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Effect of employing the knowledge economy using the problem-solving strategy on the learning of basic tennis skills

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ABSTRACT

Purpose: Identify the extent to which the knowledge economy is employed by using the problem-solving strategy in learning some basic tennis skills. **Methods:** The participants were 28 third-year female students from the College of Physical Education and Sports Sciences of the University of Kirkuk. They were randomly divided into two groups with the same number of participants. The experimental group used the problem-solving method by employing the knowledge economy, and the control group received oral explanations and guidance from the teacher. The program lasted for eight weeks, with one educational unit per week, each lasting 90 minutes. **Results:** The educational programs had a significant main effect on tennis skills performance ($p < 0.05$), with a large effect size, as the percentage of improvement ranged from 52.49–58.78% for problem-solving method employing the knowledge economy and from 27.94–39.44% for the teacher guidance method. **Conclusion:** The positive effect of employing the knowledge economy through the problem-solving strategy on skill performance in tennis was stronger than that of a normal training program.

KEYWORDS

Learning strategies; Knowledge economy; Problem-solving strategy; Tennis

1. INTRODUCTION

Growth and advancement in any society depend heavily on how effectively its educational system produces interactive learners who are commensurate with the language of the twenty-first century and its developments and technologies. Due to all the aforementioned factors, preparing an expert workforce is a key factor in educational development. Many experts believe that the success of education depends on knowledge, which is the main engine of production in any activity, regardless of its nature or field, hence the concept of the knowledge economy, which focuses on investing in the human element. Therefore, the concept of the knowledge economy focuses on the dissemination, production and employment of knowledge in all areas of societal activity through building human capacities and their successful distribution (David & Foray, 2002). By promoting the discovery of knowledge and methods for using it among students, education based on the knowledge economy enables students to acquire new knowledge. Beyond training them, this form of education also enables them to face the challenges of the era in which they live so they can be capable and effective. It has become necessary to transfer the learner from the traditional role to a positive, active participant who discusses, debates and presents ideas, acquires and employs thinking and creativity and to train learners' creative skills. That is, the learner becomes active, learns how to learn and works individually and collectively if the teacher wants to reach educational goals while saving time and effort. This requires the teacher to take into account the characteristics of the learner among other learners according to the method he prefers to receive information through the problem-solving method, which is an indirect method of learning that focuses on the learner's subjectivity and takes into account individual differences and allows experimentation, discovery and decision-making, which contribute to the development of creativity. It can be indicated that motivation is one of the factors that directly influences the academic performance of students (Manzano Sánchez & Jiménez-Parra, 2022). It relies mainly on the student's thinking and is a basis for solving problems (Duval, 2006) in the sense that this strategy encourages learners to identify multiple and appropriate ways to solve motor problems. Such problems include motor problems in tennis, which is a competitive individual game that is very popular throughout the world and has evolved from a leisurely game into an Olympic game that requires high physical requirements, skills, and planning. The game of tennis depends on basic skills as an important basis on which this game is built. Advancements in performance also requires a ladder for advancement to be prepared, so care must be directed to the stages of its learning, as it requires much effort and practice to master.

Researchers have focused on the fact that the education of the knowledge economy has taken a prominent place in the thinking of educators, experts and curriculum developers owing to its importance, as learners face an increasingly complex future that requires higher thinking skills for making decisions, testing, solving problems and undertaking various initiatives. The results of some research indicate that athletes outperform non-athletes on problem-solving tests (Jacobson & Matthaeus, 2014). University students are one of the axes of the educational process, and attention to them is a duty of those in charge of educational and educational institutions, as the output from them is no longer graduating generations that depend on memorisation and indoctrination. Rather, the outputs have expanded to reach students' self-learning, as well as the skills of obtaining knowledge and employing it to produce new knowledge based on previous information. Thus, problem-solving is an employability skill since such abilities currently in high demand (Klegeris et al., 2019).

The problem-solving strategy encourages learners to identify multiple appropriate ways to solve kinetic problems by focusing on the learner's subjectivity, which enhances his thinking skills. Therefore, the learner has an urgent need to equip himself with the skills needed to compete in an era in which success and excellence are linked to one's ability to think their skills. In light of the foregoing discussion, this study identified the extent to which the knowledge economy is employed by using the problem-solving strategy in learning basic tennis skills, to achieve qualified educational outcomes for society in the knowledge economy and developing appropriate solutions to overcome problems or find alternatives that reduce obstacles and that work to connect the learner, to facilitate the process of learning the correct performance of basic tennis skills while requiring as little time and effort as possible.

2. METHODS

2.1. Participants

The research population was chosen by the intentional method from the third year of female students at the College of Physical Education and Sports Sciences of the University of Kirkuk for the 2021–2022 academic year. In total, 40 female students were recruited for this study. Failing, deferred female students and club practitioners were excluded due to their lack of homogeneity with the sample members. After their exclusion, the number of participants was 28 female students, who constituted 70% of the research population (age: 21.48 ± 2.20 years; height: 166.13 ± 3.48 cm; body mass: 64.53 ± 4.36 kg). The subjects were randomly divided into two groups with the same number of participants. The experimental group used the problem-solving method by employing the knowledge economy, and the control group received oral explanations and guidance from the teacher. All participants were informed of the study design and protocol prior to the study's commencement. None of them reported having any previous injuries. Then, they signed a free informed consent form prior to the testing procedure. The study protocol was approved by the ethics committee of the University of Kirkuk, and all procedures followed the ethical standards of the Declaration of Helsinki for the study of humans. There were no significant differences between the groups in terms of some anthropometric measurements and basic tennis skills before the educational programs were implemented ($p > 0.05$).

2.2. The skill tests used in the research

A form was designed to determine the most important basic skills in tennis and the tests for these skills. This form was presented to a group of experts to gather their opinions, in which they agreed to identify the groundstroke tennis test and serve for four equal areas test (Abdul Kareem et al., 2006). The groundstroke ability test evaluates basic tennis abilities, namely, the ability of the forehand and backhand groundstrokes. The validity of the test ranged from 0.873–0.965, and the reliability of the test ranged from 0.762–0.931. The serve for four equal areas test evaluates serve accuracy. The test validity value was 0.854, and the reliability value of the test was 0.729.

2.3. The proposed educational program

The researchers designed an educational program to improve basic tennis skills according to the problem-solving method. They reviewed relevant studies on tennis events in general and tennis skills in particular. In addition, the program was presented to a set of experts who were consulted with regard to the program's principles concerning its reliability, the procedure for assessing its aims, and its suitability for the targeted group. The opinions and remarks of the experts were taken into consideration.

The program lasted for eight weeks, with one educational unit per week, each of which lasted 90 minutes. The program involved the following:

1) Determining the start and the end periods of the program.
2) Implementing tests to assess basic skills in tennis (serve, forehand, backhand).
3) Dividing the educational units into the following parts:
   a) General and specific warm-ups, which lasted 25 minutes. These were intended to promote physical and psychological preparation and blood circulation. They consisted of a set of simple entertaining and preliminary actions.
   b) The main part, which lasted 50 minutes, including 20 minutes to apply the problem-solving method employing the knowledge economy for the experimental group and teacher guidance for the control group.
   c) The cool-down phase, which lasted for 15 minutes. This phase allowed the participants to reset their bodies to normal, relaxed conditions. This part involved a set of simple actions and exercises.

2.4. Data analysis

The statistical processing was performed with the Statistical Package for the Social Sciences

(SPSS) for Windows, version 22.0 (IBM Corp., Armonk, NY, USA). The percentages were calculated. The analysis also involved means, standard deviations, the correlation coefficient, the paired sample t-test, and the independent sample t-test. Statistical significance was set at $p < 0.05$. Practical differences were assessed by calculating Cohen's d effect size (ES) (Cohen, 2013; Lakens, 2013). The magnitudes of the t-test results were labelled as follows (Batterham & Hopkins, 2006): 0.2–0.5 – small, 0.5–0.8 – moderate, > 0.8 – large.

3. RESULTS

The mean pre- and post-program results for the tested basic tennis skills of the experimental and control groups are included in Table 1. A significant main effect of the educational programs was found for the assessed tennis skills ($p < 0.05$). Large ES values were observed for differences in the tennis skills (serve, forehand and backhand) between pre- and post-program assessments (problem-solving method employing the knowledge economy) (d: 13.414, 14.198, 17.669, respectively), as the percentage of improvement ranged from 52.49–58.78%. Large ES values were also found for differences in tennis skills (serve, forehand and backhand) between pre- and post-program assessments (teacher guidance) (d: 8.638, 15.418, 6.100, respectively), as the percentage of improvement ranged from 27.94-39.44%.

Table 1. Basic tennis skills in the pre- and post-programs of the experimental and control groups.

Group	Tennis skill	Pre-program	Post-program	R (p)	T (p)	Effect size	Magnitude	Improvement (%)
Experimental								
	Serve (degree)	17.86 ± 2.03	28.29 ± 2.20	0.73 (0.003)**	25.1 (<0.001)**	13.414	Large	58.40
	Forehand (degree)	21.50 ± 1.95	32.79 ± 1.89	0.66 (0.011)*	26.56 (<0.001)**	14.198	Large	52.49
	Backhand (degree)	19.93 ± 2.46	31.64 ± 2.13	0.84 (<0.001)**	33.06 (<0.001)**	17.669	Large	58.78
Control								
	Serve (degree)	17.64 ± 2.17	22.57 ± 2.38	0.88 (<0.001)**	16.16 (<0.001)**	8.638	Large	27.94
	Forehand (degree)	20.29 ± 2.05	28.29 ± 2.84	0.96 (<0.001)**	28.84 (<0.001)**	15.418	Large	39.44
	Backhand (degree)	18.29 ± 2.76	25.14 ± 2.57	0.65 (0.013)*	11.41 (<0.001)**	6.100	Large	37.50

*Note: Significant difference between two the groups: ** p < 0.01, * p < 0.05*

The independent sample t-test was employed to determine whether either of the two educational programs had a more robust effect than the other on the participants' basic tennis skills (Table 2). The t-values were 6.60 for the serve, 4.94 for the forehand and 7.28 for the backhand. These values indicate that there was a significant difference between the two educational programs ($p < 0.05$) favouring the experimental group. Large ES values were found for differences in the serve ($d = 2.496$), the forehand ($d = 1.865$) and the backhand ($d = 2.754$)

Table 2. Basic tennis skills in the post-program of the experimental and control groups.

Tennis skill	Experimental	Control	T (p)	Effect size	Magnitude
Serve (degree)	28.29 ± 2.20	22.57 ± 2.38	6.60 (<0.001)**	2.496	Large
Forehand (degree)	32.79 ± 1.89	28.29 ± 2.84	4.94 (<0.001)**	1.865	Large
Backhand (degree)	31.64 ± 2.13	25.14 ± 2.57	7.28 (<0.001)**	2.754	Large

*Note: Significant difference between two the groups: ** $p < 0.01$, * $p < 0.05$*

4. DISCUSSION

The development in the control group resulted from the daily exercises used in the instructional unit in addition to the method followed, which depended mainly on the teacher without involving the learner in the lesson, except for a small percentage of instances, depending on the application by the learner, which depends on trying to imitate the teacher correctly without the need of him to think, so the learner finds himself facing a challenge that requires him to find alternatives, generate ideas and develop various solutions to reach an appropriate solution to the problem. The learner works on applying the skill through the teacher's explanation of the technical stages of the skill, trying to reach the correct performance and repeating the performance to try to master the skill in the correct manner. The enhanced repetition of the exercise helps the player or learner master the sub-movements that collectively represent the skill to be learned and achieve consistency between these movements, making them in the correct sequence and with appropriate timing (Kruse-Weber & Parncutt, 2014). Also, the daily and varied exercises that the teacher gives are necessary for the tennis player to control the position of his body and the movement of its parts. This allows the learner to perform the skill perfectly. Any improvement that occurs in performance resulted from learning, and it is a form of behaviour that can be learned and acquired through many factors that develop those capabilities (Hakim, 2015). This is why we found a slight development in the control group compared to the experimental group.

The researchers also attributed the superiority of the experimental group in the skill performance represented by accuracy to the multiple repetitions by means of exercises and multi-ball exercises in different areas inside the field, which forced the players or learners to move and dispose of the balls from the movements. These moves develop players' or learners' motor speed, which enables them to reach the balls quickly, and then they have the option to direct the ball to any area inside the opponent's court. As long as the motor abilities are an integrated unit, the development of any one of them is linked to the development of the rest of them. It is the individual's ability to control his voluntary movements towards a specific goal (Ramadan et al., 2022).

The researchers also attributed the superiority of the experimental group over the control group in terms of skill performance to the positive effect of the educational units. The problem-solving method and its content give the learner an opportunity to search, discover, choose and rely on different types of thinking processes. Such exercises help the individual attain kinetic creativity, direct his attention toward skilful learning and understand the correct way. The learner also challenges his ideas and pushes himself to collect information, impose hypotheses, experiment and apply to achieve beneficial results that can be generalised and identified.

The problem-solving strategy has become one of the most important teaching strategies because it is of great importance in the life of the learner, increases his levels of scientific and cognitive achievement, helps the learner identify problems and analyse them into their main elements, work to collect information, propose hypotheses and test them and then approve the appropriate solution and work to generalise the solution to other educational situations in life or school (Häkkinen et al., 2017). Studies have revealed that collective problem-solving promotion-based flipped classrooms enhance students' learning performance, efficacy, f knowledge and interactions (Hwang & Chen, 2019). Such results indicate that the problem-solving strategy is a process in which the individual uses previously acquired information and skills to meet an unusual situation such that practice improves players' abilities to solve problems (Price et al., 2021). The learner must also reorganise what he previously learned and apply it to the new situation. This requires the ability to analyse and synthesise the elements of the new situation. It has been shown that employing a problem-solving strategy in education has many advantages that make lessons interesting, interesting and effective (Raes et al., 2016). This is what was done when designing the educational units according to the problem-solving strategy by employing the knowledge economy because it recalls the learner's previous experiences and links them to subsequent experiences. This is done through practice and participation. From here, the researchers believe that it is necessary to implement new strategies in which teaching methods change to move the learner from a recipient of information to self-education that puts the student in research and investigation sites, where he can invest in his mental and physical abilities. Also, the sequence followed in presenting the exercises in terms of the level of difficulty and the diversity of the exercises according to their effects contributed to the optimal development of motor abilities based on the principle of suspense, which led to the distinctive interaction of the research sample with performance. The importance of exercises includes utilising the largest number of muscles while improving old skills, in addition to using a variety of exercises in order to develop the elements of physical fitness to prepare to learn new skills and access automatic compatibility (Piercy et al., 2018).

The researchers also attribute the experimental group's superiority over the control group in the post-tests to the use of the problem-solving method to teach basic tennis skills by stimulating thinking processes and using the scientific method of thinking and training to generate ideas to develop and develop cognitive processes and mental abilities on which creative thinking depends. The problem-solving method encourages the development of self-education toward learning skills according to the learner's pace and promotes scientific thinking (Huzii et al., 2021). Successful teachers advance his students' ideas from one stage to another and make students think and perform what they can perform under his supervision and guidance to face all difficulties, which makes their education beneficial and stable (Mitchell, 2014). This is because, coaches and teachers who apply explicit learning strategies tend to emphasise technical skills and the movement of specific body parts while teaching skills through internal attention instructions (Ramezani et al., 2022). Also, the problem-solving strategy contributed to transferring the learner from the role of a listener to the role of an active participant who discusses, asks questions and gives ideas, thus contributing to the acquisition of new skills such as creativity and thinking to reach the main goal of the educational unit with relatively little time and effort by relying on himself or the group. This is the importance of the knowledge economy for the human element, which is aimed at investing human elements in the education process to prepare individuals who are able to think and develop their skills through developing their knowledge and acquiring new knowledge. In addition to previous experiences and the scientific basis for creative thinking, the transition to a knowledge economy requires a special preparation of the individual. The traditional roles played by the teacher and the learner in the educational process are no longer commensurate with the challenges and requirements of the era of the knowledge economy, as the knowledge economy redraws the dimensions of education and training at all stages. Accordingly, advanced methods of education must be introduced that focus on teaching students how to learn and the importance of self-development in their daily lives (Broström et al., 2021; Wiseman et al., 2014).

5. CONCLUSIONS

The educational program based on employing the knowledge economy through the problem-solving strategy significantly improved the level of tennis skill performance compared to a program that employed teacher explanations and guidance. The positive effect of the knowledge economy through the problem-solving strategy on tennis skill performance was stronger than that of a normal training program.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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