Teachers' Learning Empowerment for Applying to Enhancing the 21st-Century Characteristics

Wasupol Ma-uy[1,*] & Phrakhrusutheejariyawattana[1]

[1]Mahamakut Buddhist University, Isan Campus, Khon Kaen Province, Thailand

*Correspondence: Mahamakut Buddhist University, Isan Campus, Khon Kaen Province, Thailand. Tel: 66-0961-651-544. E-mail: Jackwasupol@gmail.com

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Abstract

This study examined various perspectives on 21st-century teachers, focusing on their definitions, characteristics, roles, developmental guidelines, challenges encountered during growth, and assessment criteria. The primary objective was to create educational modules for online self-training programs that enhanced teachers' skills. The research was divided into two main projects: the first aimed to equip teachers with guidelines to become more effective in their roles, while the second concentrated on implementing the acquired knowledge in student education. Employing a 5-step Research and Development methodology, the final phase involved conducting experimental research using a one-group pretest-posttest design within a school setting. The sample included 10 teachers and 154 students in the experimental group. Findings indicated that the newly developed educational innovation, titled "Online Self-Training Program for Empowering Teachers to Put Their Learning into Action to Enhance the Characteristics of 21st-Century Teachers," successfully met the research hypotheses. Specifically, 1) Teachers in the experimental group achieved post-experiment test scores that met the 90/90 standard, significantly surpassing their pre-experiment scores, and 2) Teachers demonstrated improved evaluation results for students after the experiment. This program was deemed suitable for nationwide implementation across secondary schools under the Office of the Basic Education Commission.

Keywords: empowering teachers, put learning into action, characteristics of 21st-century teachers

1. Introduction

1.1 Significance of the Research Problem

In the rapidly evolving educational landscape of the 21st Century, the need for teachers to adapt and enhance their skill sets has never been more pressing. The shift from traditional teaching pedagogies to innovative, learner-centered approaches necessitates transforming educators' attributes and competencies (Morrison & Lowther, 2010). This research on Teachers' Learning Empowerment for Enhancing 21st-Century Characteristics addresses a critical professional development gap for teachers who are integral facilitators of student learning outcomes.

First, the core of this research problem lies in the recognition that 20th-century pedagogical models are no longer sufficient in preparing students for contemporary challenges. Integrating information technology, collaborative project-based learning, and critical thinking skills are paramount in nurturing learners who thrive in a fast-paced, digital-driven environment (Partnership for 21st Century Skills, 2009). Teachers must, therefore, undergo a significant paradigm shift in their approach to Education, transitioning from merely delivering content to becoming enablers of critical thinking, creativity, and collaboration.

The significance of empowering teachers through an Online Self-training Program cannot be overstated. Research indicates that effective professional development is characterized by ongoing, relevant, and practical training that encourages applying new skills in the Classroom (Darling-Hammond et al., 2017). By focusing on online self-training, this initiative provides teachers with flexibility in their learning and incorporates adult learning principles that are often more effective for professional growth (Knowles et al., 2012). This model allows for personalized learning pathways that align with individual teacher needs, thus increasing motivation and engagement

in the learning process.

Moreover, the emphasis on developing knowledge and understanding before application is crucial. Instructional strategies grounded in constructivist theory suggest that learners (in this case, teachers) must first grasp theoretical frameworks before successfully implementing them in practical settings (Bransford et al., 2000). By structuring the professional development program to prioritize understanding, the research supports the idea that informed teachers can ultimately lead to better student learning outcomes (Hattie, 2009).

Additionally, the research addresses the need for a systemic approach to professional development that considers the broader impact on learner development, which is foundational to the ultimate goals of Education. Educators with 21st-century competencies can create learning environments that foster student autonomy, resilience, and adaptability—essential for success in a globalized world (OECD, 2018). This shift has implications for individual classrooms and entire educational systems, enhancing the overall quality of Education delivered.

The importance of this research is also visible in the growing body of literature advocating for transformative learning experiences among educators. As Mezirow (1991) highlighted, transformative learning involves critically reflecting on one's assumptions and beliefs, which can lead to fundamental changes in perspective. The proposed Online Self-training Program fosters this transformative potential, equipping teachers to reflect on their previous practices and embrace new methodologies that align with 21st-century learning objectives.

In conclusion, the significance of this research problem transcends individual teacher development; it speaks to the broader educational imperative of fostering a responsive and innovative teaching workforce capable of meeting the diverse needs of today's learners. The transition from 20th-century to 21st-century teaching characteristics is not merely an adjustment but a necessary evolution driven by a commitment to Education that prioritizes student growth, critical thinking, and lifelong learning. By using an R&D methodology to develop an innovative training program, this research lays the groundwork for impactful educational reforms that can reshape teaching and learning practices on a national and global scale.

1.2 Research Objectives

This research explored various perspectives on 21st-century teachers, including their definitions, essential characteristics, roles, development guidelines, and challenges. The goal was to apply this knowledge to create online self-training modules as an educational innovation. The research consisted of two projects: 1) developing guidelines for 21st-century teachers and 2) applying these learnings to students.

1.3 Research Hypothesis

This research employed R&D methodology to create an online self-training program for teachers, focusing on Knowledge and Action as Power. Utilizing credible articles, we developed learning modules and assessed their effectiveness with students. Previous studies, like those by Kratumnok and Phrakhrusutheejariyawattana (2024), confirmed the practicality of similar educational innovations. Our research aimed to achieve two hypotheses: 1) Teachers in the experimental group would achieve post-experiment test scores meeting the 90/90 standard, significantly higher than pre-experiment scores. 2) Teachers would demonstrate improved evaluation results for students post-experiment.

1.4 Literature Review

This research aimed to study various perspectives on enhancing teachers' 21st-century characteristics in the following issues: definition of a 21st-century teacher, characteristics of 21st-century teachers, the role of 21st-century teachers, guidelines for developing characteristics, problems, and obstacles, and evaluation of 21st-century teachers. It aimed to obtain data to create learning modules for teachers' learning and to create a working manual to apply the learning outcomes to their educational institutions and students.

However, among these issues, it was evident that "guidelines for enhancing teachers' 21st-century characteristics" were essential because they provided recommendations for various practices, such as principles, ideas, thoughts, techniques, methods, quotes, inspirational words, strategies, or activities that teachers needed to know and implement to produce results. Some items were familiar; however, many items constituted new suggestions based on a 21st-century educational perspective. These suggestions served as a GPS, guiding teachers in the right direction with principles and academic suggestions, helping them avoid getting lost, which could cause wasted time and ineffectiveness.

From the insights of Greene (2022), Chattopadhyay (2021), Thomas (2021), Barton (2019), Today's Geniuses (2019), Nishantsinha (2018), and Menezes (n.d.), we synthesized a comprehensive list of 39 guidelines to strengthen the

characteristics of 21st-century teachers:

1. Focused on Content, not Tools: This aligns with pedagogical content knowledge (Shulman, 1986), indicating that effective teaching requires a deep understanding of content and pedagogy. Teachers must prioritize content mastery to facilitate meaningful learning experiences.

2. Remembered Tried-and-True Resources: Utilizing reliable resources taps into the theory of constructivism, which emphasizes the importance of building knowledge upon existing frameworks (Piaget, 1952). Familiar resources serve as scaffolds for learning.

3. Provided Choices for Students: Offering choices supports student agency and autonomy, which aligns with Deci and Ryan's (2000) self-determination theory, emphasizing the psychological needs for competence, autonomy, and relatedness.

4. Always Had a Plan B: This highlights the importance of adaptability and resilience in teaching, reflecting the transformative learning theory (Mezirow, 1991), where educators must be prepared to navigate unexpected challenges.

5. Used Cameras to Document and Share Work: This practice encourages reflection and metacognition, supported by Schön's (1983) theory of reflective practice, enhancing teachers' awareness of their pedagogical strategies.

6. Used Tech to Teach Storytelling: Integrating technology with Storytelling can foster creativity and engagement, aligning with the principles of multimodal learning (Kress, 2003), where multiple modes of communication enhance understanding.

7. Explored Virtual Reality (VR): VR can facilitate immersive learning experiences, resonating with experiential learning theory (Kolb, 1984), where learners gain knowledge through reflection on doing.

8. Learned from Peers with Professional Learning Networks: Collaboration embodies social learning theory (Bandura, 1977), asserting that social interactions significantly influence learning processes.

9. Introduced Web-Based Portfolios: This practice encourages self-assessment and reflection, crucial components in constructive alignment (Biggs, 1996), linking learning outcomes with assessment methods.

10. Shared Knowledge—Even if Nervous: This notion addresses the importance of vulnerability and community in professional development and supports the principles of collegiality (Hord, 1997).

11. Included Gamification: Gamification principles can engage students and increase motivation, reflecting the motivational theory (Deterding et al., 2011), emphasizing game elements' role in enhancing engagement.

12. Fostered Collaborative Learning: Collaborative learning fosters dialogue and interaction, essential tenets of Vygotsky's (1978) social constructivism, which emphasizes knowledge construction through social processes.

13. Implemented Flipped Classroom: The flipped classroom model emphasizes active learning, aligning with constructivist approaches (Bishop & Verleger, 2013), where students engage with content outside the Classroom.

14. Adopted Spaced Learning: The spacing effect, as characterized by Ebbinghaus (1885), suggests that distributed learning improves retention, underscoring its importance in educational practices.

15. Encouraged Crossover Learning: Cross-curricular strategies reflect integrated learning theories (Beane, 1997), promoting connections across various subject areas to enhance understanding.

16. Promoted Self-Learning: Self-directed learning correlates with Knowles' (1975) principles of andragogy, emphasizing autonomy in adult education.

17. Utilized VAK Teaching: This approach connects with multiple intelligences theory (Gardner, 1983), recognizing that learners have varied strengths and preferences.

18. Used Technology Effectively: Effective technology integration in pedagogy is supported by the TPACK framework (Mishra & Koehler, 2006), blending technology, pedagogy, and content knowledge.

19. Blended Students' Learning Experiences: Blended learning environments support differentiated instruction (Tomlinson, 2001) and allow for various learner pathways to success.

20. Employed Innovative Teaching and Learning Practices: Innovation in pedagogy resonates with the principles of transformative pedagogy (Brookfield, 1995), which focuses on student engagement and empowerment.

21. Differentiated Service Learning vs. Community Service: Understanding this distinction points toward experiential learning theories, which emphasize the application of learning to real-world contexts (Jacoby, 1996).

22. Discussed Pedagogy in Education: Reflective discussions on pedagogy support Schön's (1983) reflective practice, which is crucial for continuous improvement.

23. Advocated Personalized Learning: Personalized learning aligns with differentiated instruction (Tomlinson, 2001) and caters to individual learning preferences and needs.

24. Focused on Curriculum Development for Global Citizens: This approach can be linked to global education models (Murphy, 2008), stressing the need for cultural competency and global awareness.

25. Offered Coaching for Change: Coaching aligns with adult learning principles and promotes growth through targeted feedback and professional development (Whitmore, 1992).

26. Built an Inquiry-Based Learning Network with a Checklist: Inquiry-based learning strategies foster critical thinking, reflected in Bruner's (1961) constructivist approach.

27. Engaged in Experiential Learning: Emphasizing experience as a basis for learning aligns closely with Kolb's (1984) experiential learning cycle.

28. Explored the Philosophy of Classroom Management: Effective classroom management strategies can be linked to Positive Behavioral Interventions and Supports (PBIS) frameworks, which advocate for proactive approaches (Sugai & Simonsen, 2012).

29. Implemented Technology in the Classroom: Integrating technology with pedagogy fosters a dynamic learning environment, supporting the TPACK framework (Mishra & Koehler, 2006).

30. Assisted Students in Developing Interests: Encouraging exploration and self-discovery taps into intrinsic motivation, an essential aspect of Deci and Ryan's (2000) self-determination theory and student-centered learning.

31. Offered Regular Assessments and Feedback: Formative assessment supports ongoing learning, building on Black and Wiliam's (1998) research on assessment's role in enhancing student achievement.

32. Maintained Active Engagement: Active engagement strategies are linked to Blueprints for improving student engagement (Fredricks, Blumenfeld, & Paris, 2004), highlighting the importance of student involvement.

33. Accepted and Embraced Change: This reflects the adaptive leadership theories (Heifetz & Laurie, 1997), highlighting the ability to navigate uncertainties and facilitate change.

34. Became Digital Gurus: Developing digital competence aligns with the digital literacy framework (Gilster, 1997), promoting informed and critical use of digital resources.

35. Cultivated Adaptive Workers: This concept relates to lifelong learning and adaptability (Candy, 1991), which is essential in preparing students for future careers.

36. Fostered Champion Collaborators: Emphasizing collaboration aligns with relationship-based leadership theories (Lowney, 2003), ensuring effective teamwork among educators.

37. Encouraged Innovative Thinkers: Promoting critical thinking and creativity connects to the 21st Century Framework (Partnership for 21st Century Skills, 2009), emphasizing these skills in Education.

38. Promoted Lifelong Learning: As Candy (1991) highlights, fostering an environment for continuous learning is paramount in developing adaptable and prepared individuals.

39. Empowered Influencers: This recommendation aligns with transformational leadership theories (Bass, 1985), which state that empowering others leads to positive change in educational environments.

This critical analysis and synthesis of the 39 suggestions highlight their interconnectedness with existing educational theories, demonstrating the comprehensive approach to enhancing teacher characteristics in the 21st Century. Each guideline is grounded in substantial research, providing a strong foundation for successful implementation in educational institutions.

2. Research Methodology

2.1 Research Concept and Procedures

This research utilized the Research and Development (R&D) Methodology to create an effective online self-training program for educational innovation. It included two projects: 1) developing teachers to enhance their skills for the 21st Century and 2) enabling teachers to apply these skills with students. Sanrattana (2023) emphasized updating knowledge from reputable sources to create Learning Modules for teacher development, promoting the idea that

teacher growth should extend beyond just knowledge acquisition. The research steps were in the R1D1…. RiDi format is as follows:

R1D1 process: The literature was explored concerning enhancing 21st-century teachers, focusing on various issues identified within the "Literary Studies" topic. This investigation highlighted the significance of diverse perspectives as articulated in articles authored by credible writers or organizations, ultimately compiled into learning modules.

The R2D2 step has culminated in creating a comprehensive program to significantly enhance teacher training and improve teachers' 21st-century characteristics in real-world settings. This innovative approach is structured around two key initiatives: the "Online Self-training Program for Teachers' Learning Empowerment for Applying to Enhancing the 21st-Century Characteristics."

The first initiative, the Teacher Learning Development Project, provides well-crafted self-learning modules based on extensive research and literature reviews. These modules address important topics crucial for educators navigating today's fast-changing educational environment, including:

1. Definition of a 21st-Century Teacher: Studies by Safsms (2017), Nuwg (2017), Bhattacharya (2021), Chandar (2021), and W's Tech Talk (2022) provide insights into what defines a 21st-century teacher.

2. Challenges for 21st-Century Teachers: This section highlights challenges in modern educational contexts, referencing works by Chen (2022), The Connected Educator (2021), Hallerman et al. (2019), GamaLearn Blog Team (n.d.), Miller (n.d.), and International School Parent (n.d.).

3. Characteristics of 21st-Century Teachers: Research from Cox (2019), Palmer (2015), Abeka Christian School (n.d.), and Couros (n.d.) outlines the essential traits of effective educators today.

4. Role of 21st-Century Teachers: This area explores teachers' evolving responsibilities, referencing insights from Resilient Educator (2020), Gupta (2019), Sardar (2018), Flamand (n.d.), Gianchandani (n.d.), Nola (n.d.), and Power School.

5. Guidelines for Developing Characteristics: This section offers growth strategies based on the perspectives of Greene (2022), Chattopadhyay (2021), Thomas (2021), Barton (2019), Today's Geniuses (2019), Nishantsinha (2018), and Menezes (n.d.).

6. Problems and Obstacles: Challenges faced by educators are discussed, drawing from the works of Swartz (2021), Carecheck (n.d.), GamaLearn Blog Team (n.d.), and Heick (n.d.).

7. Evaluation of 21st-Century Teachers: This section presents an evaluation framework based on studies by Swathi (n.d.), Teach Thought (a) (n.d.), Teach Thought (b) (n.d.), Ravitz (2014), and Bukidnon State University (2018).

Each module is organized with clear learning objectives aligned with Bloom's Taxonomy. It presents content in both Thai and English to ensure accessibility for a broader audience. Interspersed questions help teachers assess their comprehension, drawing from learning psychology principles based on Pavlov and Skinner's theories. Engaging activities are integrated into the modules, prompting teachers to reflect on their knowledge and experiences.

The second initiative, the Teachers Leading Learning Outcomes to Development Project, specifically focuses on fostering the acquisition of teachers' 21st-century characteristics. This comprehensive manual includes essential components for providing a solid framework for educators:

1. Instructions;

2. An overview of the expected characteristics of 21st-century teachers;

3. A recap of strategies for enhancing these characteristics;

4. A step-by-step development guide;

5. A student perception survey related to teachers' 21st-century characteristics;

6. Self-assessments for teachers regarding their strategy implementation;

7. Assessments on the steps taken to improve 21st-century characteristics and

8. A reflective form for evaluating performance.

This program strives to empower educators to adapt to and thrive within the dynamic landscape of modern Education. Teachers are encouraged to refer to the specific presentation format outlined in each learning module available at http://www.mbuisc.ac.th/phd/Module9/Wasupol.pdf to deepen understanding. This format includes detailed content structure guidelines that cover objectives, key concepts, interactive elements, and assessment criteria, ensuring a

well-rounded and inclusive learning experience.

The R3D3 process assessed the quality of the online self-training program through two focus group stages. The first stage, "Preliminary Field Testing and Revision," included five teachers from a school outside the research area. The second stage, "Main Field Testing and Revision," involved ten teachers from a different school that was not part of the experimental research.

R4D4 process: Two sets of instruments were developed for the experimental research: 1) a teacher learning outcome test and 2) a student perception assessment regarding teacher expression (further details will be provided in the research tools section).

The R5D5 process evaluated the effectiveness of online self-training programs using a one-group pretest-posttest experimental design at a specially randomized school. The study involved 10 teachers and 154 students during the second semester of the 2024 academic year. It consisted of two phases: 1) a month-long experimental project to enhance teachers' understanding of 21st-century education guidelines and 2) a two-month project to help teachers apply their learning outcomes with students.

2.2 Research Tools

2.2.1 The Teacher Learning Outcome Test

The Teacher Learning Outcome Test was a 4-choice multiple-choice assessment developed based on the cognitive domain, moving from lower-order thinking skills to higher-order thinking skills: remembering, understanding, applying, analyzing, evaluating, and creating, as outlined in the revised Bloom's Taxonomy (Krathwohl, 2002). The test underwent a quality evaluation in two distinct stages.

In the initial stage, five educational experts assessed content validity using the Indexes of Item-Objective Congruence (IOC) method proposed by Rovinelli and Hambleton (1977). Analysis revealed that all questions achieved an IOC value exceeding 0.50 (Chaichanawirote & Vantum, 2017), confirming that the test questions were appropriate for achieving the intended measurement objectives.

The second stage involved a test trial run with 30 teachers from a school outside the experimental area to evaluate the overall quality further. Analysis of the resulting data indicated that all test items maintained a difficulty index within the acceptable range of 0.20 to 0.80, coupled with discrimination power falling between 0.20 and 1.00. The KR-20 statistic, which serves as the reliability coefficient, reached a value indicating a reliability higher than the established threshold of 0.70, confirming the test's robustness. The assessment's difficulty level was also within the expected parameters.

2.2.2 The Assessment of Students' Perception of Teacher Expression

The Assessment of Students' Perception of Teacher Expression utilized a 5-level rating scale of Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. This assessment was developed based on insights into the characteristics of 21st-century teachers from various sources, including Cox (2019), Palmer (2015), Abeka Christian School (n.d.), and Couros (n.d.), as well as evaluations of 21st-century teaching practices from Swathi (n.d.), Teach Thought (a) (n.d.), Teach Thought (b) (n.d.), Ravitz (2014), and Bukidnon State University (2018).

The assessment underwent quality evaluation in two phases. In the first phase, five educational experts reviewed the content validity. Analysis showed that all items achieved an IOC value greater than 0.50, confirming that the questions were suitable for their intended purpose.

In the second phase, the reliability or internal consistency of the assessment was tested using a sample of 30 students from a school outside the experimental area. The analysis yielded an alpha reliability coefficient for the overall evaluation was 0.77, indicating solid reliability. When assessed across individual aspects, the dimensions of having a vision, lifelong learning, creativity, use of technology, the establishment of a learner-centered classroom and environment, as well as the enhancement of 21st-century skills for students, were found to have reliability coefficients of 0.63, 0.55., 0.71, 0.49, 0.86, and 0.96 respectively. All these values exceeded the acceptable criterion of 0.70, as George and Mallery (2003) outlined.

2.3 Data Analysis

Data were analyzed based on Yamkasikorn's (2008) standard criteria of 90/90, where the first 90 indicates the average score percentage of all teachers, and the second 90 reflects the percentage of teachers meeting test criteria for all objectives. Mean scores from pre- and post-tests were compared using the dependent t-test.

3. Research Results

The results of the research to test the specified research hypothesis found that the outcomes aligned with the hypothesis as follows:

3.1 Results of Testing the First Research Hypothesis

After conducting the experimental research for the first project, titled "The Project to Develop Teachers to Learn about the Guidelines for Strengthening 21st Century Teachers," 10 teachers in the experimental group underwent evaluation through the "Teacher Learning Outcome Test" to assess the effectiveness of the project against the 90/90 standard criteria. The findings revealed:

1. The average post-experiment score of the teachers in the experimental group was 32.6 points, corresponding to 90.56 % of the total score of 36 points, meeting the first 90 standard criteria.

2. Additionally, 91.67 % of the teachers in the experimental group successfully passed the test according to all objectives, aligning with the final 90 standard criteria.

Furthermore, comparing the average scores from the learning outcomes test before and after the experiment indicated that the 10 teachers had a pre-test average score of 25.80 with a standard deviation of 4.42. In contrast, their post-test average score was 32.60, with a standard deviation 2.27. When these data points were analyzed using the Dependent t-test, the results demonstrated that the post-test scores were significantly higher than the pre-test at a statistical level of 0.05.

These findings suggest that the implemented strategies effectively enhanced the teachers' learning outcomes, confirming the research hypothesis in Table 1.

Table 1. Compare the average Scores from the Teacher Learning Outcome Test before and after the Experiment Using a Dependent T-Test

Testing	Sample size	Mean	Standard Deviation	t
Pre-test	10	25.80	4.42	7.32*
Post-test	10	32.60	2.27	

*Significant at ($p<0.05$)

The results of the research hypothesis tests indicate that the "Online Self-Training Program," part of the "Development Project for Teachers to Learn about the 21st Century Teacher Enhancement Approach," is practical and effective in meeting all specified research hypotheses. This project demonstrates the quality and feasibility necessary for implementation with the target population.

The positive outcomes reveal that the program aligns with educational standards and successfully enhances teachers' competencies, preparing them to navigate the challenges of 21st-century Education better. Consequently, this initiative is well-positioned for broader dissemination and adoption within educational settings, aiming to empower teachers and improve student learning experiences.

3.2 The Results of the Second Hypothesis Test

The results of the second hypothesis test conducted after the experimental research for the "Teachers Implement Learning Outcomes with Students Project," involved 154 students in the experimental group. They evaluated their perceptions using the "Student Perception Evaluation Form on Teacher Expression" to assess the project's effectiveness. The evaluations were analyzed both before and after the experiment, considering the overall impact as well as classifications by each specific aspect are shown in Table 2 as follows:

Table 2. Mean and Standard Deviation of Students' Perception of Teachers' Expression before and after the Experiment

Students' Perceptions of Teacher Expression	Evaluation			
	Pre-test		Post-test	
	$\bar{\chi}$	S.D.	$\bar{\chi}$	S.D.
Have a Vision	**3.39**	**0.92**	**4.58**	**0.61**
1. Provide opportunities for learners to identify and pursue their dreams.	3.44	0.84	4.63	0.57
2. Help learners develop the steps necessary to achieve their dreams.	3.56	1.20	4.60	0.61
3. Critically review past experiences for future progress.	3.37	1.01	4.49	0.67
4. Use innovative learning media to help students think outside the box and engage more in the lesson.	3.25	0.77	4.51	0.67
5. Preparing today's children for what the future holds	3.31	0.79	4.65	0.54
Lifelong Learning	**3.43**	**0.96**	**4.53**	**0.65**
6. Adapt old lesson plans to make them current	3.34	1.02	4.47	0.67
7. Seek new ideas and new methods to develop teaching abilities.	3.60	0.94	4.59	0.61
8. Use feedback from friends, teachers, or experts to revise your work.	3.54	0.96	4.56	0.63
9. Learn new technologies in teaching and work.	3.25	0.77	4.53	0.64
10. Have fun or enjoy learning new things.	3.73	1.18	4.57	0.62
11. Develop a commitment to learning as a lifelong process.	3.13	0.89	4.44	0.70
Creativity	**3.35**	**0.92**	**4.55**	**0.63**
12. Use idea-generation techniques such as brainstorming or concept mapping.	3.18	0.85	4.51	0.65
13. Develop your mindset by stepping out of your comfort zone and trying new things.	3.36	0.90	4.59	0.59
14. Have diverse ideas or imaginations	3.45	0.96	4.58	0.62
15. Create or invent new and better things to develop learners.	3.11	1.13	4.56	0.63
16. Provide opportunities to demonstrate risk-taking and initiative learning.	3.25	0.77	4.51	0.66
17. Use a variety of tools to solve new problems.	3.75	1.16	4.66	0.56
Using Technology	**3.50**	**1.03**	**4.58**	**0.60**
18**.** Learn to use technology as a learning tool.	3.35	1.13	4.58	0.57
19. Use ICT to create media for your use.	3.10	0.98	4.47	0.65
20. Use interactive technology for teaching	3.75	1.16	4.58	0.62
21. Know how to use technology in the Classroom and become familiar with teaching tools	3.23	0.77	4.59	0.59
22. Encourage students to use mobile phones in class	3.71	1.18	4.61	0.59
23. Use technology to search for and analyze information.	3.86	0.97	4.64	0.56
Creating a Learner-Center Classroom and Environment	**3.45**	**1.08**	**4.54**	**0.64**
24. Students are allowed to demonstrate their learning in various formats.	3.31	0.95	4.55	0.62
25. Let learners reflect and evaluate their learning experiences.	3.69	1.19	4.50	0.67
26. Let students present their group work to the class, teacher, or others.	3.40	0.95	4.57	0.61
27. Give students ownership of their learning, increasing intrinsic motivation	3.27	1.24	4.44	0.70
28. Let students choose a project topic for learning.	3.58	1.08	4.59	0.59
29. Arrange classrooms and areas conducive to learning and focus on learners as the center.	3.77	1.04	4.57	0.64
30. Promote a learning atmosphere that keeps pace with the learning society for the 21st Century.	3.11	1.13	4.53	0.65

Students' Perceptions of Teacher Expression	Evaluation			
	Pre-test		Post-test	
	$\bar{\chi}$	S.D.	$\bar{\chi}$	S.D.
Enhance 21st-Century Skills for Students.	**3.49**	**0.98**	**4.57**	**0.63**
31. Promote the use of technology or the internet for learning.	3.25	0.77	4.51	0.68
32. Strengthen communication skills	3.75	1.16	4.60	0.59
33. Strengthen students' teamwork skills	3.29	0.88	4.62	0.60
34. Fostering innovative work behavior among students	3.31	1.08	4.50	0.67
35. Develop students' analytical thinking skills	3.76	0.96	4.51	0.68
36. Strengthen students' collaborative learning skills	3.75	1.01	4.63	0.57
37. Promote students' awareness of online safety and good digital citizenship.	3.35	0.99	4.63	0.59
Total	**3.43**	**0.98**	**4.56**	**0.62**

The findings from Table 2 illustrate the outcomes of the experimental group of students assessing their perceptions of their teachers' expressions. The average score obtained from the pre-test assessment was 3.43, accompanied by a standard deviation of 0.98. In comparison, the average score for the post-test assessment increased to 4.56, with a standard deviation of 0.62. A Dependent t-test analysis demonstrated that the average score from the post-test was significantly higher than that of the pre-test at the 0.05 significance level, as indicated in the data analysis results presented in Table 3.

Table 3. The Comparative Analysis of the Mean Scores from the Evaluation of Students' Perception of Teachers' Expression before and after the Experiment Was Performed Using a Dependent T-Test

Evaluating	Sample size	Mean	Standard Deviation	t
Pre-test	154	3.43	0.98	53.65*
Post-test	154	4.56	0.62	

*Significant at ($p<0.05$)

The results obtained from the research hypothesis test provide strong evidence that the "Online Self-Training Program," which is part of the "Teacher Project Bringing Learning Outcomes to Practice with Students," is effective and compelling in its approach. This finding substantiates the initial hypothesis posited by the researchers, confirming that the program's quality and educational outcomes are on par with those achieved by the previously examined teaching initiative.

Furthermore, the encouraging outcomes signal that this innovative online training program can be effectively integrated within the target demographic of educators. This integration would empower teachers to seamlessly apply theoretical learning outcomes to real-world classroom scenarios, thereby enhancing the educational experience for their students. The evident success of the program underscores its significant potential to refine teaching methodologies, improve instructional strategies, and foster greater levels of student engagement and academic achievement. By equipping educators with the necessary tools and techniques, the program aims to create a more dynamic and interactive learning environment that genuinely benefits students in their educational journeys.

4. Discussion

This research examines various perspectives regarding 21st-century educators, emphasizing their definitions, essential characteristics, roles, professional development, challenges, and assessment methods. The primary objective is to synthesize knowledge across these domains to develop online self-training modules as a form of educational innovation. The study consists of two projects: one focused on enhancing teachers' understanding of 21st-century pedagogical practices and the other on applying the resulting learning outcomes to students.

The findings indicate that both projects met practical criteria aligned with the research hypothesis. This suggests that the online self-training program, titled "Empowering Teachers to Put Their Learning into Action to Enhance the

Characteristics of 21st-Century Teachers," is both practical and suitable for dissemination among the target population, which comprises 2,360 secondary schools governed by the Office of the Basic Education Commission across the nation.

Adhering to research and development methodology principles, the innovation was subjected to rigorous research, development, and testing through experimental methods. The results affirm the innovation's practicality based on established criteria, confirming its applicability to the target population. Furthermore, this research aligns with previous studies that share similar objectives and methodologies, including works by Niruttimatee and Sanrattana (2022), Kromthamma and Supakicco (2023), and Thammasarot, Sanrattana, and Phrasrivajiravati (2024).

The research outcomes underscore the importance of ongoing professional development for educators to benefit students. The central concept revolves around empowering teachers and recognizing their role as significant influencers in students' educational journeys. To facilitate meaningful changes in student learning behaviors, educators must be equipped with comprehensive knowledge that aligns with the evolving demands of the 21st Century.

It is essential for teachers to be nurtured in a manner that encourages continuous learning and growth rather than limiting their scope to a narrow set of information. Many educators may still require contemporary knowledge to teach effectively. Consequently, the focus of initiatives should prioritize practices that ultimately enhance student learning, as students are the primary beneficiaries of Education.

This approach is consistent with principles of teacher professional development, which emphasize the necessity for continuous and practical strategies. Edmentum (2018) identifies several key components for effective teacher development, including opportunities for teachers to acquire new techniques, offering support during implementation, actively engaging teachers in the learning process, and delivering content pertinent to their specific disciplines.

Moreover, insights from Kaplane (n.d.) reinforce the necessity of embedded professional development and the value of diverse, engaging methodologies that incorporate modeling and promote collaboration among educators. The ultimate aim should be to ensure that teachers receive adequate support while adopting new instructional strategies that can positively impact their students.

In addition, according to the research hypothesis, successful outcomes are contingent upon leveraging knowledge that reflects the vision or perspective of reputable academic institutions relevant to this study. This is particularly applicable to knowledge disseminated as "articles" published online, which is regarded as universal knowledge that showcases various ideas in alignment with the demands of the 21st Century. The author aims to present innovative and practical ideas derived from academic insights or real-world experiences that can be effectively implemented to achieve tangible results.

5. Conclusion

This research highlights the multifaceted nature of 21st-century educators, underlining their definitions, essential characteristics, roles, professional development, challenges, and assessment methods. The successful implementation of the online self-training program, "Empowering Teachers to Put Their Learning into Action to Enhance the Characteristics of 21st-Century Teachers," indicates that innovative educational strategies can effectively meet the needs of contemporary educators and the students they serve. Given that the program is practical and suitable for dissemination across 2,360 secondary schools under the Office of the Basic Education Commission, it can serve as a vital resource for professional development (Niruttimatee & Sanrattana, 2022; Kromthamma & Supakicco, 2023; Thammasarot, Sanrattana, & Phrasrivajiravati, 2024).

Findings from this research underscore the necessity for ongoing professional development tailored to educators, recognizing their critical role in influencing student outcomes. For educators to foster meaningful changes in learning behaviors, they must access comprehensive, up-to-date knowledge that aligns with the evolving demands of the 21st Century.

6. Recommendations

1. Promote Continuous Learning: Educational institutions should prioritize ongoing professional development, encouraging teachers to learn lifelong. This could be achieved by offering training programs beyond basic competency and delving into contemporary pedagogical practices.

2. Support Practical Strategies: Training initiatives should focus on practical strategies that empower teachers to enhance student learning experiences, as these practices are essential for the primary beneficiaries of Education—students (Kaplane, n.d.).

3. Integrate Collaborative Learning: Professional development programs should incorporate diverse methodologies that promote educator collaboration. By modeling effective teaching strategies and providing opportunities for peer discussions, institutions can enhance educators' learning experiences (Kaplane, n.d.).

4. Utilize Current Knowledge Resources: Educational programs should leverage current academic insights and real-world experiences, utilizing online resources as "universal knowledge" that showcases evolving ideas relevant to the 21st Century. This integration will help ensure educators are well-equipped with appropriate and applicable information (Niruttimatee & Sanrattana, 2022).

In conclusion, facilitating a culture of continuous professional development, offering practical and collaborative learning opportunities, and utilizing contemporary knowledge resources can significantly enhance the preparedness of 21st-century educators, ultimately benefiting their students' educational journeys.

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Authors contributions

As an Ed.D. student Wasupol Ma-uy undertakes a multifaceted role in conducting research involving several crucial steps. These steps include identifying the research problem and topic, reviewing existing literature, clarifying the issue, defining key terms and concepts, determining suitable research methodologies, conducting field research,

collecting data, interpreting the findings, and summarizing the results. This comprehensive process ultimately leads to writing research articles that contribute to academic knowledge.

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