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RESEARCH ARTICLE

# The Impact of a Training Program Based on the TAWOCK Model for Teaching Computational Thinking Skills on Improving Teaching Practices among Computer Teachers

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**ABSTRACT**

The aim of this research was to investigate the impact of a training program based on the TAWOCK model for teaching computational thinking skills on enhancing teaching practices among female computer teachers. Employing a quasi-experimental approach with pre-test and post-test design, including a control group, an electronic training program aligned with the TAWOCK model was developed alongside the creation of the research instrument, the Teaching Practices Observation Card. The study population comprised all middle and high school computer and information technology teachers in the Al-Nahda Education Office, Riyadh. The research sample included (8) teachers in the experimental group and (7) in the control group. The findings revealed a significant difference ($\alpha \leq 0.05$) in the average ranks of computer teachers between the experimental and control groups in the post-test, favouring the experimental group. The Eta squared value for the total Teaching Practices Observation Card was (0.828), indicating a substantial impact on improving teaching practices among computer teachers. Furthermore, a statistically significant difference ($\alpha \leq 0.05$) was observed in the average ranks of computer teachers within the experimental group between the pre-test and post-test, favouring the post-test. The Cohen's d value for the total Teaching Practices Observation Card was (2.06), suggesting a significant improvement in teaching practices among computer teachers in the experimental group.

## INTRODUCTION

The effectiveness of teaching within the classroom is enhanced when educators possess a strong cognitive background and a diverse skill set. This enables them to select the most appropriate approach for each teaching scenario. Thus, teachers should have a comprehensive understanding of both the desired learning outcomes for students and the mechanisms through which learning occurs (Saada & Ibrahim, 2020). Abdel Kader and Abdul Wahab (2015) underscore the significance of teachers' familiarity with the cognitive aspects of teaching to enhance their performance. To achieve this, emphasis should be placed on teacher training, enabling them to acquire new skills and employ a variety of methods, techniques, and educational technologies throughout the teaching process (Saada & Ibrahim, 2020).

With the advancement of technology, training methods have diversified, and the introduction of electronic training has become a new reality for training systems in many countries worldwide. This shift has brought about significant changes in the nature of the training process, including its content and procedures, and has also redefined the roles and tasks of both the trainers and the trainees. Furthermore, electronic training hat the potential to mitigate the limitations of traditional training methods by offering more interactive tools and programs (Saraya, 2012).

However, it is crucial to view electronic training as a proactive response to genuine needs, rather than simply reaction to an existing problems or performance deficiencies. This underscores the necessity for conducting a comprehensive analysis of information and the identifying training needs before developing electronic training curricula (Fadil, 2019). One effective approach to achieve this is by utilizing the TAWOCK (Training Analysis Workshops for Curriculum Knowledge) model in delivering such training programs. The TAWOCK model ingrates the requirements of adult learning, fosters independence, align with participants' maturity levels, encourages actionable learning, and establishes a foundation for knowledge-based electronic training delivery (Arifin et al., 2020 A).

On the other hand, the global expansion of digital technology and the emergence of the digital society have introduced a range of digital skills crucial for success in both professional and personal spheres, including computational thinking skills (The International Telecommunication Union, 2018), which are deemed essential in the 21st century (Wing, 2015). These skills not only foster perseverance but also facilitate engagement in various activities among students (Ottenbreit-Leftwich & Kimmons, 2020). Consequently, there is a pressing need to focus on the training of computer teachers and provide continuous professional development opportunities in the realm of computational thinking skills. This is underscored by the identified weaknesses in computer teachers' attainment of computational thinking skills standards, as revealed by Al-Asmari and Shareefi (2019). Therefore, it is imperative to enhance their understanding of how to effectively incorporate these skills into classroom practices. Bocconi et al. (2016) advocate for the integration of computational thinking skills into school curricula, the provision of ongoing professional development for computer teachers, and the implementation of training activities aimed at facilitating the seamless transfer of skills to their classrooms. Al-Amiri (2015) also identifies the pressing need for computer teachers to acquire teaching methods that stimulate students' critical thinking abilities.

To effectively train female computer teachers in teaching computational thinking skills, ensuring they grasp the intricacies of the teaching process and how to seamlessly integrate technology, tailored training programs are essential (Alhusseini, 2021). Such training should be designed to meet specific needs of female computer teachers, recognizing that education for work entails distinct requirements, particularly in the realm of andragogy, or adult education. This level education demands competency-based, work-oriented training approaches, emplying suitabke methods tailored for adult learners (Arifin et al., 2020 B).

Regular and continuous professional development training for computer teachers can significantly impact various aspects of their development, thereby enhancing their performance and teaching quality, ultimately benefiting student learning outcomes. Research by Hijazi's (2013) concluded that conducting training courses and specialized workshops aimed at improving teaching practices among female teachers yielded positive results. Thoonen et al. (2011) emphasized that teachers' engagement in professional learning activities, particularly through reflection and experiential learning, significantly correlates with the improvement of teaching practices, encompassing planning, teaching, assessment, feedback provision, and student communication. These teaching practices are influenced by personal experiences, cultural factors, institutional systems, and can also be shaped by training and socialization within the school environment. Hence, these teaching practices adopted by teachers play a pivotal role students' learning outcomes and academic achievements, fostering student engagement and motivation to learn (OECD, 2014).

To enhance the practices contributing to effective teaching, it is crucial for teachers to possess comprehensive knowledge of the curriculum content and their areas of specialization. They should also be adept at employing diverse teaching strategies tailored to this content, understand effective methods for delivering the material to students, and grasp the dynamics of student learning (Burns, 2011). Achieving this requires continuous professional training and development opportunities for teachers, enabling them to stay abreast of educational advancements and empower their students by imparting contemporary skills. Therefore, this research aims to develop a training program tailored for computer teachers to support them in teaching computational thinking skills, which are increasingly recognized as essential in the 21st century. The program aims to enhance their teaching practices and equip them with the necessary skills to effectively impart communicational thinking to their students.

## LITERATURE REVIEW

### Teaching practices

According to Shubar et al. (2010) teaching practices encompasses “the set of activities that the teacher engages in during a teaching situation to assist students in achieving learning objectives” (p. 10). Similarly, Alshamrani and Algamdi (2019) defined them as “the organized and planned behavior that the teacher exhibits within the classroom” (p. 62). In order to fulfill their primary, essential, and effective role to the fullest, teachers must possess certain practices and skills that enable them to carry out their teaching duties with efficiency: namely, planning, implementing, and evaluating teaching methods. The teaching practices of educators are among the most significant educational inputs in achieving the desired educational objectives. Through the teaching process, knowledge, information, and experiences are transferred to enhance students' levels and foster positive changes in them (Al-Shammari, 2019). The American Educational Association has identified seven principles of good teaching practices, which are:

**Good teaching practices prioritize interaction between the teacher and the learners:** Engaging in meaningful communication, both within and outside the classroom, is vital for fostering student motivation and involvement in the learning process. Such interaction encourages students to contemplate their values and aspirations for the future.

**Good teaching practices are foster collaboration among learners:** Research indicates that collaborations learning significantly enhances the learning experience. Effective teaching, akin to successful teamwork, thrives on collaboration and cooperation, rather than fostering competition and individual isolation.

**Good teaching practices promote active learning:** Learners are not passive recipients of knowledge; instead, they actively participate by articulating concepts, relating new information to prior experiences, and applying their learning in practical contexts.

**Good teaching practices provide timely feedback:** Offering constructive feedback in a timely manner enables students to assess their understanding, identify areas for improvement, and reflect on their learning progress.

**Good teaching practices allocate sufficient time for learning (Time + Energy = Learning):** Adequate time is essential for meaningful learning experiences, and students benefit from developing effective time management skills to optimize their learning potential.

**Good teaching practices set high expectations (Expect More, Get More):** Establishing ambitious performance standards motivates students to strive for excellence and challenges them to reach their full potential.

**Good teaching practices recognize divers intelligence and learning styles:** Acknowledging that students have different learning preferences and abilities informs effective teaching strategies that accommodate this diversity.

Alnaji (2007) outlined key teaching practices aligned with constructivist principles, which include:

1. Providing features that foster thinking and self-learning within the learning environment.

2. Shifting teacher's role to that of a guide who assists students in constructing knowledge and forming meanings. This is achieved through diverse utilization of sources, resources, and educational activities that are meaningful and directly relevant to students' lives and environments.
3. Promoting participation, collaboration, and dialogue among students to showcase their cognitive and skill potentials, while considering individual differences and facilitating the exchange of experiences among peers.
4. Employing thought-provoking questions to stimulate learners to explore multiple solutions for a given problem, encouraging innovative creative thinking.
5. Cultivating a culture of exploration among learners, fostering curiosity and a desire for discovery.

Here's a summarized overview of the key teaching practices for the 21st century as outlined by Al-Roaus (2021):

1. Emphasizing critical thinking and problem-solving skills through educational experiences centred on questioning, analysis, interpretation, and data-driven decision-making, aiming for a deep understanding of concepts.
2. Facilitating meaningful learning experiences by connecting new information with learners' existing cognitive structures using discovery learning methods, inductive reasoning, concept mapping, and advanced electronic organizational tools.
3. Implementing active learning strategies that empower learners to actively engage in planning, execution, and assessment of their learning experiences.
4. Integrating modern technology into the educational process to deliver content, facilitate practical applications, conduct educational tasks, and employ contemporary assessment methods effectively.
5. Employing various assessment strategies, including formative assessment, authentic performance-based assessment, computer-based assessment, and electronic learning management systems.
6. Creating adaptable learning environments through differentiated instruction, self-directed learning strategies, cooperative learning, peer learning, and teamwork, thereby catering to individual differences and fostering the development of learners' talents and skills to align with 21st century demands.

Let's explore the role of teaching practices:

Teaching practices are dynamic and interactive processes characterized by constant movement and interaction. They entail a reciprocal relationship between the teacher and the student, each influencing and being influenced by the other. This interaction forms a three-dimensional process involving the teacher, the student, and the educational material. The primary aim of teaching practices is to enhance the behaviour and performance of the student. They are inherently social behaviours, necessitating social interaction not only between the teacher and students but also among the students themselves. Despite advancements in modern educational technologies, teaching practices retain a human aspect, emphasizing the irreplaceable role of the teacher (Mujahid, 2020).

Several studies have highlighted the significant impact of teaching practices on student learning outcomes. For instance, Long et al. (2022) discovered a correlation between teaching practices and student achievement, particularly emphasizing the effectiveness of inquiry-based teaching methods. Furthermore, Öncü and Bichelmeyer (2021) observed that when teachers utilize cooperative practices centred on the learner, students exhibit higher levels of engagement in both learning and classroom activities.

Furthermore, Mailizar and Fan (2021) have identified a close association between teaching practices observed in classrooms and the particular types of tasks assigned during lessons. Conversely, Al-Shammari (2017) has pinpointed deficiencies in the teaching practices among computer science teachers, prompting the current research to develop a training program aimed at enhancing the teaching practices of these educators. The initiative seeks to evaluate the effectiveness of the training program in improving the teaching practices of both male and female computer science teachers, with the goal of formulating relevant recommendations to address any disparities in teaching practices between genders.

Rindone (1993) identifies three main areas influencing teaching practices:

**School and classroom organization:** Classroom settings are characterized by numerous tasks and events, simultaneous occurrences of different situations, and unpredictable events. Moreover, the accumulation of experiences and routines throughout the school year adds to the complexity. Managing interaction time between students and teachers to meet diverse student needs presents continuous challenges for educators. To address these pressures, teachers must innovate ways to organize space, manage time effectively, and adopt teaching methods that efficiently confront these challenges.

**School and teacher beliefs and values:** School culture awareness aids in comprehending teachers' practices, their rationale, and their influence on the selection of appropriate teaching methods. For example, teaching practices centred on reading and lecturing may stem from a desire to maintain a quiet classroom environment, as many educators believe that students learn best in such conditions. This approach reflects deeply ingrained beliefs among teachers who prioritize discipline and respect for the teacher's authority in the classroom.

**Teacher training:** Despite efforts, teacher preparation programs often fail to meet necessary standards, underscoring the significance of in-service teacher training initiatives through specialized courses. Such training significantly influences teachers' practices within the classroom, consequently impacting student achievement levels.

Given that female computer science teachers are tasked with imparting 21st-century skills to their students and considering Al-Khwildi's (2014) findings that the teaching performance of computer science teachers, measured against quality standards, is above average, Al-Shammari (2017) stresses the importance of developing programs and technical workshops aimed at training these educators in lesson planning, implementation, and evaluation. This emphasis on training is justified by the significant impact that such programs have on the teaching practices of computer science teachers.

Here are some principles to be considered in teacher training programs aimed at preparing educators who foster student thinking and learning (The Frame for the Teacher Training Program in PROVED, 2016):

Integration of theory and practice: The training should incorporate both theoretical knowledge and practical applications in education.

Collaborative learning: Teachers should function as consultants during training, supporting one another through the exchange of experiences.

Specialized and diverse training: Programs should offer a variety of specialized training activities aimed at enhancing processes, procedures, and theoretical understanding in specific subject areas.

Balance between individual and group activities: Training should include both individual activities to develop personal competencies (e.g., self-awareness, adaptability) and group activities to enhance social competencies (e.g., communication, collaboration).

Variety in training methods: Diverse training methods should be employed to develop problem-solving strategies, enabling teachers to effectively support student learning processes.

To effectively teach computer science, both male and female teachers should possess various types of knowledge, as identified by Gal-Ezer and Stephenson (2010):

Content knowledge: A deep understanding of computer science concepts, theories, and principles.

Knowledge of other content: Understanding how computer science is applied in other disciplines or fields, facilitating interdisciplinary connections.

Knowledge of learners: Awareness of students' backgrounds, interests, abilities, and learning styles to tailor instruction accordingly.

Knowledge of educational goals and general pedagogical knowledge: Understanding educational objectives, curriculum standards, and effective teaching strategies applicable across subject areas.

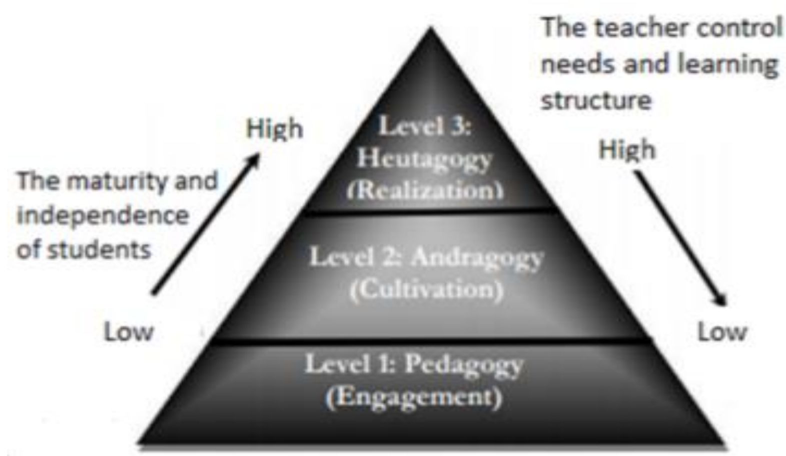
In light of evolving educational landscapes, particularly in computer science curricula, teachers must be adequately prepared to respond to new demands. Therefore, training programs are essential to enhance teachers' professional learning and equip them with the skills needed to adapt to changing educational requirements (Zhou et al., 2020).

To ensure the success of computer science education, it is imperative to examine the teaching conditions for computer science teachers and identify key trends for their training, as emphasized by Oshanova et al. (2021). This enables educators to adopt modern teaching strategies that align with advancements in computer science education worldwide. Such strategies prioritize enhancing learning effectiveness and placing the learner at the centre of the educational process. As a result, the computer science curriculum becomes more valuable and relevant to the learner's life, fostering greater engagement and learning outcomes (Al-Gamal & Al-Desouky, 2020).

## RESEARCH DESIGN

The experimental group, comprising (8) female teachers, participated in training sessions focused on an electronic training program grounded in the TAWOCK model for teaching computational thinking skills. This program aimed to support computer science educators in effectively imparting computational thinking abilities to their students. The training program spanned a duration of (15) days, with an average of three hours per day, totalling (45 hours) of instruction.

Meanwhile, the control group, consisting of (7) female teachers, received training on a program for teaching computational thinking skills utilizing conventional methods. This entailed in-person attendance and face-to-face interaction between the teachers and the trainer. The TAWOCK model operates at an intermediate level according to the learning levels depicted in Figure (1).




(Arifin et. al., 2020 C, 788)

**Figure 1: Illustrates the levels of learning between pedagogy, andragogy, and heutagogy**

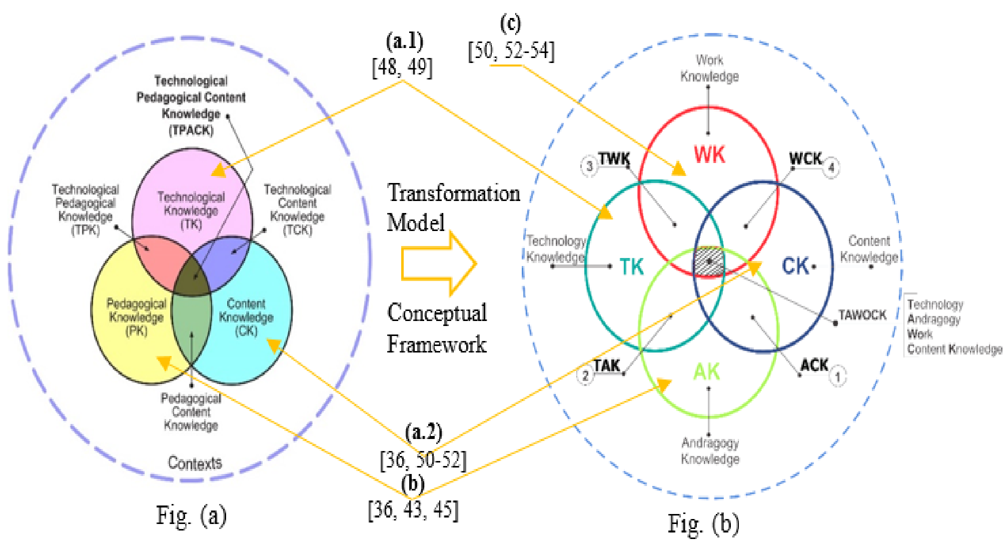
The first level: Pedagogy pertains to educational participation and represents a basic or foundational teaching approach. At this level, students are participants who follow the guidance of the teachers. In educational theory, this level is characterized by a lack of freedom for students to evolve into independent, mature, and procedural adults, leading to a sense of unproductivity.

The second level: Andragogy emphasizes maturity and independence in learning, making it suitable for adult education.

The third level: Heutagogy, also known as self-directed learning, represents the highest level, surpassing the demands of adult education by becoming an integral part of life.

The TAWOCK model (Transformation of TPACK to Work-Related Context) is a novel framework adapted from the TPACK (Technological Pedagogical Content Knowledge) model within the realm of professional education (Arifin et al., 2020 A).

This model represents a conceptual evolution of the TPACK framework (Arifin et al., 2020 C), integrating new concepts such as work content and andragogy, as depicted in Figure (2).




(Arifin et. al., 2020 B, 701)

**Figure 2: llustrates the transformation from the TPACK Model to the TAWOCK Model.**

From Figure (2), it is evident that the conceptual transformation from the TPACK model to the TAWOCK model comprised three parts (Arifin et al., 2020 C):

Part that retained the original concept and did not change in the new model (A1 and A2): Technology Knowledge (TK) and Content Knowledge (CK).

Part that transitioned from the original concept to a new one (B): Andragogy Knowledge (AK), referring to knowledge of appropriate methods and strategies for teaching adults.

The last part is a newly added concept (C): Work Knowledge (WK).

To meet the demands of 21st century learning, particularly in the realm of technology and knowledge content, the TAWOCK model (Technology, Andragogy, Work, Content, and Knowledge) has been adapted to facilitate the delivery of professional education and training using technology. As part of this adaptation, a component related to professional values and work objectives has been incorporated into the model (Arifin et al., 2020 C). Professional education places emphasis on cultivating competencies aligned with required tasks (Arifin et al., 2020 A). Therefore, the current research aims to evaluate the impact of the designed training program based on this model on teaching practices and self-efficacy effectiveness, addressing the essential competencies necessary for effective teaching.

Warju et al. (2020) emphasized the significance of employing the TAWOCK model in professional domains, highlighting its suitability for professional learning facilitated by technology. This model aims to cultivate the abilities of students and trainees, enabling them to excel in their respective fields of work. Vocational education, being education for work, necessitates an educational approach capable of showcasing individual capabilities professionally and subsequently fostering the development of skills and competencies tailored to workplace demands (Arifin et al., 2020 B). To address this, the TAWOCK model incorporates the work domain and enhances the concept of andragogy, making it particularly suitable for vocational education and training. Meanwhile, other elements such as technological knowledge and content knowledge remain unchanged within this framework (Arifin et al., 2020 A).

## METHODOLOGY

The purpose of the research was to examine the effects of a training program rooted in the TAWOCK model for teaching computational thinking skills on enhancing the teaching practices of computer science teachers. This was achieved by addressing the following question: What is the impact of the training program based on the TAWOCK model for teaching computational thinking skills on improving the teaching practices of computer science teachers? The study utilized a quasi-experimental methodology employing a pre-test and post-test design, which included both an experimental group and a control group.

### Study participants

The participants in the study comprised 16 female computer science and information technology teachers from the middle and high levels at the Al-Nahda Education Office in Riyadh. They volunteered to take part in the research and were randomly assigned to two groups, each consisting of 8 female teachers, to ensure equitable opportunities. Random assignment ensured that each teacher had an equal chance of being allocated to either the experimental group or the control group (Al-Assaf, 2016). However, one teacher from the control group withdrew from the study due to personal reasons.

### Research instruments

The instruments were developed following these steps:

1. Defining the objective of the observation card: The observation card aimed to assess the impact of the training program based on the TAWOCK model on enhancing teaching practices among female computer science teachers, addressing the second research question.
2. Identifying sources for preparing the observation card: The observation card was developed based on various sources, including previous studies, textbooks, computer science and information technology curriculum documents for intermediate and secondary levels, computer science teacher's guide, and computer science teacher's standards.
3. Preparation of the initial version of the observation card: The observation card for teaching practices included two parts:

Part One**:** Teacher information, encompassing details such as name, academic qualifications, years of experience, teaching load, training courses, and school name.

Part Two: Axes of the observation card, comprising teaching planning, teaching execution, teaching assessment and feedback, and communication with students.

4. Presentation of the observation card to experts: Specialists and experienced individuals reviewed the observation card to ensure clarity of phrases, alignment with the axes, linguistic accuracy, and appropriateness of the scale gradient.
5. Modification of the observation card based on expert feedback: Key modifications included defining three levels for assessing teaching practices instead of four, reducing the number of teaching practices, and adjusting the wording or alignment of some teaching practices.
6. Formulating the final version of the observation card.

The internal consistency of the teaching practice observation card was assessed using the Pearson correlation coefficient between each phrase of the dimension and the total score of the dimension it belongs to, as well as Pearson correlation coefficients for each dimension with the total score of the card, as presented in Tables (1) and (2).

**Table 1: Correlation Coefficients for each statement of the dimension with the total score of the dimension for the teaching practices observation card**

| # | Teachinsg Planning | Teaching Execution | Teaching Evaluation and Feedback | Communication and Interaction with Students |
|---|---|---|---|---|
| 1 | **0.803**** | **0.822**** | **0.791**** | **0.664**** |
| 2 | **0.835**** | **0.809**** | **0.857**** | **0.773**** |
| 3 | **0.692**** | **0.863**** | **0.835**** | **0.740**** |
| 4 | **0.632**** | **0.805**** | **0.846**** | **0.586**** |
| 5 | **0.727**** | **0.789**** | **0.816**** | **0.685**** |
| 6 | **0.733**** | **0.740**** | **0.744**** | **0.761**** |
| 7 | **0.832**** | **0.705**** | **0.849**** | **0.648**** |
| 8 | **0.670**** | **0.769**** | **0.728**** | **0.751**** |
| 9 | **0.766**** | **0.799**** | **0.809**** | |
| 10 | **0.805**** | **0.731**** | **0.673**** | |
| 11 | **0.772**** | **0.822**** | | |
| 12 | | **0.830**** | | |
| 13 | | **0.847**** | | |
| 14 | | **0.761**** | | |
| 15 | | **0.827**** | | |
| 16 | | **0.761**** | | |

(**) Significant at 0.01

**Table 2: Pearson correlation coefficients for the dimensions of the teaching practices observation card with the total score of the card**

| | Correlation Coefficient |
|---|---|
| Teaching Planning | **0.832**** |
| Teaching Execution | **0.920**** |
| Teaching Evaluation and Feedback | **0.908**** |

| | Correlation Coefficient |
|---|---|
| Communication and interaction with Students | **0.892**** |

(**) Significant at 0.01

The tables (1, 2) demonstrate that all correlation coefficients are statistically significant at the 0.01 level, indicating a high level of internal consistency between the items of each dimension and the total score of the respective dimension. Furthermore, to verify the reliability of the teaching practices observation card, the researcher and supervisor applied it to a sample of three teachers from the research community using the multiple observer's method. The agreement coefficient (Cooper coefficient) was calculated to assess inter-rater reliability, as per Cooper's equation:

**Inter-rater reliability = (Number of agreements / (Number of agreements + Number of disagreements)) × 100**

The results of this reliability assessment are presented in Table (3).

**Table 3: Reliability Coefficient Values for Each Dimension of the Teaching Practices Observation Card**

| | Agreement Percentage |
|---|---|
| Teaching Planning | **97%** |
| Teaching Execution | **99%** |
| Teaching Evaluation and Feedback | 97% |
| Communication and interaction with Students | 95% |

From Table (3), it is clear that the agreement percentage ranged from 95% to 99%, indicating a high level of agreement between the observers, which suggests good reliability of the teaching practices observation card. Now, let's address the equivalence of the experimental and control groups in the pre-application of the teaching practices observation card.

The teaching practices observation card was administered to a random sample comprising eight female teachers in each group. This assessment took place in the week preceding the implementation of the training program for each group. Specifically, it occurred in the third week of the third semester of the school year 1443 AH for the experimental group and the fifth week of the third semester of the academic year 1443 AH for the control group. This was done to ascertain the equivalence of the experimental and control groups in the pre-application of the teaching practices observation card. To analyze the equivalence between the two groups, the Mann-Whitney test was employed, as illustrated in Table (4).

**Table 4: Mann-whitney test results for calculating the difference between the mean ranks of computer teachers in the experimental and control groups in the pre-application of the teaching practices observation card**

| | Group | Mean Rank | Sum of Ranks | Mann-Whitney U | Statistical Significance |
|---|---|---|---|---|---|
| Teaching Planning | Control | **8.79** | **61.50** | **22.50** | **0.521** |

| | Group | Mean Rank | Sum of Ranks | Mann-Whitney U | Statistical Significance |
|---|---|---|---|---|---|
| | Experimental | **7.31** | **58.50** | | |
| Execution of Teaching | Control | **6.68** | **48** | **20** | **0.349** |
| | Experimental | **9** | **72** | | |
| Evaluation and Feedback | Control | **8.64** | **60.50** | **23.50** | **0.598** |
| | Experimental | **7.44** | **59.50** | | |
| Communication and Interaction | Control | **6.93** | **48.50** | **20.50** | **0.378** |
| | Experimental | **8.94** | **71.50** | | |
| Total | Control | **8.29** | **58** | **26** | **0.817** |
| | Experimental | **7.75** | **62** | | |

Table (4) indicates that there is no statistically significant difference at the significance level of $\alpha \leq 0.05$ between the mean ranks of female computer teachers in the experimental and control groups in the pre-application of the teaching practice observation card across all axes (teaching planning, teaching execution, evaluation and feedback, communication with interaction, and total). The significance levels for each dimension were as follows: (0.521, 0.349, 0.598, 0.378, and 0.817) respectively. These values are greater than 0.05, suggesting that there is no significant difference between the groups. Therefore, it can be concluded that the two groups were equivalent in their pre-application teaching practices as assessed by the observation card.

## DATA ANALYSIS

To address the research question regarding the impact of the training program based on the TAWOCK model on improving teaching practices among female computer teachers, the following steps were taken:

### Post-Intervention Assessment

The teaching practice observation card instrument was administered to both the experimental and control groups two weeks after the implementation of the training programs.

This assessment occurred in the 8$^{th}$ week of the third semester of the year 1443 AH for the experimental group and the 11$^{th}$ week of the third semester of the year 1443 AH for the control group.

**Calculation of mean ranks difference:** The difference between the mean ranks of female computer teachers in the experimental and control groups was calculated based on the post-application of the teaching practice observation card.

**Assessment of change in experimental group:** The difference between the mean ranks of computer teachers in the experimental group was calculated for both pre- and post-applications of the teaching practice observation card.

**Computation of effect size:** Effect size was computed to quantify the magnitude of the difference observed between groups or within the experimental group before and after the intervention.

These steps were undertaken to evaluate the impact of the training program on teaching practices among female computer teachers and to provide insight into the effectiveness of the intervention.

**RESULT**

The Mann-Whitney test was employed to ascertain the disparity between the mean ranks of computer teachers in both the experimental and control groups following the application of the teaching practice observation card. To gauge the effect size, Eta squared was utilized. The results of these analyses are presented in Table (5):

**Table 5: Results of the Mann-whitney test and eta squared to evaluate the impact of the training program based on the TAWOCK model for teaching computational thinking skills on enhancing teaching practices among female computer teachers.**

| | Group | Mean Rank | Sum of Ranks | Mann-Whitney U | Statistical Significance | Eta Squared |
|---|---|---|---|---|---|---|
| Teaching Planning | Control | **4** | **28** | **0** | **0.001*** | **0.618** |
| | Experimental | **11.50** | **92** | | | |
| Teaching Execution | Control | **4** | **28** | **0** | **0.001*** | **0.781** |
| | Experimental | **11.50** | **92** | | | |
| Teaching Evaluation and Feedback | Control | **4** | **28** | **0** | **0.001*** | **0.692** |
| | Experimental | **11.50** | **92** | | | |
| Communication and Interactions with Students | Control | **4** | **28** | **0** | **0.001*** | **0.794** |
| | Experimental | **11.50** | **92** | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Total | Control | **4** | **28** | **0** | **0.001*** | **0.828** |
| | Experimental | **11.50** | **92** | | | |

(*) Significant at the 0.05 level

From Table (5), it is evident that there is a statistically significant difference at the (0.05) level between the mean ranks of computer teachers in the experimental and control groups in the post-application of the teaching practices observation card across all dimensions (teaching planning, teaching execution, teaching evaluation and feedback, communication and interaction with students, and total). The significance level for each dimension was (0.001), which is smaller than 0.05, indicating a difference in favour of the experimental group with an average rank of (11.50) across all dimensions. This suggests an effect of the TAWOCK model-based training program on improving teaching practices among computer teachers.

The Eta squared values for the dimensions of the teaching practices observation card (teaching planning, teaching execution, teaching evaluation and feedback, communication and interaction with students, and total) were (0.618, 0.781, 0.692, 0.794, and 0.828) respectively. These values indicate a large effect size on improving teaching practices among computer teachers attributed to the independent variable, which is the type of training program (TAWOCK model-based computer thinking skills teaching training program).

The results in Table (5) indicate that the independent variable, the type of training program (TAWOCK model-based computer thinking skills teaching training program), had a greater impact on improving teaching practices among computer female teachers in the dimension of communication and interaction with students, as evidenced by the Eta squared value of (0.794). This is followed by the dimension of teaching execution, with an Eta squared value of 0.781, then the dimension of teaching evaluation and feedback, with an Eta squared value of (0.692), and finally the dimension of teaching planning, with an Eta squared value of (0.618).

The Wilcoxon test was employed to ascertain the disparity between the mean ranks of computer teachers in the experimental group before and after the application of the teaching practices observation card. Cohen's d was utilized to compute the effect size, as detailed in Table (6).

**Table 6: Wilcoxon Test Results and Cohen's d for evaluating the effect of the TAWOCK Model-Based computer thinking skills teaching training program on enhancing teaching practices among computer teachers**

| | Application | Mean Rank | Sum of Ranks | Z Value | Statistical Significance | Cohen’s d |
|---|---|---|---|---|---|---|
| Teaching Planning | Pre | **0** | **0** | **2.54** | **0.011*** | **2.17** |
| | Post | **4.50** | **36** | | | |
| Teaching Execution | Pre | **0** | **0** | **2.52** | **0.012*** | **2.02** |
| | Post | **4.50** | **36** | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Teaching Evaluation and Feedback | Pre | **0** | **0** | **2.53** | **0.011*** | **2.43** |
| | Post | **4.50** | **36** | | | |
| Communication and Interaction with Students | Pre | **0** | **0** | **2.52** | **0.012*** | **2.40** |
| | Post | **4.50** | **36** | | | |
| Total | Pre | **0** | **0** | **2.52** | **0.012*** | **2.06** |
| | Post | **4.50** | **36** | | | |

(*) Significant at the 0.05 level.

From Table (6), it is evident that there is a statistically significant difference at the ($\alpha \leq 0.05$) level between the average ranks of computer female teachers in the experimental group in the pre- and post-application of the teaching practices observation card in all dimensions (teaching planning, teaching execution, teaching evaluation and feedback, communication and interaction with students, total). The significance level for each dimension was (0.011, 0.012, 0.011, 0.012, 0.012) respectively, which are values smaller than (0.05). This indicates a significant difference in favour of the post-application with an average rank of (4.50) in all dimensions (teaching planning, teaching execution, teaching evaluation and feedback, communication and interaction with students, total), suggesting an impact of the TAWOCK-based training program on improving teaching practices among computer female teachers.

The Cohen coefficient values for the dimensions of the teaching practices observation card (teaching planning, teaching execution, teaching evaluation and feedback, communication and interaction with students, total) were (2.17, 2.02, 2.43, 2.40, 2.06) respectively. These values indicate a large effect size on improving teaching practices among computer female teachers in the experimental group, attributed to the independent variable, which is the type of training program (the TAWOCK-based electronic training program for teaching computational thinking skills).

The results in Table (6) also demonstrate that the independent variable, which is the type of training program (the TAWOCK-based electronic training program for teaching computational thinking skills), had a greater impact on improving teaching practices among computer teachers in the experimental group in the dimension of teaching evaluation and feedback, with a Cohen coefficient value of (2.43). This is followed by the dimension of communication and interaction with students, with a Cohen coefficient value of (2.40). Then, the dimension of teaching planning, with a Cohen coefficient value of (2.17). Finally, the dimension of teaching execution, with a Cohen coefficient value of (2.02).

## DISCUSSION

The analysis of the teaching practices observation card data revealed a statistically significant difference at the ($\alpha \leq 0.05$) level between the average ranks of computer teachers in the experimental and control groups in the post-application of the teaching practices observation card across all dimensions. This indicates an effect of the TAWOCK-based training program on improving teaching practices among computer teachers. Additionally, the Eta squared value for the total card (0.828) indicates a large effect size for improving teaching practices among computer teachers in the experimental group compared to the control group.

Furthermore, the results indicated a statistically significant difference at the ($\alpha \leq 0.05$) level between the average ranks of computer teachers in the experimental group in the pre- and post-application of the teaching practices observation card across all dimensions. The Cohen coefficient value for the total card (2.06) suggests a large effect size for improving teaching practices among computer teachers in the experimental group after exposure to the training program.

The positive results observed in the study can be attributed to the design of the training program, which was based on the TAWOCK model. This model focuses on actionable learning and acknowledges teachers as adult learners, effectively integrating technology into the training process. This approach is crucial in enhancing the quality of professional development for teachers (Arifin et al., 2020 B). By utilizing e-training methods, the program targets the cognitive and performance aspects of computer female teachers (Hasan, 2017), promoting active engagement and interaction within a social learning context. Consequently, this approach has a significant impact on improving teachers' skill performance levels.

Moreover, the emphasis on practical application in the e-training environment facilitates better skill retention among teachers, allowing them to apply learned concepts more effectively in similar situations over time (Al-Shammari, 2017). As highlighted by Zhou et al. (2020), participation in e-training programs enhances computer teachers' content and pedagogical content knowledge (CK, PCK), leading to tangible transformations in their teaching practices and ultimately benefiting student performance.

The dimension of communication and interaction with students exhibited the most significant impact on the teaching practices of computer teachers, as evidenced by its Eta squared value of (0.794), the highest among all dimensions for the experimental group compared to the control group. Additionally, the Cohen's d value of (2.40), the second highest for the experimental group, further underscores this finding. This outcome can be attributed to the content of the training program, which aimed to equip computer teachers with the skills to teach computational thinking.

The training program encompassed computational thinking skills and teaching methodologies specific to computer science courses, empowering teachers with new approaches and techniques for engaging with students. Consequently, this dimension experienced a notable influence compared to others in the teaching practices observation sheet.

Training teachers in computational thinking not only enhances their pedagogical skills but also makes classroom instruction more effective and enjoyable. Computational thinking serves as a robust problem-solving model, incorporating analytical, abstract, and algorithmic skills (Abuhussain, 2018). This aligns with previous research by García-Peñalvo (2018), which underscores computational thinking as a superior problem-solving framework. Implementing computational thinking requires computer teachers to meticulously plan lessons, deliver content scientifically, employ motivating teaching methods, and accommodate individual student differences (Almutiri, 2013).

The planning dimension exhibited the least influence on the teaching practices of computer teachers, indicated by an Eta squared value of 0.618, the lowest among all dimensions for the experimental group compared to the control group. Additionally, the Cohen's d value of (2.17), the second lowest for the experimental group, supports this finding. This outcome can be attributed to the prevalent practice among teachers of relying on ready-made electronic preparation files or preparing through the *"Madrasati"* platform, mandated by their supervisors. Consequently, despite achieving a significant impact, this dimension was less affected compared to others.

## CONCLUSIONS

The utilization of technological knowledge, which entails understanding how to leverage technology as a tool to enhance the training of computer teachers, has significantly contributed to the improvement of teaching practices among female computer teachers. This is achieved by carefully selecting programs, applications, and digital tools that align with the content of the training program, the designated time for training activities, and the proficiency levels of the teachers in using them. Furthermore, incorporating QR codes or links during the presentation of the training program facilitates easy access to the required applications and digital tools for participating in the training activities. Hasan (2017) underscores the effectiveness of the electronic training approach in fostering the cognitive and performance aspects of computer teachers.

Training computer teachers based on competency and work-oriented approaches, employing adult education methods (andragogy), significantly contributes to enhancing teaching practices among computer teachers. This is achieved through several strategies:

1. Incorporating diverse examples and activities to cater to various learning styles and preferences.
2. Recognizing and addressing individual differences among teachers, tailoring training to their specific needs and skill levels.
3. Empowering teachers to actively engage in the training program, fostering a sense of ownership and responsibility.
4. Employing varied training strategies to promote interaction and participation, avoiding monotony, and promoting a lively learning environment.
5. Utilizing a mix of activities, including individual, group, and paired exercises, to cater to different learning preferences and promote collaboration.
6. Adapting training methods to leverage teachers' diverse experiences and backgrounds, respecting their autonomy and opinions in the learning process.
7. Facilitating opportunities for teachers to share experiences and experiments with one another, fostering a collaborative learning community. Al-Shammari (2017) emphasizes the significant influence of teachers' actions and interactions within the social context of electronic training on their performance levels of skills in the classroom.

Training computer teachers in content knowledge contributes significantly to improving their teaching practices. This can be achieved through the following steps:

1. Thoroughly reviewing and understanding the training program's content before proceeding with any activities.
2. Ensuring that each step or stage of the program is adequately covered and understood before moving forward, utilizing formative assessment to gauge proficiency during training.
3. Encouraging teachers to engage deeply with the subject matter, reflecting on and recalling their prior knowledge.
4. Continuously updating and evolving the content of training programs to keep pace with advancements in the field. This ongoing development enhances computer teachers' content and pedagogical content knowledge (CK, PCK), ultimately leading to positive transformations in their teaching practices (Zhou et al., 2020).

Training computer teachers based on their understanding of the nature of their work yields significant benefits in improving their teaching practices. This can be accomplished by:

1. Cultivating the right attitudes towards professional work among teachers.
2. Offering practical training to develop acquired skills.
3. Providing opportunities for teachers to reflect on their teaching practices.

Moreover, delivering specialized content and pedagogical content knowledge through electronic training programs has proven highly beneficial in enhancing teachers' teaching practices (Zhou et al., 2020).

Training computer teachers through the effective representation and formulation of content that caters to adult understanding, a facet of knowledge of adult teaching methods, is crucial in enhancing teaching practices among computer educators. This can be achieved through the following strategies:

1. Presenting scientific material for training activities after discussing it with teachers to gauge their prior knowledge.
2. Encouraging collaborative work among teachers to foster a sense of community and shared learning.
3. Incorporating practical skills demonstrations to provide tangible examples and enhance understanding.
4. Integrating games and interactive activities to stimulate and motivate teachers' engagement with the material.
5. Adapting the pace of instruction to align with teachers' proficiency levels, respecting their capabilities and experiences.
6. Facilitating knowledge exchange and peer learning among teachers to leverage collective expertise.
7. Utilizing storyboards as collaborative tools to promote creativity and knowledge sharing among teachers.
8. Implementing the six thinking hats technique to encourage self-directed learning and diverse perspectives.
9. Employing concept maps to stimulate teachers' critical thinking and motivation, fostering a conducive learning environment.

Establishing an interactive atmosphere and fostering effective collaboration among participants are essential components for successful training programs, ensuring that the learning environment meets the diverse needs of teachers (Zaytoun, 2004).

Training computer female teachers through the utilization of technology-enhanced adult education methods is a pivotal aspect of electronic training programs, capable of significantly influencing the enhancement of teaching practices among computer educators. This can be achieved through the following approaches:

1. Developing training materials that cater to the characteristics and preferences of adult learners, utilizing devices, programs, or applications tailored to their needs.
2. Encouraging interactive engagement by enabling commenting on posts and facilitating knowledge sharing through platforms such as electronic walls, blogs, and websites, fostering collaborative learning and idea exchange.
3. Leveraging programs and applications designed to facilitate effective communication and dialogue among teachers within the training environment, promoting peer interaction and knowledge dissemination.
4. Integrating training activities centred around electronic games to create an engaging and motivating learning experience for teachers, fostering a sense of competition and enthusiasm for learning. Ibrahim (2018) emphasizes that the electronic training paradigm effectively addresses teachers' training requirements by providing an immersive learning environment equipped with advanced capabilities, enabling extensive interaction among teachers, and offering greater control over the training process.

Training computer teachers through the integration of technology within their professional environment and fostering knowledge building (work-related technical knowledge) is a critical component of electronic training programs, capable of driving improvements in teaching practices among computer educators. This can be accomplished through the following strategies:

1. Utilizing electronic platforms, such as electronic walls, to facilitate open communication and collaboration among teachers, allowing them to share teaching challenges, exchange experiences, and seek solutions collectively.
2. Employing electronic programs and applications that enable teachers to apply newly acquired knowledge and reflect on their teaching experiences, thereby motivating them to engage in continuous learning and skill development.
3. Encouraging the sharing and exchange of relevant files and resources among teachers, fostering a culture of collaboration and knowledge sharing. This promotes the dissemination of best practices,

innovative ideas, and creative solutions among educators, guiding their professional development journey towards tangible action. Research conducted by Mohamed and Abo Zeed (2017) underscores the efficacy and impact of electronic training programs in enhancing teachers' competencies and skills.

Training computer teachers in work-related content knowledge is essential for enhancing their teaching practices. This can be achieved through the following strategies:

1. Offering opportunities for teachers to apply newly acquired knowledge in real-world contexts, enabling them to immediately integrate what they've learned into their teaching practices.
2. Creating a training environment that fosters initiative and accountability among teachers, encouraging them to take ownership of their professional development journey.
3. Guiding teachers' learning towards actionable outcomes by facilitating opportunities for reflection on their teaching practices, enabling them to identify areas for improvement and implement effective strategies.
4. Providing practical lessons aligned with the training program's objectives, wherein teachers can experience first-hand the application of various teaching methods. This collaborative approach promotes the exchange of experiences, experiments, and knowledge among educators, driving continuous improvement in teaching practices. Ibrahim (2018) underscores the importance of enabling teachers to acquire specific skills through hands-on application during training sessions.

Training computer teachers in specific skills through adult teaching methods and technology is crucial for enhancing their teaching practices. During training, the following strategies can be implemented:

1. Encouraging active participation from teachers by allowing them to contribute based on their prior knowledge, share experiences, and provide their own interpretations of concepts. This approach fosters self-concept development and intrinsic motivation among teachers, driving engagement and learning during the training program.
2. Facilitating collaborative learning experiences by dividing teachers into groups, thereby promoting the exchange of experiences, experiments, and knowledge among peers. Effective dialogue among teachers is encouraged through communication within the training environment.
3. Providing opportunities for teachers to apply newly acquired knowledge by delivering a lesson from their respective courses using available programs, applications, and digital tools. This hands-on approach enables teachers to immediately translate theory into practice, reinforcing learning outcomes.

Employing voting applications and websites as necessary can help assess the extent of consensus on specific phenomena or proposals among teachers, thereby facilitating alignment of perspectives and guiding their learning towards actionable outcomes. Mahmoud et al. (2015) underscore the importance of leveraging modern technological tools in designing training programs for teachers, including those specialized in computer education, as they significantly contribute to skill development (Mohamed & Abo Zeed, 2017). Effective communication among teachers (Ghanem & Hassouna, 2016) can enhance their subject content knowledge and pedagogical content knowledge (CK, PCK), leading to changes in teaching practices and ultimately improving students' performance (Zhou et al., 2020). The e-training environment aids teachers in organizing experiences, problem-solving, and applying skills, facilitating smooth performance in similar contexts (Al-Shammari, 2017).

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## Declarations

**Ethics approval and consent to participate:** Written consent was obtained from all the participants who participated in the study. Their participation was voluntary, and they had the option to leave the study at any point.

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