place, allowing students to learn at their own pace and on their own schedule. Therefore, I fully support digital learning to be continued in small-sized elementary schools even though we now are at new normal and having on-site teaching like before the COVID-19 pandemic" (E7)

"The other advantage of digital learning is education becomes more accessible to students who may not have access to traditional educational resources. For example, those students who are living in remote areas or those with disabilities will face barriers to attending in-person classes." (E8)

"Digital learning can be tailored to meet the individual needs and interests of students, providing a personalized learning experience. This can be our strategy to practice coding education" (E9)

"Digital learning can be more cost-effective than traditional in-person instruction, as it eliminates the need for physical classroom space, textbooks, and other materials." (E10)

"Digital learning can facilitate collaboration among students and teachers, allowing them to work together on projects and assignments regardless of their physical location." (E1)

The results of the focus group discussion concluded that digital learning is providing us with various advantages, such as flexibility, accessibility, personalization, cost savings, and enhanced collaboration. However, digital learning also poses some challenges, for example, the need for students to have access to appropriate technology and digital literacy skills, the potential for students to feel isolated from their peers and instructors, and the need for effective assessment and evaluation strategies.

Digital literacy development

The fifth component of coding educational management is digital literacy development. Students become more confident and competent in using digital technologies for learning and professional purposes by developing their digital literacy skills. The verbatim responses have clearly exhibited the importance of digital literacy development in practicing coding educational management:

"Educate students on responsible digital behavior, including online safety, privacy, and etiquette." (E2)

"Offer training on how to use digital tools and resources effectively, such as online research, collaboration tools, and social media." (E3)

"Teach students to critically evaluate digital information and sources, and to distinguish fact from fiction." (E4)

"Encourage students to use digital technologies to create and share their own content, such as videos, podcasts, and blogs." (E5)

"Teach students how to use digital tools to solve real-world problems, such as coding, data analysis, and simulation software." (E6)

"Ensure that students have access to the necessary technology and resources, either at school or at home, to develop their digital literacy skills." (E7)

The above discussion results showed that the experts recommended some strategies for digital literacy development, namely teaching digital citizenship, providing technology training, emphasizing critical thinking, fostering creativity, promoting digital problem-solving, and promoting access to technology for school administrators to implement coding education.

Curriculum development

The final component of coding educational management is curriculum development. Teachers can help students develop critical thinking skills by integrating computational thinking into the curriculum that are essential for success in the digital age. The following verbatim responses evidently showed how to develop a curriculum that emphasizes computational thinking can be considered the following steps:

"Start by defining clear learning objectives that focus on computational thinking skills, such as problem-solving, data analysis, and algorithm development." (E1 to E10)

"Identify the key concepts and skills that are vital for computational thinking, such as decomposition, abstraction, pattern recognition, algorithm development, and evaluation." (E1 to E10)

"Choose appropriate teaching methods that are aligned with the learning objectives and key concepts, such as project-based learning, inquiry-based learning, and collaborative learning." (E1 to E10)

"Develop assessment strategies that measure students' mastery of computational thinking skills and concepts, such as rubrics, quizzes, and performance tasks." (E1 to E10)

"Integrate technology tools and resources into the curriculum to support computational thinking, such as programming languages, data analysis tools, and simulation." (E1 to E10)

"Provide professional development opportunities for teachers to develop their own computational thinking skills and teaching strategies." (E1 to E10)

In conclusion, a curriculum development that emphasizes computational thinking must follow this sequence: Define learning objectives, identify key concepts, select appropriate teaching methods, design assessment strategies, integrate technology, and provide professional development. These computational thinking skills can prepare students for a wide range of careers, including those in science, technology, engineering, and mathematics (STEM) fields.

Final Phase: Heuristic Evaluation Results

The heuristic evaluation results were reported by 10 experts indicating the quality of the created strategies to practice the six components of coding educational management in terms of their feasibility, suitability, consistency, and usefulness.

The highest mean score related to the consistency of the strategies used in terms of applicability (mean score = 4.80, *SD* = 0.53). This was followed by the usefulness of the strategies which displayed the second-highest degree of applicability with a mean score of 4.68 and a standard deviation of 0.40. The suitability of the strategies used in terms of applicability was found with a mean score of 4.46 and a standard deviation of 0.61). Even though the feasibility of the strategies used was found to have the lowest mean score (4.32) with a standard deviation of 0.74, it was still deemed to be applicable.

Conclusion

The overall results revealed that components of coding education, namely digital learning communities, learning ecosystem, research and evaluation, digital learning, digital literacy skills, and curriculum development should be utilized by school administrators of small-sized elementary schools as effective strategies that can help improve student outcomes, optimize administrative tasks, and drive innovation in educational technology.

The results are found consistent with Musikanon's (2022) results. This implies that school administrators in the new normal era must apply the suggested strategies to the design and developmental process of coding education, have an attitude to be good role models, learn about communication technology and digital technology to stay abreast of changes and drive, encourage, support, and motivate their teachers to practice coding education. Following this line of reasoning, teachers are able to create more effective and user-friendly solutions that better meet the needs of students.

The results of the heuristic evaluation indicated that the suggested strategies to practice the six components of coding educational management in terms of their consistency, usefulness, suitability, and feasibility ranged from mean scores of 4.80, 4.68, 4.46, and 4.32 in that order. This implies that the 10 experts strongly agreed with identified usability strategies for improving the user interface design while school administrators of small-sized elementary schools implement coding

educational management.

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References

Antonopoulou, H., Halkiopoulos, C., Barlou, O., & Beligiannis, G. N. (2021). Associations between traditional and digital leadership in academic environment during the COVID-19 pandemic. Emerging Science Journal, August. https://doi.org/10.28991/esj-2021-01286

Audrin, C., & Audrin, B. (2022). Key factors in digital literacy in learning and education: A systematic literature review using text mining. Education and Information Technologies, 2022(27), 7395-7419.

Creswell, J. W., & Plano Clark, V. L. (2011). Designing and conducting mixed methods research (2nd ed.). Los Angeles, USA: Sage.

Georgarakou, R. (February 8, 2023). How to build an online learning community. https://www.learnworlds.com/build-online-learning-community/

Gill, I. S. (2020). Policy approaches to artificial intelligence based technologies in China, European Union and the United States. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3699640

Kanjanawasi, S. (2011). New theory of testing (3rd ed.). Bangkok, Thailand: Printing House Chulalongkorn University.

Li, Y., Schoenfeld, A. H., diSessa, A. A., Grasser, A. C., Benson, L. C., English, L. D., & Duschl, R. A. (2020). Computational thinking is more about thinking than computing. Journal for STEM Education Research, 3(1), 1-18. https://doi.org/10.1007/s41979-020-00030-2

Musikanon, C. (2022). Educational management in the next normal. Western University Research Journal of Humanities and Social Science, 8(2), 280-293.

Payne, L., Tawfk, A., & Olney, A. M. (2022). Computational thinking in education: Past and present. Tech Trends, 66, 745-747. https://doi.org/10.1007/s11528-022-00766-1

Peangchan, T. (2020). The guideline for developing the quality of small-sized schools in Bueng Kan province. Rajabhat Chiang Mai Research Journal, 21(3), 1-23.

Nguyen, L. T., & Tuamsuk, K. (2022). Digital learning ecosystem at educational institutions: A content analysis of scholarly discourse. Cogent Education, 9(1), 2111033. https://doi.org/10.1080/2331186X.2022.2111033

United Nations Educational, Scientific and Cultural Organization (February 2, 2023). What you need to know about digital learning and transformation of education. https://www.unesco.org/en/digital-education/need-know

Zhong, L. (2017). Indicators of digital leadership in the context of K-12 education. Journal of Educational Technology Development and Exchange, 10(1),27-40.