

Development for Teacher's 21st-Century Skills Enhancement into Effective Practices

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Abstract

This research used the Research and Development (R&D) methodology, which has research steps in the form of R1D1...R2D2...RiDi to get an educational innovation called "Online Self-Training Program to Development for Teacher's 21st-Century Skills Enhancement into Effective Practices" that is effective. It is an educational innovation with certified research results that can be used and disseminated to benefit development in schools that are the target population on a large scale. The online self-training program consisted of 2 projects: 1) Development Project for Teachers' Learning with six self-training modules used to develop teachers; and 2) The Project for Teachers to Bring Learning Outcomes into Practice with Students with one self-training module to be used as a guideline for teachers. The results of the experimental research in the first project revealed that among the experimental group of 17 teachers, the learning outcomes had met the standard of the 90/90 criteria. Moreover, the average test scores after the experiment had been significantly higher than before the experiment, according to statistical analysis. In the experimental research of the second project, it was found that among the 510 students involved in the experiment, the average scores from the assessment of perception towards teachers' practices had been significantly higher after the experiment compared to before the experiment. It was found that the research results aligned with the pre-determined research hypotheses, indicating the effectiveness of educational innovations resulting from the research. These findings can be utilized to enhance and cultivate 21st-century skills for teachers in the targeted schools, demonstrating the potential for future research dissemination and application.

Keywords: online self-training program, teachers' learning, teacher's 21st century skills

1. Introduction

Being a teacher in the 21st century is no walk in the park. Teachers' skills are put to the test every single day when it comes to teaching Gen Z. In the past, the teaching-learning process was quite monotonous. However, due to the constant influence of the rapid progress in technology, many students worldwide are being exposed to a plethora of educational avenues and career options as a result. Therefore, this requires teachers in the 21st century to be well-equipped with the knowledge and skills to provide support and assistance for their students. (Menezes, n.d.)

Lynchmay (2023) said that teachers in the 21st Century should be characterized as communicators, experts in their field, innovative thinkers, patient educators, communicators of diversity, advocates for their students, role models for their students, patient and disciplined educators, always learning, effective communicators, effective problem solvers, effective educators, effective leaders, and lifelong learners. Bond (n.d.) mentioned the role of the teacher in the 21st-century classroom as 1) the communicator; the model; the adaptor; the learner; the visionary; the collaborator; and the risk taker.

The foregoing discussion underscores the significance of teacher's 21st-century skills and the various approaches that are used to enhance and cultivate these skills, especially when exploring information on the internet. It is evident from diverse perspectives that touch upon multiple aspects, including definitions, importance, characteristics, obstacles, and the ways to overcome obstacles, develop guidelines, and conduct evaluations.

Various perspectives on teachers' 21st-century skills, as mentioned, are views that the researchers have found valuable and that can be utilized as guidelines to enhance and cultivate 21st-century skills for teachers in secondary schools under the jurisdiction of the Basic Education Commission of Thailand.

In this research, the researchers employed R&D methodology to develop an educational innovation called the "Online Self-Training Program for Development for Teacher's 21st-Century Skills Enhancement into Effective Practices". The underlying concept is "knowledge and action are power." Various perspectives on teacher's 21st-century skills, as mentioned earlier, were utilized to shape the development approach for teachers, to prioritize teacher learning. The intention was to stimulate and encourage teachers to apply the acquired knowledge and learning outcomes to foster practical actions with students going forward.

As discussed in the subsequent research methodology section, the researchers believe that the R&D methodology, with its principles, concepts, and operational steps, will result in an effective "Online Self-Training Program for Development for Teacher's 21st-Century Skills Enhancement into Effective Practices". This innovation can be effectively disseminated to benefit the enhancement of 21st-century skills for teachers in secondary schools under the jurisdiction of the Basic Education Commission, which is the target population for the dissemination of the research findings in this project throughout the country. According to the principles of R&D methodology, any innovation developed and tested in representative experimental areas, when found to be effective based on pre-defined criteria, can be disseminated and utilized for the benefit of the target population in the research.

1.1 The Purpose of Research

The objective of this research was to conduct research using R&D methodology to develop an educational innovation called the "Online Self-Training Program for Development for Teacher's 21st-Century Skills Enhancement into Effective Practices" that is effective based on pre-defined criteria. This online self-training program comprised the following 2 projects: 1) Development Project for Teachers' Learning with six self-training modules used to develop teachers; and 2) The Project for Teachers to Bring Learning Outcomes into Practice with Students with one self-training module, which is to be used as a guideline for teachers. (See program structure and other details in Figure 1.)

1.2 Research Hypothesis

From studying other research works that aim at developing educational innovations with a focus on teacher development and subsequently applying these innovations for continuous development with students, it was found that the research outcomes had aligned with the research hypotheses as expected, such as research on Developing Teachers to Enhance Project Management Skills for Students by Nukoonkan and Dhammapissamai (2023), The Research Related to Developing Teachers to Develop Students' 21st -Century Skills by Mopara and Sanrattana (2023), and The Research on Enhancing Teachers' Learning to Develop Students to Become Successful Students by Thammabut and Thacha (2023).

Therefore, it is believed that the current study will also result in an effective "Online Self-Training Program for Development for Teacher's 21st- Century Skills Enhancement into Effective Practices". The research hypotheses, hence, were established in the following manner:

- For the Development Project for Teachers' Learning, the hypothesis was that the experimental group of teachers would achieve Post-test scores that would meet the 90/90 standard and that their scores would be significantly higher than the pre-test scores based on statistical significance.
- For The Project for Teachers to Bring Learning Outcomes into Practice with Students, the hypothesis was that students in the target group, who had received the impact of teacher practices, would have post-test scores that would be significantly higher than the pre-test scores based on statistical significance.

1.3 Literature Review

The above statement denotes that there are individuals, who would provide suggestions on various approaches that could enhance a teacher's 21st-century skills. Researchers saw value in these perspectives and proposed conducting research using R&D methodology to create an educational innovation called "Online Self-Training Program for Development for Teacher's 21st-Century Skills Enhancement into Effective Practices." In this study, the researchers studied the literature related to the diverse aspects of teacher's 21st-century skills to gather valuable insights, which were used to develop self-training modules for teachers' learning in six aspects as follows: 1. The definition from the perspectives of Bhattacharya (2021), Cox (2019), Lebo (2015), and Smythe (2014). 2. The importance from the perspectives of Barbousas (n.d), Bhattacharya (2021), Ledesma (2011), and Temurnikar (2020). 3. The

characteristics from the perspectives of Bhattacharya (2021), Churches (2010), Cox (2019), Lebo (2015), Ledesma (2011), Saavedra and Opfer (n.d.), and Temurnikar (2020). 4. The obstacles and ways to overcome obstacles from the perspectives of Harris (2018), Kell (2018), Meador (2019), and Shaw (2017). 5. The development guidelines from the perspectives of Alber (2015), Armstrong (2020), Ayua (2017), Barile (n.d.), Cecil (2004), Clifford (n.d.), Cox (2016), Dean (2019), Goodwin (2018), Lands (2011), and Reinen (n.d.). 6. The evaluation from the perspectives of Duckworth (n.d.), Gerstein (n.d.), and Heick (n.d.).

In the aforementioned six points, the perspective on “development guidelines” is considered important because it provides recommendations that highlight the “principles, concepts, techniques, methods, and activities” for the teacher's learning. This is crucial to the process of guiding teachers in utilizing the learning outcomes as a practical approach with students in subsequent steps. The researchers have synthesized “development guidelines” from the perspectives of various references such as Alber (2015), Armstrong (2020), Ayua (2017), Barile (n.d.), Cecil (2004), Clifford (n.d.), Cox (2016), Dean (2019), Goodwin (2018), Lands (2011), and Reinen (n.d.), for a total of 60 guidelines as follows: 1) be able to implement technology, 2) uses 21st-century assessments with timely, appropriate, and detailed feedback and reflection, 3) collaboration, 4) objective setting and feedback provision, 5) student-centered discussions, 6) teaching strategies to be able to teach to all learners, 7) be able to foster student relationships, 8) uses problem-solving as a teaching tool, 9) implement inquiry-based learning, 10) be forward thinking, 11) developing thinking skill, 12) contextual learning bridging the disciplines and curriculum area, 13) reading activities, 14) try graphic organizers, 15) providing feedback, 16) model as you teach, 17) provision of recognition and effort reinforcement, 18) be able to embrace change, 19) combinations of media, 20) analyze diverse media forms, 21) turn essays into videos into podcasts, 22) allow students to choose media, 23) choose the media first, 24) all student work leaves the classroom, 25) use raft, 26) use tools for digital text annotation, 27) anchors year-long discussion of certain themes, 28) produce an ongoing podcast or Youtube channel, 29) connect the old with the new in an authentic, 30) makes use of project-based learning, 31) observational activities, 32) implementation activities, 33) making connections, 34) increased autonomy, 35) make mistakes, 36) encourage learning from experience, 37) let the students teach, 38) emphasize behavior management, 39) utilize visual aids, 40) modeling, 41) addressing mistakes, 42) experiential learning, 43) graphic organizers, 44) similarities and differences identification, 45) note-taking and summarizing, 46) homework and practice, 47) nonlinguistic representation, 48) concept attainment process, 49) mental rehearsal, 50) set induction, 51) planned repetition, 52) use of examples or establishing appropriate frame, 53) stimulus variation, 54) build trust and promote open communication, 55) focus on enhancing problem-solving and critical-thinking skills, 56) differentiated instruction, 57) teacher clarity, 58) classroom discussion, 59) goal setting, and 60) use a thematic focus.

These 60 development guidelines will be useful for teacher development and for teachers to practice in the classroom. It was observed that although there were some approaches that teachers were already familiar with, there were many new approaches that teachers had not been aware of before or had to see to be aware of. Each development guideline has detailed descriptions in the self-training modules that have been prepared.

2. Research Methods

2.1 Concepts and Process

This research utilized the R&D methodology based on the perspective of Sanrattana (2023), who referred to the concept that “knowledge and action are power”. This concept led to the research idea of “starting with Development Project for Teachers’ Learning, followed by the Project for Teachers to Bring Learning Outcomes into Practice with Students in a continuous manner.” The research study was conducted in 4 steps, as follows:

Step 1 involved reviewing the relevant literature on teacher's 21st- Century Skills in the 6 aspects mentioned in the “literature review” section. This review aimed at extracting the content from each area to develop online self-training modules for teacher learning. There were a total of 6 modules corresponding to the 6 areas, as well as an additional module, which focused on practical teaching approaches for teachers. For further details and the program structure, refer to Figure 1.

Step 2 involved assessing the quality of the online self-training modules through a two-phase process. The first phase was the “Preliminary Field Testing and Revision,” which involved 5 teachers from a non-experimental school as participants. The second phase was the “Main Field Testing and Revision,” which involved 10 teachers from another non-experimental school. Both phases utilized the focus group discussion method.

Step 3 involved creating research tools for the experimental study and was composed of two sets: 1) a test to assess

the teachers' learning outcomes, and 2) a questionnaire to evaluate the students' perceptions of the teachers' 21st-century skills (Details are discussed in the Research Tools section.).

Step 4 involved testing the effectiveness of the online self-training program based on the research hypothesis. The study utilized the "Online Self-Training Program for Development for Teacher's 21st-Century Skills Enhancement into Effective Practices" and employed a one-group pre-test-post-test experimental design. The study was conducted in a selected school, with 17 teachers and 510 students in the second semester of the Academic Year of 2023. The research was divided into two phases: a 1-month experimental study focusing on the development of the teachers' learning and a 2-month experimental study focusing on the teachers' implementation of their learning outcomes into practice with students.

2.2 Research Tools

2.2.1 The Teacher's Learning Outcome Assessment

The teacher's learning outcome assessment is a multiple-choice test with 4 options. Its purpose is to assess the learning outcomes of teachers before and after an experimental research study in the project aimed at developing teacher learning.

The research team developed the test based on pre-defined scope and content, focusing on 6 aspects: definitions, importance, characteristics, obstacles and ways to overcome obstacles, development guidelines, and evaluation. Each aspect was translated into test questions, which were aligned with the cognitive domain and progressed from lower-order thinking skills to higher-order thinking skills, namely remembering, understanding, applying, analyzing, evaluating, and creating, following The Revised Taxonomy 2001 of Benjamin S. Bloom (Armstrong, 2010). This test was subjected to a two-phase quality assessment.

Phase 1: Examining the content validity This was carried out by using the method of Rovinelli and Hambleton (1977), which is known as the Indexes of Item-Objective Congruence (IOC). Five qualified experts in the fields of Curriculum and Instruction and Educational Measurement and Evaluation were involved in this process. The analysis revealed that the questions had an Item-Objective Congruence (IOC) higher than the criterion of 0.50 (Chaichanawirote & Vantum, 2017).

Phase 2: Quality checking This was performed by using the test with a sample of 30 teachers in a non-experimental school setting. The data analysis revealed the following: 1) Every test item had an index of difficulty within the range of 0.20 - 0.80 and had met the criteria for the power of discrimination, which ranged from 0.20 to 1.00. The KR-20 value, which indicated internal consistency reliability, had been 0.84, which exceeded the threshold of 0.70. The test's level of difficulty was 0.62

2.2.2 The Evaluation of Students' Perception of the Teacher's 21st-Century Skills

The evaluation of students' perception of the teacher's 21st-century skills is designed as a 5-point rating scale: Very high, High, Moderate, Low, and Very low. The research team constructed the evaluation based on a study of the characteristics representing teachers' 21st-century skills per the perspectives of Bhattacharya (2021), Churches (2010), Cox (2019), Lebo (2015), Ledesma (2011), Saavedra and Opfer (n.d.), and Temurnikar (2020). Additionally, the design of the evaluation was influenced by the study of the evaluation concepts related to teacher's 21st-century skills from the perspectives of Duckworth (n.d.), Gerstein (n.d.), and Heick (n.d.). This evaluation was subjected to a quality check in two phases:

Phase 1: Examining the content validity using the method of Rovinelli and Hambleton (1977). Five qualified experts in the fields of Educational Administration and Educational Measurement and Evaluation were involved. The analysis revealed that the questions had an Item-Objective Congruence (IOC) higher than the criterion of 0.50 for every question. This indicated that the questions in this assessment could be used to measure the intended objectives (Chaichanawirote & Vantum, 2017).

Phase 2: Validating the reliability or internal consistency The evaluation questionnaire was administered to a sample of 30 students in a non-experimental school setting. Data analysis revealed that the alpha coefficient of reliability for the evaluation questionnaire had been equal to 0.94. When analyzed by dimension, it was found that in terms of verbal communication and literacy, collaborative networking skills, innovative thinking, and entrepreneurial skills, adaptability and flexibility, self-discipline and organization, resilience, and future vision, the coefficients had been 0.95, 0.94, 0.91, 0.96, 0.96, 0.96 and 0.89, respectively. When comparing the reliability coefficient to the established criterion of equal to or greater than 0.70 (UCLA: Statistical Consulting Group, 2016), it was found that the coefficients had exceeded the specified criterion, indicating that the items had had a relatively high internal

consistency.

2.3 Data Analysis

The data analysis incorporated 2 scenarios: 1) Analyzing scores from the post-tests of teacher learning outcomes after the experiment compared to the 90/90 standard, in which the first 90 referred to the percentage of the average test scores of the teachers, while the second 90 signified the percentage of teachers, who had passed the test according to the criteria of the objectives (Yamkasikorn, 2008) and 2) Analyzing and comparing the results from the pre-tests and post-tests using the dependent t-test statistic.

3. Results

3.1 The Results of an Educational Innovation

The results from this research led to the creation of an educational innovation called the “Online Self-Training Program for Development for Teacher’s 21st-Century Skills Enhancement into Effective Practices”. This program consisted of two interrelated projects: 1. *Development Project for Teachers' Learning*, which utilized six self-training modules as follows: definition, importance, characteristics, obstacles and ways to overcome obstacles, development guidelines, and evaluation. 2) *The Project for Teachers to Bring Learning Outcomes into Practice with Students*, which incorporated a self-training module to guide teacher practices as follows: instruction, summarize the expected characteristics, summary of development guidelines, assessment form of students' perceptions of teacher's 21st-century skills, self-assessment form for teachers on the level of implementation of development guidelines (google form), teachers' self-assessment on the selection of a development process model for implementation (google form), and teacher's self-reflection form on practice (google form). Further details are illustrated in Figure 1.

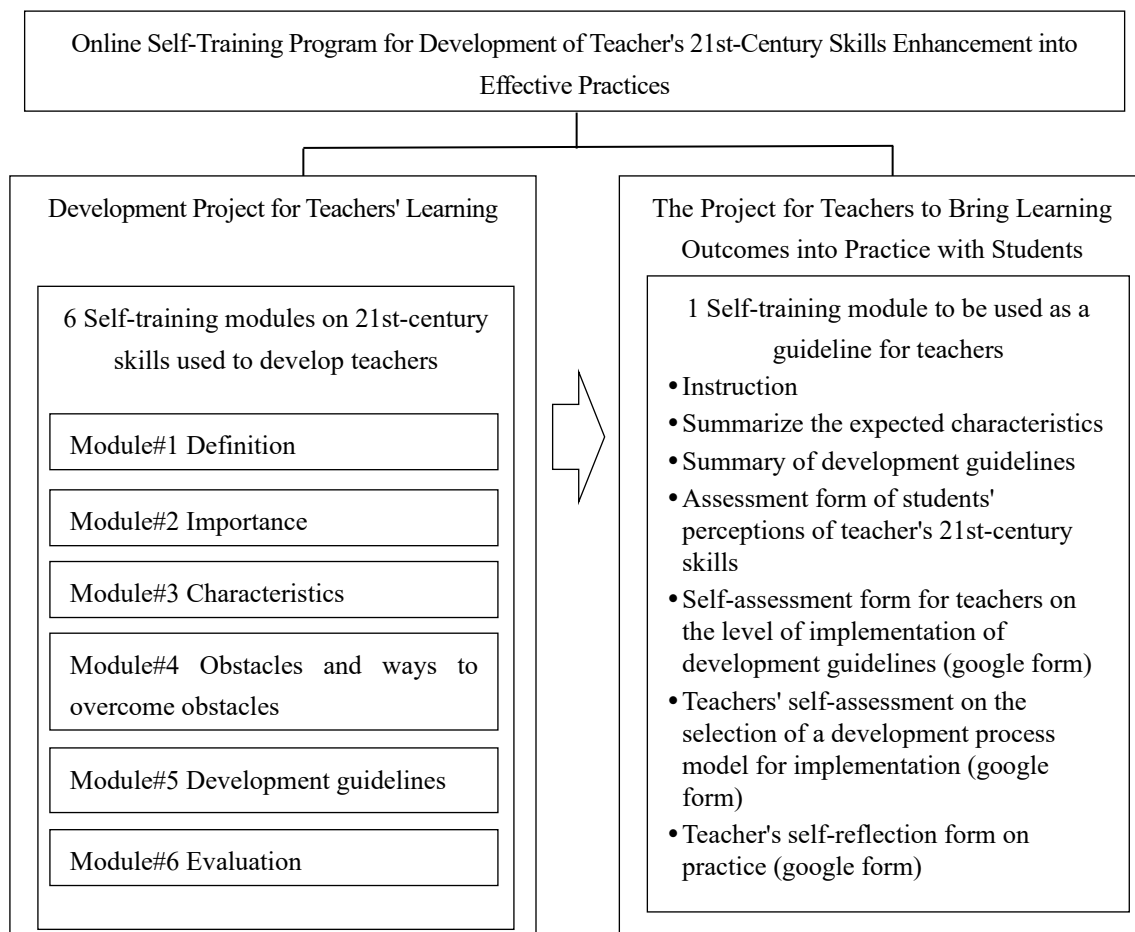


Figure 1. Online Self-Training Program for Development for Teacher’s 21st Century Skills Enhancement into Effective Practices

3.2 The Results of the Effectiveness Testing of the Online Self-Training Program

The experimental research results in the development project for teachers' learning revealed that they had aligned with the following pre-defined research hypotheses: 1) the teachers in the experimental group had had an average score from the Post-tests of 32.88 points, which represented 91.33 percent of the full score. They demonstrated learning outcomes that were found to be in line with the specified objectives at 96.07 percent, meeting the 90/90 standard, and 2) the average post-test scores had been significantly higher than the pre-test scores at a level of statistical significance of 0.05, as shown in the data analysis results in Table 1.

Table 1. Mean of Teachers' Pre-test and Post-test Scores Using Dependent t-test

Testing	Sample size	Mean	Standard Deviation	t
Pre-tests	17	21.76	2.06	6.63*
Post-tests	17	32.88	6.68	

* $p < 0.05$

The experimental research in the project for teachers to bring learning outcomes into practice with students found that it aligned with the established research hypotheses. This is evident from the analysis of the mean and standard deviation values from the evaluation of the student perceptions towards the teacher's 21st-century skills before and after the experiment, as shown in Table 2. Additionally, the comparative analysis using a dependent t-test is presented in Table 3.

Table 2. The Mean and Standard Deviation Values from the Evaluation of Student Perceptions towards Teacher's 21st-Century Skills Before and After the Experiment

The Characteristics of Teacher's 21 st -Century Skills	Evaluation results			
	Pre-test		Post-test	
	$\bar{\chi}$	S.D.	$\bar{\chi}$	S.D.
Verbal Communications and Literacy	3.98	0.88	4.20	0.81
• My teacher allows me to speak and write using my unique voice.	4.10	0.84	4.31	0.75
• My teacher helps me to develop mindfulness, enthusiasm, and passion when communicating through speech and writing.	3.97	0.90	4.21	0.77
• My teacher helps me to create basic documents in Microsoft Word in an accurate manner.	3.78	0.90	4.31	0.75
• My teacher helps me to make an effort to communicate face-to-face with other students in meetings.	4.08	0.88	4.21	0.77
Collaborative Networking Skills	4.01	0.89	4.10	0.89
• My teacher facilitates my communication and collaboration with students globally.	3.98	0.90	4.20	0.82
• My teacher provides me with opportunities to work collaboratively, both face-to-face and virtually.	4.02	0.93	4.18	0.84
• My teacher assists me in developing my learning network.	3.95	0.86	4.14	0.87
• My teacher encourages me to create documents reflecting my learning, to exchange ideas, and to work with others.	3.99	0.88	4.18	0.85
• My teacher encourages my participation in classroom activities with other students to expand my knowledge and global perspectives.	4.12	0.86	4.18	0.82
• My teacher serves as a role model and assists me in understanding and embracing my intellectual processes.	4.00	0.92	4.14	0.85
Innovative Thinking and Entrepreneurial Skills	3.84	0.89	4.25	0.82
• My teacher helps me to engage in meaningful work.	4.09	0.90	4.21	0.81
• My teacher provides me with opportunities to engage in risky or innovative learning activities.	4.07	0.91	4.12	0.85

The Characteristics of Teacher's 21 st -Century Skills	Evaluation results			
	Pre-test		Post-test	
	$\bar{\chi}$	S.D.	$\bar{\chi}$	S.D.
• My teacher assists me in developing critical thinking by stepping out of my usual boundaries and trying new things.	4.02	0.97	4.25	0.77
Flexibility and Adaptability	3.97	0.94	4.19	0.82
• My teacher helps me to accept change as natural and assists me in doing so.	3.97	0.97	4.22	0.79
• My teacher helps me to become more flexible.	3.86	0.94	4.17	0.84
• My teacher helps me to use a variety of tools to solve new problems.	3.93	0.93	4.17	0.81
• My teacher promotes awareness of online safety and being a good digital citizen.	4.03	0.93	4.25	0.81
• My teacher helps me to use technology to enhance my learning experience.	4.03	0.92	4.17	8.81
• My teacher helps me to find ways to adapt to challenging situations.	3.97	0.95	4.18	0.82
Self-discipline and Organization	3.97	0.93	4.20	0.81
• My teacher sets the example and assists me in developing and understanding my intellectual processes.	3.98	0.92	4.17	0.80
• My teacher helps me to develop the ability to motivate myself.	3.99	0.95	4.23	0.81
• My teacher helps me to reflect on and assess my learning experiences.	3.96	0.92	4.21	0.79
• My teacher encourages me to create a digital portfolio to showcase my progress and to manage my work effectively.	3.94	0.94	4.20	0.83
Resilience	3.97	0.93	4.19	0.83
• My teacher helps me to see failure as an opportunity for growth.	3.95	0.96	4.20	0.85
• My teacher promotes and cultivates my resilience naturally.	3.91	0.92	4.11	0.85
• My teacher ensures that I have confidence that all learners know that "Teachers do matter."	4.09	0.90	4.22	0.81
• My teacher creates a fun classroom atmosphere for me.	3.97	0.96	4.18	0.85
• My teacher helps me to be flexible in managing variables related to learning.	3.92	0.92	4.21	0.80
Vision for the Future	4.04	0.92	4.20	0.85
• My teacher helps me allocate time, resources, and opportunities to explore myself and pursue my dreams.	4.02	0.93	4.21	0.83
• My teacher helps me to develop the necessary procedures and strategies to achieve my dreams.	4.00	0.93	4.18	0.87
• My teacher encourages me to be a role model in being a good citizen when using online platforms and connecting with others on social media.	4.10	0.90	4.22	0.85
Totals	3.99	0.92	4.20	0.83

Table 2, it can be seen that the average scores from the evaluation of the students' perceptions of the teacher's 21st-century skills after the experiment had been higher than before the experiment. That is, the average score after the experiment was 4.20 (standard deviation was 0.83). the average score before the experiment was 3.99 (standard deviation was 0.92). Upon analyzing and comparing using a dependent t-test, it was found that there had been a statistically significant difference at the level of 0.05, as indicated in Table 3.

Table 3. The Results of Data Analysis Comparing the Mean Scores of the Pre-tests and Post-tests of the Students Using a Dependent t-test

Evaluating	Sample size	Mean	Standard Deviation	t
Pre-tests	510	3.99	0.92	4.947*
Post-tests	510	4.20	0.82	

* $p < 0.05$

4. Discussion

The results from the research, which was conducted using the R&D methodology using a one-group pre-test and post-test experimental design, were used in the final phase. Purposive sampling was used to select the target school and the experimental group, which consisted of 17 teachers and 510 students. The study's objective was to examine the effectiveness of the "Online Self-Training Program for Teacher's 21st-Century Skills Enhancement into Effective Practices," which is considered an educational innovation. The results revealed that the aforementioned educational innovation had been effective by the research hypotheses both in terms of the experimental research related to the teacher development project and the experimental research that was related to the project, in which the teachers applied the learning outcomes to their students' practices. For the experimental group of teachers, it was found that the post-test scores had met the standard criteria of 90/90 and compared to the pre-test scores, had exhibited statistically significant improvement. The students in the target group, who had benefited from the development, showed statistically significant improvement with post-test scores that were higher than their pre-test scores. The findings from this research were consistent with the research results of other researchers, who had utilized the R&D methodology with similar research designs: "Developing Teachers to Enhance Project Management Skills for Students" by Nukoonkan and Dhammapissamai (2023), "Developing Teachers to Develop Students' 21st Century Skills" by Mopara and Sanrattana (2023), and the research related to "Enhancing Teachers' Learning to Develop Students to Become Successful Students" by Thammabut and Thacha (2023).

In addition to aiming to test the effectiveness of the educational innovation, which was created as the main objective, the research team also sought additional knowledge from the teachers in the experimental group during the research process. Specifically, the team focused on knowledge, which had been derived from actual practices and was considered as learning and reflections. The interesting points and insights from this aspect are discussed below.

The teachers in the experimental group agreed with the challenges of being 21st-century teachers, which was from the perspective of Shaw (2017), who noted the problems that are faced by teachers, including those in the experimental group. The identified problems consisted of the following: 1. The daily bell schedule: The majority of teachers work within a daily bell schedule, teaching six or more classes per day, with each class averaging about 45 minutes. This short period of teaching time, combined with an enormous list of specific content standards and skills to teach, resulted in the teachers feeling pressured and needing to rush through these standards as quickly as possible. 2. Mandated curriculum pacing guides (i.e., marching orders): These are district mandates, which dictate specifically what you are to teach and when. Moreover, they are organized by grading periods (usually quarterly or every six weeks). 3. A lack of planning time: Teachers need plenty of individual planning time, as well as time to conduct collaborative planning with other teachers. Many teachers have one class period per day for planning, but some do not even have that much. 4. A lack of support in terms of professional development: If teachers are to begin designing and implementing a 21st-century model curriculum and instruction, they need knowledge and support. 5. Standardized testing: Another robber of time is all the test preparations and the taking of tests that must occur. This situation has caused teachers to abandon curricula that are creative, high-level, and meaningful since they are required to take students on a forced march through the standards. 6. The organizational structure of the school (The "Cells and Bells" problem): The current structures of schools, ranging from the physical facilities to the curriculum, create and sustain a fragmented educational experience. 7. Excessive administrative duties: teachers have too many forms to complete and report to file. Moreover, an inordinate amount of time is spent on these tasks. 8. Fear of failure. 9. Outdated Teacher Evaluation Practices. 10. The enduring factory model paradigm of teaching and learning. 11. A lack of meaningful integration of technologies. 12. A micro-analysis of everything

5. Conclusion

The results of this research are by the research hypotheses mentioned above: 1) the experimental group of teachers

would achieve post-test scores that would meet the 90/90 standard and their scores would be significantly higher than the pre-test. scores based on statistical significance, and 2) students in the target group, who had received the impact of teacher practices, would have post-test scores that would be significantly higher than the pre-test scores based on statistical significance. It can be shown that the educational innovation developed with R&D methodology with details of operations as mentioned in the research methodology section above. Including the use of the concept of "knowledge and action are power" in designing this research. Adopting various perspectives on teacher's 21st-century skills in various aspects as a guideline for teacher development to make learning a priority for teachers. Then stimulate and encourage teachers to use the learning results to practice in the classroom to the specified indicators, resulting in effective educational innovations as expected. Therefore, the educational innovation called the "Online Self-Training Program for Development for Teacher's 21st Century Skills Enhancement into Effective Practices" obtained from this research can then be disseminated for the benefit of teachers and students in schools that are the target population for this research throughout the country.

6. Recommendations

Based on the aforementioned challenges, the teachers in the experimental group recognized the fact that developing one's self to become a 21st-century teacher is not merely a difficult task, but it is an exceptionally challenging endeavor. In Thai, this can be metaphorically expressed as "attempting an uphill task," which means facing an extremely challenging or daunting task. Due to the characteristics of a 21st-century teacher, which are expected to differ significantly from those of a 20th-century teacher in almost every aspect (i.e., fundamental principles and concepts, knowledge, attitudes, skills, and behaviors), a transformation is necessary. This transformation involves shifting from processes that were designed for the 20th Century to those suited for the 21st Century, by incorporating numerous new practices that differ from the past. The synthesized results from the literature review, which were derived from the perspectives of Alber (2015), Armstrong (2020), Ayua (2017), Barile (n.d.), Cecil (2004), Clifford (n.d.), Cox (2016), Dean (2019), Goodwin (2018), Lands (2011), and Reinen (n.d.), totaled 60 guidelines. (Please refer back to the literature review section.) This total does not potentially reflect additional recommendations that may not have been incorporated into this analysis.

However, developing one's self to become a 21st-century teacher is not an easy task. Nevertheless, when situations undergo global changes, it is the teachers themselves that must evolve to keep up with these transformations. In particular, adapting to the term "21st-century Teacher" is crucial, since self-development becomes essential when seeking to embody the characteristics of a teacher, who in various significant aspects, is well-suited for teaching in the 21st Century. According to a synthesis of perspectives from Barbousas (n.d.), Bhattacharya (2021), Kivumbi (2021), Ledesma (2011), and Temurnikar (2020), it is evident that emphasizing 21st-century skills for teachers is crucial. Education in the 21st Century aims to equip students with the necessary skills that can lead them to achieve success in this new era. Teachers must have readily available information that can help to boost their students' levels of confidence when practicing those skills. Ensuring that students possess the crucial skills that are necessary for success in this new era is essential. To accomplish this, teachers need to receive support to assist them in developing skills for teaching in the 21st Century. This support enables teachers to learn, to understand various situations and events, and to adapt to changing contexts. Moreover, the trend of learning will not be solely confined to schools or classrooms in the future. Digital innovation and technology are expanding the boundaries of learning paradigms and are enabling students to learn various real-life skills that can empower them to make independent decisions. Consequently, teachers can no longer remain passive or be stuck clinging to traditional methods. Therefore, teachers need to undergo continuous development and must actively seek knowledge to stay abreast of situations. This process involves considering the three components of learning: acquiring new knowledge, gaining additional insights, and unlearning misconceptions or incorrect information. This is necessary because, in the past, there was traditional lecture-based learning, in which the teacher lectured to the entire classroom, which often did not lead to successful outcomes. It was found to be ineffective in helping students learn and apply knowledge to solve real-world problems. Furthermore, the traditional education system often hinders the development of skills, attitudes, values, and motivation, all of which are necessary for promoting creative thinking. As a result of these circumstances, students can lose the motivation to learn.

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Authors contributions

Suphakit Sunaree was responsible for conducting every step of the research. Starting with studying research problems, designing research methods, creating innovations for use in research, conducting field research, summarizing results and reporting research results. Associate Professor Dr. Wirot Sanrattana and Assistant Professor Dr. Phrasrivajiravati provided advice and consultation. in the research process. Suphakit Sunaree drafted the manuscript and revised it. Associate Professor Dr. Wirot Sanrattana and Assistant Professor Dr. Phrasrivajiravati approved the final manuscript.

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