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**Comparison the Effectiveness of Bybee's Teaching Method as Face-To-Face and Non-Face-To-Face on the Academic Achievement of Male Students of the First Secondary School in the Conditions of the Covid-19 Pandemic**

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**Keywords:**

Bybee's Teaching Method, Face-to-Face Training, Non-Face-to-Face Training, Academic Achievement, Students, Covid-19 Pandemic.

**Purpose:** The covid-19 pandemic caused many and extensive changes and transformations in educational teaching. Considering the importance of students' academic achievement, the aim of this study was to comparison the effectiveness of Bybee's teaching method as face-to-face and non-face-to-face on the academic achievement of mail students of the first secondary school in the conditions of the Covid-19 pandemic.

**Methodology:** This study was a semi-experimental with a pretest and posttest design with a control group. The research population was male students of the first secondary school in Zahedan city in the academic years 2019-2020. The sample size was 45 people (15 people for each group) who were selected by cluster sampling method and each of the clusters randomly by lottery replaced in three groups (two experimental groups and one control group). Each of the experimental groups was trained with Bybee's teaching method as face-to-face and non-face-to-face and during this time the control group was trained with the traditional method. The data were collected with Pham and Taylor's academic achievement questionnaire (1999), which whose validity was confirmed by the opinion of experts and its reliability was calculated by Cronbach's alpha method 0.92 and analyzed by methods of univariate analysis of covariance and Bonferroni post hoc test in SPSS software.

**Findings:** The findings indicated that there was a significant difference between the experimental and control groups in terms of academic achievement. In the other words, Bybee's teaching method as a both face-to-face and non-face-to-face in compared to the control group caused a significant increase in the academic achievement of mail students of the first secondary school ( $P < 0.001$ ), but between the experimental groups means Bybee's teaching method as face-to-face and non-face-to-face there was no significant difference in increasing academic achievement ( $P > 0.05$ ).

**Conclusion:** According to the results of this study mean effectiveness of both Bybee's teaching method as face-to-face and non-face-to-face on students' academic achievement and the lack of significant differences between them, to improve academic achievement can be used both Bybee's teaching method as face-to-face and non-face-to-face along with other effective teaching methods.

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## 1. Introduction

Years of education and learning play a very important role in students' lives, and academic progress indicates the status of their academic performance based on their efforts (Katagiri, Ito, Murayama, Hamada, Nakajima, Takayanagi and et al, 2021). The amount of learning and academic progress of students determines the result and consequence of all the efforts and investments that are spent on the educational system (Kabiri, 2022). One of the concerns of the officials of the educational system and the families of students is their academic progress and prevention of academic failure, which is known as one of the important issues of educational systems today (Faught, Qian, Carson, Storey, Faulkner, Veugelers and Leatherdale, 2019). In all countries, the level of academic progress of learners is an important indicator for evaluating the quality and success of educational systems (Jiang, Xiao, Liu, Guo, Jiang and Du, 2019). Academic progress of students is one of the important evaluation criteria in the education system and all the efforts of this system are to achieve academic progress. The education system is interested in the individual's destiny, excellence and successful development in the society and expects the individual to grow and develop in various cognitive, emotional, skill, social, etc. fields (Li, Han, Wang, Sun and Cheng, 2018). Academic achievement means learned or acquired ability about the presented lessons or school subjects that are evaluated with the help of standardized and teacher-made tests (Hassevoort, Khan, Hillman, Kramer and Cohen, 2018). This construct includes behaviors that lead to increased learning and is opposed to academic failure that imposes a high cost on the family and society (Lopez-Lopez, Kwong, Washbrook, Tilling, Fazel and Pearson, 2021). The educational progress of any society shows the success rate of the educational system of that society in achieving the goals and paying attention to meeting the individual needs of that society. The level of academic progress of the students of any society is one of the indicators of success in scientific activities, and accordingly, in recent years, academic progress is considered an important issue for educational organizations and especially the education system (Lai, Lee and Lai, 2020). One of the ways to increase academic progress is to use Bayibi teaching method (Al Assaf, 2019). The teaching method is one of the important elements of the curriculum and one of the important and effective stages of educational design, which plays an important role in achieving or not achieving educational goals (Sotakova and Ganajova, 2023). Baybi's teaching method is one of the learner-oriented teaching methods based on the structuralism approach proposed by Karplus and Their (1967) and modified by Baybi in the early 1980s (Cakir, 2017). The structuralist approach believes that the structure of knowledge is not something that is outside of the student's mind, but the structure of knowledge is the result of continuous interaction with existing structures and testing and refining its mental representations to find a more correct understanding of the outside world, and accordingly, the learning activity should be considered. (Tegegne and Kelkey, 2023). Traditional and common teaching methods cannot respond to the rapid movement of science and knowledge, and accordingly, active and dynamic teaching methods such as Bayibi's learner-centered teaching method should be used to educate capable and active people (Abdulmohsen, 2017). Educational administrators should be aware of teaching methods for different educational content and should use teaching methods that are cognitively appropriate to the cognitive level of learners (Ulas, Sevim & Tan, 2012). Bayabi's teaching method has five stages of activation, exploration, description, elaboration and evaluation. In the activation phase, the teacher, as the facilitator of education, evaluates the previous knowledge of the learner and helps them to engage in new concepts and be stimulated by doing new activities. In the exploration phase, exploratory experiences are provided for students. Students also use their previous knowledge and generalize their previous knowledge by using exploratory questions and doing experiments. In the explaining stage, learners explain their understanding of the concepts, and the teacher can guide learners to deeper learning with their explanations. In the development stage, learners expand the concepts they have learned and apply what they have learned. In the evaluation stage, both the learners evaluate themselves and the teacher evaluates the progress of the learners (Ashraah and Mustafa, 2021). This teaching method includes many advantages, including learner-centeredness, meaningful learning activities, preventing rote memorization of information, absorption and

adaptation of information through problem solving, making learners do more activities and encouraging them to have creative and divergent thinking (Hu, Gao and Liu). , 2017). Bayabi's teaching method includes activities that increase students' interest in research and cause active and dynamic use of knowledge and information. At each stage of this teaching method, students are encouraged to engage in activities and simultaneously build their knowledge and improve their thinking and cognition levels (Nazziwa, Uwamahoro and Wakumire, 2022).

Studies indicate that the way teachers teach changed in the context of the Covid-19 pandemic, and these conditions changed the theoretical concepts, attitudes, processes and roles related to educational systems (Pouladi Borj, Khaleghhah, Heidari and Davoodi, 2021). The outbreak of Covid-19 imposed unprecedented conditions on the educational situation of the country, and since the way of spreading this disease was through human to human, it was necessary to close the classrooms of schools and universities. After the spread of this disease and lack of face-to-face teaching in schools, non-face-to-face teaching grew significantly and teaching was done virtually (Alipour, Ghasemi and Salar Sadeghi, 2022). Non-attendance teaching was a good way to teach and teach during the Covid-19 era, and this teaching method provided opportunities to improve and promote learning (Pandey and Tiwari, 2014). Non-attendance teaching using appropriate hardware and software brought a new horizon to educational systems and this method was able to play an effective role in improving the quality of education (DeMelo Ghisi, Aultman, Konidis, Sandison and Oh, 2023).

Although no research was found comparing the effectiveness of Bayibi's teaching method in both face-to-face and non-face-to-face ways, some researches have been conducted in this field, which will be briefly described below. For example, the research results of Eroglu and Bektas (2022) indicated that teaching based on Bybee improved academic achievement, scientific creativity and students' views about the nature of science. Rostamnezhad and Sardari (2021) concluded in research that education based on Bayabi's five-stage teaching model increased students' academic competence and academic fascination. The results of the Karthikeyan and Densia (2021) research showed that the Bayabi learning cycle model increased the academic progress of students and the retention of knowledge in their minds. Al Assaf (2019) concluded in research that the teaching of a lesson unit based on Bayabi's five-stage cycle improved the academic progress and problem-solving skills of ninth grade students. Also, the results of Mousavi's research (2019) showed that Bayabi's five-stage teaching model increased learning and motivated students' academic progress. Komasi, Aliabadi and Zaraii Zavaraki (2018) in research concluded that the effectiveness of education through the Telegram social network compared to face-to-face education increased students' learning and memorization. In another study, Cakri (2017) reported that Bayabi's learning model increased academic achievement and improved students' attitudes toward science and science process skills. In addition, the research results of Yasbolaghi Sharahi, Zare and Sarikhani (2016) indicated that Bayibi's teaching method increased students' learning and memorization of basic concepts in comparison to the traditional teaching method. Azizi, Norouzi and Zarei Zavaraki (2015) concluded in research that the Bayibi teaching method increased the learning rate and motivated students' academic progress compared to the lecture teaching method.

The drop in education is one of the most important current problems of the education system, and every year a huge amount of money is wasted from the country and the efforts of the forces remain fruitless. Therefore, examining the academic progress of students is very important (Zaheri, Es'haghi, Kheiri and Ghaderi, 2021). Therefore, it seems necessary to examine the factors affecting academic progress and provide solutions to improve it and design educational programs in this field (Mohtashami, Moradi and Bigdeli, 2020). One of the effective teaching methods to improve academic characteristics, especially academic progress, which has been confirmed in a relatively large number of studies, is Bayibi teaching method. In other words, many researches indicated the effectiveness of Bayibi's teaching method on academic achievement, but the current research gap was created due to the spread of Covid-19. That is, the gap of the present research is whether the method of teaching Bayibi in a non-attendance manner can

increase academic achievement as well as the attendance method. Therefore, the current research seeks to answer the question of whether there is a difference between the effectiveness of Bayibi's teaching method in person and in person on the academic progress of male students of the first secondary school in the conditions of the covid-19 pandemic? The results of the present study can help counselors, teachers and other people involved in educational systems to know an effective teaching method in crisis situations such as Covid-19, and they can widely use the mentioned method to improve academic progress and even other educational variables. The covid-19 pandemic caused many and extensive changes and transformations in educational practices. Considering the importance of students' academic progress, the aim of this study was to compare the effectiveness of Bayibi's face-to-face and non-face-to-face teaching method on the academic progress of first secondary school boy students in the conditions of the Covid-19 pandemic.

## 2. Methodology

This was a semi-experimental study with a pre-test and post-test design with a control group. The research population was male students of the first secondary school in Zahedan city in the academic year 2018-2019. The sample size was 45 people (15 people for each group) who were selected by cluster sampling method and each of the clusters was randomly replaced by lottery in three groups (two experimental groups and one control group). To determine the sample size, Cohen's table (1987) with alpha of 0.5, average effect size of 0.5 and test power of 0.88 was used, based on which the sample size was calculated for each group of 13 people to ensure the sample size and dropouts. Possible, the sample size for each group was 15 people.

In order to conduct this study, firstly, the teaching method of Bybee planning and then the samples were identified. For the samples, the importance and necessity of the research was explained and they were assured about the observance of ethical standards. Also, they were asked to inform their parents about the importance and necessity of the research and the observance of ethical standards in the current research and ask them to participate in the research and for this purpose sign the consent form to participate in the research. In the cluster sampling method, three schools were selected among all the schools in the research community, and if each school had several classes, one class was selected as a sample, and 15 people from each class agreed to participate in the research and their parents had signed the consent form. , they did not have a history of failure in the previous grades, at least 3 months have passed since they were infected with Covid-19, they live with their parents and they have not experienced stressful events such as divorce and death of relatives in the last six months, as a sample of selection. became The samples of three classes were randomly selected as the in-person test group, the absent test group, and the control group. Each of the experimental groups was trained with Bayabi's teaching method in person and offline, and during this time, the control group was trained with the usual method. The content of the intervention in the experimental groups, which was conducted in person in one group and offline in the other group, can be seen in Table 1.

**Table 1.** Content of Bayabi teaching method intervention in face-to-face and non-face-to-face form

Numbr	axis	The role of the teacher	The role of the student
1	Involvement and activation of thinking	Creating interest, arousing curiosity, questioning and diagnostic evaluation	Asking questions, showing interest and thinking about how to discover content
2	Exploration and research	Encouraging students to work together without direct teacher teaching, observing and listening to students interacting, asking clarifying questions, providing opportunities for students to discuss and exchange ideas for problem solving and appropriate use of real problems.	Thinking freely, testing predictions and hypotheses, hypothesizing and predicting results, testing different options and discussing them, and recording different observations and opinions.
3	explanation	Encouraging students to explain concepts and definitions in their own language, asking students to provide evidence and reasons, providing	Explaining possible solutions and answers to others, sharing ideas and listening responsibly to others' explanations, listening and trying to

		correct definitions and using previous experiences.	understand the teacher's explanations, referring to previous activities and using observations recorded while giving explanations
4	expansion	Expecting students to use formal titles, definitions, and explanations provided, encouraging students to apply or expand concepts and skills in new situations, reminding students of explanations provided, and explaining exploration strategies.	Applying labels, definitions and explanations, skills in similar situations, checking the understanding of the topic by peers and making decisions and designing experiments.
5	assessment	Observing students while performing the activity of measuring knowledge and skills, looking for evidence of change in students' thinking and behavior, giving opportunities for self-evaluation, asking open-ended questions and conducting evaluations before, during and after teaching.	Answering questions, showing your knowledge and skills, evaluating your activities and posing questions for further thinking and research.

The data of the current research were collected with the academic achievement questionnaire of Pham and Taylor (1999); So, this questionnaire had 48 items, which are graded according to the five-point Likert scale with the options of never, little, somewhat, a lot, and very much, respectively, with scores from 1 to 5. In the Pham and Taylor (1999) educational achievement questionnaire, the score of the tool is calculated with the total score of the items, and a higher score indicates higher academic achievement; So that the minimum score is 48 and the maximum score is 240. Pham and Taylor (1999) investigated the construct validity of the instrument with the method of exploratory factor analysis and the results indicated the existence of five factors: self-efficacy, emotional effects, planning, lack of control over consequences, and motivation. Also, the reliability value was calculated using Cronbach's alpha method of 0.74. In Iran, Askari, Makvandi and Neisi (2020) reported reliability with Cronbach's alpha method for the academic achievement questionnaire as 0.83 (quoted by Atarod and Abbasi, 2022). In the present study, the validity of the educational achievement questionnaire was confirmed by the opinion of experts and its reliability was calculated using the Cronbach's alpha method of 0.92. It should be noted that the data of the present study were analyzed using univariate analysis of covariance and Bonferroni's post hoc test in SPSS software.

### 3. Findings

The samples of this study were equally replaced in three groups; So that 33.33% equivalent to 15 samples were present in each group. The results of the average and standard deviation of the academic progress of the experimental and control groups in the pre-test and post-test stages can be seen in Table 2.

**Table 2.** The results of the average and standard deviation of the academic achievement of the experimental and control groups in the pre-test and post-test stages

group/stage	Pre test		Post test	
	Mean	Sd	Mean	Sd
Bayabi's face-to-face teaching method	111/86	5/46	151/06	8/88
Bybi's method of teaching in absentia	110/93	8/18	153/46	11/10
Control	112/40	7/99	113/53	10/60

As can be seen in Table 2, the average of the post-test compared to the pre-test of the academic progress of the experimental groups, i.e. Bayibi teaching method in person and in person, has increased more compared to the control group.

The presuppositions of the analysis method of the current research were checked, based on which the assumption of normality of the academic achievement variable of the experimental and control groups was established in the pre-test and post-test stages. Also, the assumption of equal variances of educational

achievement variables was also maintained. In addition, the assumption of equality of the regression slope of the pre-test scores and the covariance of the academic achievement variable was established ( $P > 0.05$ ). As a result, it was allowed to use the analysis methods of the current research. The results of univariate covariance analysis to determine the effectiveness of Bayibi's teaching method in person and in person on students' academic progress can be seen in Table 3.

**Table 3.** The results of univariate covariance analysis to determine the effectiveness of Bayibi's face-to-face and non-face-to-face teaching method on the academic progress of male students in the first secondary school.

Source of change	Ms	Df	Ss	F	sig	Effect size
pre-exam	1167/24	1	1167/24	14/77	0/001<	0/26
group	958/47	2	479/23	6/06	0/001<	0/22
error	3239/15	41	79/00			

As can be seen in Table 3, there was a significant difference between the experimental and control groups in terms of academic achievement in male students of the first secondary school. The results of Bonferroni's post hoc test to compare the effectiveness of Bayibi's teaching method in person and in person on students' academic progress can be seen in Table 4.

**Table 4.** The results of Bonferroni's post hoc test to compare the effectiveness of Bayibi's face-to-face and non-face-to-face teaching method on the academic progress of male students in the first secondary school.

first group	The second group	mean difference	standard error	sig
Bayabi teaching face-to-face	Teaching Baibi in non-attendance	-1/86	0/83	0/05>
Bayabi teaching face-to-face	Control	39/75	0/89	0/001<
Teaching Baibi in non-attendance	Control	41/61	0/89	0/001<

As can be seen in Table 4, Bayibi's teaching method, both face-to-face and offline, compared to the control group, caused a significant increase in the academic achievement of male students in the first secondary school ( $P < 0.001$ ), but between the experimental groups, that is, Bayibi's teaching method in the form of There was no significant difference between attendance and non-attendance in increasing academic achievement ( $P > 0.05$ ).

#### 4. Discussion

Considering the conditions of the covid-19 pandemic and the closure of schools and changes in teaching methods, the purpose of this study was to compare the effectiveness of Bayibi's teaching method in person and in person on the academic progress of male students of the first secondary school in the conditions of the covid-19 pandemic.

The findings of this study showed that Bayibi's teaching method, both face-to-face and face-to-face, compared to the control group or the same conventional method, increased the academic achievement of male students in the first secondary school. Although no research was found on the implementation of Bayibi's teaching method in a non-attendance manner, the findings of this study on the effectiveness of Bayibi's teaching method on increasing academic achievement are in line with the findings of Eroglu and Bektas (2022), Rostamnezhad and Sardari (2021), Karthikeyan and Densia (2021). , Al Assaf (2019), Mousavi (2019), Komasi et al (2018), Cakri (2017), Yasbolaghi Sharahi et al (2016), Azizi et al (2015) were aligned.

In explaining the effectiveness of Bayibi's face-to-face and non-face-to-face teaching methods compared to conventional teaching methods on increasing students' academic progress, it can be said that teaching and learning is a complex subject and that each person has different mental capacities, interests and cultural and historical situations from the teaching and learning process. follows a certain Therefore, teaching styles can

be effective in this process that can consider all the internal and external dimensions of teaching and learning, and the methods derived from the structuralism approach, such as Bayibi's teaching method, also have this feature. In the experimental groups, the teachers were able to optimally implement Bybee's teaching method based on the structuralism and learner-centered approach. Also, in the implementation process of Bayabi's teaching method, both face-to-face and non-face-to-face, models such as thinking, criticism and review, research, exchange of ideas, experiments, making tools, etc. were used, which provided the basis for increasing students' participation in all academic activities. . Therefore, adding quality to the teaching and learning methods with the help of Bayibi's teaching method led to a deep understanding of the nature of various subjects and sciences, and this caused the groups that benefited from Bayibi's teaching method to show higher academic progress both in person and offline. give Also, Bayabi's teaching method is built on the basis that learning is not passive, but an active process, and the key to learning is based on students' participation in the production of new knowledge. The construction of scientific knowledge is dependent on the student's experience in the classroom, and the educational environment must provide the context for students to organize their learning experiences in such a way that they can relate new information to them and make connections between new information and the information in their cognitive construction. do This is implemented when learning and teaching are done in a collaborative and problem-solving manner, and since the same principles are used in Bayabi's teaching method, and the students examine the subject matter in groups and discuss and exchange opinions about it. Therefore, it seems logical that both face-to-face and non-face-to-face teaching methods will increase the academic progress of students, regardless of their implementation method. As can be seen in Table 4, Bayibi's teaching method, both face-to-face and offline, compared to the control group, caused a significant increase in the academic achievement of male students in the first secondary school ( $P < 0.001$ ), but between the experimental groups, that is, Bayibi's teaching method in the form of There was no significant difference between attendance and non-attendance in increasing academic achievement ( $P > 0.05$ ).

Considering the conditions of the covid-19 pandemic and the closure of schools and changes in teaching methods, the purpose of this study was to compare the effectiveness of Bayibi's teaching method in person and in person on the academic progress of male students of the first secondary school in the conditions of the covid-19 pandemic. The findings of this study showed that Bayibi's teaching method, both face-to-face and face-to-face, compared to the control group or the same conventional method, increased the academic achievement of male students in the first secondary school. Although no research was found on the implementation of Bayibi's teaching method in a non-attendance manner, the findings of this study on the effectiveness of Bayibi's teaching method on increasing academic achievement are in line with the findings of Eroglu and Bektas (2022), Rostamnezhad and Sardari (2021), Karthikeyan and Densia (2021). , Al Assaf (2019), Mousavi (2019), Komasi et al (2018), Cakri (2017), Yasbolaghi Sharahi et al (2016), Azizi et al (2015) were aligned.

In explaining the effectiveness of Bayibi's face-to-face and non-face-to-face teaching methods compared to conventional teaching methods on increasing students' academic progress, it can be said that teaching and learning is a complex subject and that each person has different mental capacities, interests and cultural and historical situations from the teaching and learning process. follows a certain Therefore, teaching styles can be effective in this process that can consider all the internal and external dimensions of teaching and learning, and the methods derived from the structuralism approach, such as Bayibi's teaching method, also have this feature. In the experimental groups, the teachers were able to optimally implement Bybee's teaching method based on the structuralism and learner-centered approach. Also, in the implementation process of Bayabi's teaching method, both face-to-face and non-face-to-face, models such as thinking, criticism and review, research, exchange of ideas, experiments, making tools, etc. were used, which provided the basis for increasing students' participation in all academic activities. . Therefore, adding quality to the teaching and learning methods with the help of Bayibi's teaching method led to a deep understanding of the nature of various subjects and sciences, and this caused the groups that benefited from Bayibi's

teaching method to show higher academic progress both in person and offline. give Also, Bayabi's teaching method is built on the basis that learning is not passive, but an active process, and the key to learning is based on students' participation in the production of new knowledge. The construction of scientific knowledge is dependent on the student's experience in the classroom, and the educational environment must provide the context for students to organize their learning experiences in such a way that they can relate new information to them and make connections between new information and the information in their cognitive construction. do This is implemented when learning and teaching are done in a collaborative and problem-solving manner, and since the same principles are used in Bayabi's teaching method, and the students examine the subject matter in groups and discuss and exchange opinions about it. Therefore, it seems logical that both face-to-face and non-face-to-face teaching methods will increase the academic progress of students, regardless of their implementation method.

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In this research, the ethical standards including obtaining informed consent, guaranteeing privacy, confidentiality, etc. are observed, and the participants are hereby thanked.

### **Contribution of authors**

In the present study, the student was in charge of collecting data, implementing the intervention and writing the article, and the professors were in charge of supervising the proper analysis of the data and writing the article.

### **Conflict of interest**

There was no conflict of interest in the present study



## References

- Abdalmohsen MA. (2017). The effect of Bybee method applying for structural learning on karate sport skills. *Journal of Applied Sports Science*. 7(1): 19-27.
- Al Assaf JAF. (2019). The effectiveness of teaching an educational unit according to the learning cycle-5 Es model "Bybee" in the development of problem-solving skills and academic achievement in geography subject in grade 9 in Jordan. *Journal of Curriculum and Teaching*. 8(3): 143-159.
- Alipour M, Ghasemi SA, Salar Sadeghi M. (2022). Virtual teaching of mathematics during the Covid-19 pandemic: Narratives of an elementary teacher' experiences. *Journal of Research in Elementary Education*. 4(8): 52-68. [Persian]
- Ashraah MM, Mustafa AS. (2021). The effect of teaching according to the Bybee constructive learning model on the acquisition of secondary school students of concepts of Islamic Education in Jordan. *Dirasat: Educational Sciences*. 48(2): 60-80.
- Atarod E, Abbasi B. (2022). Comparison the academic performance and mental health of gifted and normal female students. *Iranian Journal of Educational Society*. 7(2): 154-164. [Persian]
- Azizi H, Norouzi D, Zarei Zavaraki E. (2015). The effect of Bybee teaching method on learning and educational achievement motivation of students. *Biquarterly Journal of Cognitive Strategies in Learning*. 3(5): 39-55. [Persian]
- Cakir NK. (2017). Effect of 5E learning model on academic achievement, attitude and science process skills: Meta-analysis study. *Journal of Education and Training Studies*. 5(11): 157-170.
- DeMelo Ghisi GL, Aultman C, Konidis R, Sandison N, Oh P. (2023). Developing a group-based virtual education curriculum for cardiac rehabilitation and the associated toolkit to support implementation in Canada and across the globe. *Heart & Lung*. 57: 80-94.
- Eroglu S, Bektas O. (2022). The effect of 5E-based STEM education on academic achievement, scientific creativity, and views on the nature of science. *Learning and Individual Differences*. 98: 102181.
- Faught EL, Qian W, Carson VL, Storey KE, Faulkner G, Veugelers PJ, Leatherdale ST. (2019). The longitudinal impact of diet, physical activity, sleep, and screen time on Canadian adolescents' academic achievement: An analysis from the COMPASS study. *Preventive Medicine*. 125: 24-31.
- Hassevoort KM, Khan NA, Hillman CH, Kramer AF, Cohen NJ. (2018). Relational memory is associated with academic achievement in preadolescent children. *Trends in Neuroscience and Education*. 13: 8-16.
- Hu J, Gao C, Liu Y. (2017). Study of the 5E instructional model to improve the instructional design process of novice teachers. *Universal Journal of Educational Research*. 5(7): 1257-1267.
- Jiang W, Xiao Z, Liu Y, Guo K, Jiang J, Du X. (2019). Reciprocal relations between grit and academic achievement: A longitudinal study. *Learning and Individual Differences*. 71: 13-22.
- Kabiri M. (2022). Comparison of achievement, output-input (efficiency), and output-process ratios in some provinces based on TIMSS. *Research in Curriculum Planning*. 19(46): 168-180. [Persian]
- Karthikeyan S, Densia SP. (2021). The Effect of 5E learning cycle model in teaching physics on students' academic achievement and the permanence of their knowledge. *Elementary Education Online*. 20(5): 6324-6330.
- Katagiri M, Ito H, Murayama Y, Hamada M, Nakajima S, Takayanagi N, et al. (2021). Fine and gross motor skills predict later psychosocial maladaptation and academic achievement. *Brain and Development*. 43(5): 605-615.
- Komasi M, Aliabadi Kh, Zaraii Zavaraki E. (2018). Comparing the method of teaching through social network and face training and its impact on the level of learning and retention of adult students in the social sciences. *Journal of Education Strategies in Medical*. 51(11): 25-32. [Persian]
- Lai HL, Lee YF, Lai KC. (2020). The influence of humanised anatomical pedagogy on psychophysiological responses and academic achievement in nursing students. *Journal of Professional Nursing*. 36(4): 245-250.
- Li J, Han X, Wang W, Sun G, Cheng Z. (2018). How social support influences university students' academic achievement and emotional exhaustion: The mediating role of self-esteem. *Learning and Individual Differences*. 61: 120-126.
- Lopez-Lopez JA, Kwong ASF, Washbrook L, Tilling K, Fazel MS, Pearson RM. (2021). Depressive symptoms and academic achievement in UK adolescents: a cross-lagged analysis with genetic covariates. *Journal of Affective Disorders*. 284: 104-113.

- Mohtashami Z, Moradi H, Bigdeli H. (2020). Relationships between academic achievement with personality traits and early maladaptive schemas with self-determination mediation in students. *Iranian Journal of Educational Sociology*. 3(1): 176-188.
- Mousavi F. (2019). Training based teaching model Bybee step (5e) on learning and motivate student achievement. *Journal of New Approaches in Educational Administration*. 10(1): 1-14. [Persian]
- Nazziwa C, Uwamahoro J, Wakumire R. (2022). Impact of inquiry-based learning using the 5E model on teachers' practices and learners' achievement in force and motion in secondary schools of Jinja District, Uganda. *East African Journal of Education and Social Sciences*. 3(5): 137-148.
- Pandey S, Tiwari S. (2014). Education and prosperity through technology – Case of virtual education limited, Nigeria. *Procedia – Social and Behavioral Sciences*. 157: 55-62.
- Pham LB, Taylor SE. (1999). From thought to action: Effects of process- versus outcome-based mental simulations on performance. *Society for Personality and Social Psychology*. 25(2): 250-260.
- Pouladi Borj H, Khaleghkhan A, Heidari H, Davoodi H. (2021). Presenting the pattern of personality components and psychological factors affecting teachers' teaching during the outbreak of Covid-19. *Journal of Research in Behavioral Sciences*. 19(3): 519-528. [Persian]
- Rostamnezhad F, Sardari B. (2021). The effectiveness of education based on the Bybee's five-step teaching pattern (5E) on academic competency and academic flow. *Journal of Education Studies*. 7(27): 1-13. [Persian]
- Sotakova I, Ganajova M. (2023). The effect of the 5E instructional model on students' cognitive processes and their attitudes towards chemistry as a subject. *Eurasia Journal of Mathematics, Science and Technology Education*. 19(9): em2317: 1-22.
- Tegegne TA, Kelkay AD. (2023). Comparative study of using 5E learning cycle and the traditional teaching method in chemistry to improve student understanding of water concept: The case of primary school. *Cogent Education*. 10(1): 2199634.
- Ulas AH, Sevim O, Tan E. (2012). The effect of worksheets based upon 5e learning cycle model on student success in teaching of adjectives as grammatical components. *Procedia – Social and Behavioral Sciences*. 31: 391-398.
- Yasbolaghi Sharahi B, Zare M, Sarikhani R. (2016). Effects of the Bybee (5E) teaching method on learning and retention in the basic concepts of nursing. *Journal of Nursing Education*. 5(1): 30-37. [Persian]
- Zaheri A, Es'haghi Z, Kheiri S, Ghaderi H. (2021). Investigating the relationship between emotional intelligence and academic achievement and academic motivation in students of Shahrekord Paramedical School in 1397-1398. *Horizon of Medical Education Development*. 12(2): 21-32. [Persian]