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Increasing the cognitive activity of students through the use of modular learning technologies

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Abstract

The aim of this study is to determine the perception levels of university students about increasing the cognitive activities of students by using modular learning technologies. The research was carried out in the survey model, which is one of the quantitative research methods. The sample of the research consists of 245 university students studying in the education faculties of 4 different universities in Kazakhstan. The perception scale for increasing cognitive activities through modular learning technologies was developed by researchers. During the development of the scale; the stages of creating an item pool, ensuring the content and face validity of the items, determining the construct validity and reliability were followed by

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making a literature review. The data obtained as a result of the research were analysed using the Statistical Package for the Social Sciences 20.0 statistical package program in a computer environment. As a result of the research; it has been determined that university students participating in the research have a moderate perception of the modular learning technologies sub-dimension, cognitive activity sub-dimension and increasing cognitive activities through modular learning technologies. A significant difference was determined according to the gender variable in the perceptions of university students participating in the study about increasing cognitive activities through modular learning technologies. It is seen that male students' perceptions of increasing cognitive activities through modular learning technologies are higher than female students. There was no significant difference in the perceptions of university students participating in the study about increasing cognitive activities through modular learning technologies, according to the variable of the department they studied.

Keywords: Modular learning technology, cognitive activity, university students;

1. Introduction

In our century, where time is the most important factor, individuals should not be late to catch up with the era and technology (Puchkova, Sorokoumova, Cherdymova, & Temnova, 2021). This adaptation process can be passed quickly and easily with the training sessions that individuals will receive (Yazcayir & Selvi, 2014). This can only be achieved by utilising the opportunities offered by instructional technology and employing new technologies in instruction (Rosli & Siregar, 2022). The word technology is associated with all human activities, including education. Educational technologies enable the individual to participate in more than one sense of the learning environment and enable the individual to learn meaningfully (Bianco, Giaconi, Gison, D'Angelo, & Capellini, 2021; Keser, Uzunboylu, & Ozdamli, 2011).

1.1. Theoretical and conceptual framework

What makes a training program modular is the implementation of the relevant program based on competence within the framework of a module (teaching material) (Abante et al., 2021). Therefore, every aspect of the module should be compatible with the definition, purpose, content, effectiveness and measurement tools of competence, and each module covers a specific knowledge and/or skill (Arabacioglu, 2013; Ibyatova, Oparina, & Rakova, 2018; Poltoratskaya & Kadaner, 2009). When all these are applied to vocational and technical education, educational activities will become more flexible and economical, as well as faster adaptation to changing technological and social conditions (Guilhardi, Yi, & Church, 2007; Mirqosimova, 2021). Since modular teaching bases its basic philosophy on teaching in which the individual is in the centre and the student is active, it advocates an approach in which programmed teaching is effective (Cengizhan, 2008).

The programmed teaching model was included in the educational literature for the first time by Skinner (Gutierrez, 2021). Developed on the basis of programmed teaching, modular teaching consists of modules of the training program and the successive processes of the parts of each module (Olivo, 2021). In the content of each module, it is ensured that knowledge and skills for competency are acquired (Coros, 2022; Tobin & Hieker, 2021). This situation causes the modular curriculum to become a more systematic and consistent education model (Peteros, 2022). In addition to allowing students to progress at their own pace, modular teaching allows them to choose their own learning style and define their own strengths and weaknesses (Sadiq & Zamir, 2014). In addition, it ensures that the teacher is in a guiding position and that the student performs individual learning actively (Capinding, 2022). It also allows students to work individually and in groups in the teaching environment (Lightfoot, 2006; Tokhirovna, 2022).

The modular curriculum keeps students away from rote learning and ensures that the information is permanent and that they gain problem-solving skills (Shchitov, Ol'ga, Shchitova, Stasinska, & Chieu, 2015). The model requires clearly determining the goals to be achieved at the end of learning, systematically controlling the effective stimuli and student responses in learning, and making it necessary to plan these points in detail in advance (Salamuddin, 2021). The word cognition is defined as gaining knowledge about an object as a result of personal experiences, the act of learning that object or becoming conscious of the existence of an object or event. Cognitive learning includes knowledge and mental abilities and skills arising from knowledge (Cortes et al., 2022; Usmanova & Umarova, 2018). Educational practices in this field are generally aimed at acquiring behaviours related to concepts, principles, laws, theories and problem-solving process. Based on this, it is important to increase students' cognitive activities by using modular learning technologies (Solieva, 2020; Ugli & Ugli, 2022).

1.2. Related research

In their study, Abbasian and AfsharImani (2012) aimed to evaluate the modular language education program by teachers and students. The program content of the teacher and students' modular program was evaluated in terms of program efficiency and program resources. De Guzman (2022) aimed to evaluate the modular approach to science teaching in his study. According to the findings, the teachers' views on the application of a modular approach in science teaching were found to be consistent in terms of content, teaching resources, pedagogical approaches and evaluation. In their study, Uyangör, Şahan, and Tanriverdi (2013) conducted situational research aiming to determine teachers' perceptions of the modules used in vocational and technical education.

Mulgrew, Drage, Gardiner, Ireland, and Sandy (2009) examined the effectiveness of a web-based modular curriculum hosted in a virtual learning environment. Despite the popularity of the web-based learning resource, trainees continued to value the opportunity for face-to-face interaction with their teachers and peers. In Agarin's (2021) study, they evaluated the difficulties and status of modular learning and examined the effect of students on academic behaviour and performance. As a result of the research, it was concluded that academic behaviour and performance decreased as modular learning became more difficult. Rhodes (2002) examined learning and classroom activities in technical classrooms where modular education is applied in his study titled 'The Ethos of a Middle School Modular Technology Education Classroom'. In the study, it was concluded that the students adapt to modular education.

'Application of the Modular Education System in the Field of Information Technologies in Vocational and Technical Secondary Education Institutions and its Evaluation in terms of Teachers and Students' measured the satisfaction of students with the modular system and determined that there was a significant difference in favour of modular education (Sert, 2007). In his study on Gender Grouping and the Effects of Learning Style on Student Curiosity in Modular Technology Education Laboratories, Draper (2004) measured the effect of gender and learning style on learning curiosity. In the study, it was determined that grouping students according to gender and style was effective in modular education.

1.3. Purpose of the research

The purpose of this research is to determine the perception levels of university students about increasing the cognitive activities of students by using modular learning technologies. The research questions associated with the purpose of the research are as follows.

1. What are the students' perceptions of increasing their cognitive activities by using modular learning technologies?

2. Do students' perceptions of increasing their cognitive activities by using modular learning technologies differ according to the gender variable?

3. Do students' perceptions of increasing their cognitive activities by using modular learning technologies differ according to the variable of their education?

2. Methods and materials

2.1. Research method

Since the research aims to describe the level of perceptions of students about increasing their cognitive activities by using modular learning technologies, it was carried out in the survey model, which is one of the quantitative research methods. As it is known, scanning models are research approaches that aim to describe a past or present situation as it is, and the event, individual or object that is the subject of the research is tried to be defined in its own conditions and as it is (Khaldi, 2017). In this study, the scanning model was used in accordance with the purpose.

2.2. Participants

The sample of the research consists of 245 university students studying in the education faculties of 4 different universities in Kazakhstan. 107 of the university students are girls and 138 are boys. In addition, 62 of the students are studying in primary school teaching, 44 in mathematics teaching, 51 in preschool teaching, 41 in geography teaching and 47 in physics teaching departments.

2.3. Data collection tools

'Perception Scale for Increasing Cognitive Activities through Modular Learning Technologies' for students; the stages of creating an item pool, ensuring the content and face validity of the items, determining the construct validity and reliability were followed by making a literature review.

2.3.1. Create an item pool

At this stage, first of all, a literature review was conducted based on metacognition, the importance of metacognition in terms of education, and the measurement of metacognition. In this direction, an item pool of 56 items was created. It was discussed among 6 researchers in order to evaluate the items in terms of clarity, comprehensibility and purposefulness, and to add or remove items, and the final number of items was determined as 47 by making necessary adjustments on some items. Students' degree of agreement with the items in the scale was classified as 1 'Strongly disagree', 2 'Disagree', 3 'Partly Agree', 4 'Agree' and 5 'Strongly Agree'.

2.3.2. Ensuring scope and face validity

The items in the item pool were examined by five curriculum and instruction field expert faculty members. In addition, the examination of the prepared items in terms of spelling, punctuation and expression compatibility was provided by an expert in the field of language education. The opinions of the experts were collected with the 'Expert Opinion Form' prepared by the researcher, which includes a classification scale to rate the suitability of each item (not appropriate, partially appropriate and appropriate). After the expert opinion, the item pool of the scale was reduced to 51 items. Thus, the draft prepared before the pre-application 'Perception Scale for Increasing Cognitive Activities through Modular Learning Technologies' included 19 items.

2.3.3. Ensuring construct validity

Exploratory factor analysis and confirmatory factor analysis techniques were used to determine the construct validity of the trial scale. The draft scale was applied to 216 university students, and as a result of this application, 7 forms that were not filled in appropriately and had extreme values were not included in the analysis. The skewness and kurtosis coefficients of the items forming the data set obtained from 209 students were examined, and it was determined that the data set provided the normality assumption. Before the exploratory factor analysis, whether the data of the research was suitable for factor analysis was examined with the Kaiser-Meyer-Olkin (KMO) coefficient and Barlett Sphericity test, and the KMO measurement value was 0.88 and the Barlett Sphericity test result was also significant (χ^2 = 4,574.69, p = 0.00; p < 0.05) thus it was understood that the data set was suitable for factor analysis.

In order to determine the factor structure of the scale, rotated principal components analysis and then the Varimax vertical rotation technique was used. In the process of creating the factors; the eigenvalue of each factor should be at least 1, the factor load value should be 0.40 or higher, the difference between the two load values of the items with a high load value in more than one factor should be at least 0.10, the meaning and content of the items in each factor in terms of internal consistency, criteria were taken into account. As a result of Varimax rotation, 5 items that did not meet these criteria were removed from the scale, the analysis was repeated for the remaining 14 items, and it was seen that 14 items were grouped under 2 factors. There are six items in the first factor of the scale and eight items in the second factor. All items are positive. A confirmatory factor analysis study was conducted to confirm the 2-factor structure obtained as a result of the exploratory factor analysis. According to this; mean square root of approximate errors = 0.046, standardised root mean squared error = 0.07, unnormed fit index = 0.90, incremental fit index = 0.97, comparative fit index = 0.97, goodness of fit index (GFI) = 0.91, AGFI = 0.90. While these ratios reveal that the GFI of the scale is high, they show that the 2-factor structure of the scale is confirmed.

2.3.4. The reliability study of the scale

The Cronbach Alpha internal consistency coefficient was calculated for the reliability of 14 items of the scale. The internal consistency coefficient for the 'Modular Learning Technologies' sub-dimension is 0.90 and the internal consistency coefficient for the 'Cognitive Activity' sub-dimension is 0.87. The internal consistency coefficient obtained for the whole scale was determined as 0.92. The obtained values show that this scale is a reliable measurement tool to measure the perception of increasing cognitive activities through mobile learning technologies.

2.4. Data collection process

In the process of collecting the research data, the 'Perception Scale for Increasing Cognitive Activities through Modular Learning Technologies' was applied to university students through google forms. The collection of research data took approximately 2 months.

2.5. Data collection analysis

The data obtained as a result of the research were analysed using the Statistical Package for the Social Sciences 20.0 statistical package program in a computer environment. In the analysis of the difference according to the gender variable, a *t*-test was used for independent groups. One-way analysis of variance (ANOVA) was performed to test the difference according to the department of education. The scale item score intervals were taken as equally spaced according to the formula '5−1 = 4, 4/5 = 0.80'. The 5.00–4.20 score range was considered and interpreted as very high, 4.19–3.40 high, 3.39–2.60 medium, 2.59–1.80 low and 1.79–1.00 very low.

3. Results

In Table 1, the sub-dimensions of the perception scale for increasing cognitive activities through modular learning technologies and the mean and standard deviations of the overall scale are given.

Table 1. Perception scale for increasing cognitive activities through modular learning technologies

	X	**SS**
Modular learning technologies	3.28	0.967
Cognitive activity	3.21	0.782
Overall scale	3.23	0.801

When Table 1 is examined, it has been determined that university students participating in the research have moderate perceptions in the modular learning technologies sub-dimension (X = 3.28) and cognitive activity sub-dimension (X = 3.21). The general average of the perception scale related to increasing cognitive activities through modular learning technologies (X = 3.23) reveals that the students have a medium level of income.

In Table 2, the *T*-test results of the university students participating in the research are given according to the gender variable.

Table 2. *T*-test results by gender variable

Gender	***N***	***X***	**SS**	***F***	***p***
Female	107	2.97	0.663	16.521	0.000
Male	138	3.43	0.869		

When Table 2 is examined, it has been determined that there is a significant difference according to the gender variable (F = 16.521, $p < 0.05$) in the perceptions of university students regarding increasing cognitive activities through modular learning technologies. The results reveal that the significant difference is in favour of male students.

In Table 3, the results of the ANOVA of the university students participating in the research are given according to the variable of their education.

Table 3.

Class	*N*	*x*	SS	*F*	*p*
Primary school teaching	62	3.21	0.685	6.339	0.426
Math teaching	44	3.29	0.630		
Pre-school teaching	51	3.20	0.683		
Geography teaching	41	3.22	0.655		
Physics teaching	47	3.26	0.692		

Table 3 was examined, and it was determined that there was no significant difference in the perceptions of university students regarding increasing cognitive activities through modular learning technologies, according to the variable of the department they studied ($F = 6.339$, $p > 0.05$).

4. Discussions

It was determined that the university students participating in the study had moderate perceptions in the modular learning technologies sub-dimension and in the cognitive activity sub-dimension. It was determined that the students' perceptions of increasing cognitive activities through modular learning technologies were at a moderate level. It has been observed that there is a significant difference according to the gender variable in the perceptions of university students participating in the research about increasing cognitive activities through modular learning technologies. Accordingly, it was determined that male students' perceptions of increasing cognitive activities through modular learning technologies were higher than female students. It was determined that there was no significant difference in the perceptions of the university students participating in the study about increasing cognitive activities through modular learning technologies, according to the variable of the department they studied.

Hanisch, Eichelberger, Richard, and Doepfner (2020) investigated the effects of the modular teacher coaching program on children's attention problems and destructive behaviours, and teachers' self-efficacy and stress. As a result of the research, it was concluded that the modular program reduces children's attention deficit and has positive effects on teacher self-efficacy. Pribadi and Susilana (2021), in their study, evaluated mental processes in order to facilitate distance learning of students in modular writing based on printed learning materials. As a result of the research, it was concluded that printed modular-based learning materials improved students' mental skills and writing skills. Jou, Mariñas, and Safflor (2022) examined the effect of students' modular distance education on students' cognitive activities. As a result of the research, it was revealed that modular distance learning technologies should be improved in terms of application, evaluation and use by decision makers in institutions in line with student opinions.

5. Conclusion

Developing the knowledge and skills of the individual in the education process emerges as a requirement of the scientific and technological developments in our age. The main reason for the development of modular programming as a new technology in curriculum arrangement in education is to provide more effective and efficient programming of educational applications that have gained a complex character in the face of scientific and technological developments. In our age, with the support of technology, applications in which the student is active and the teacher is the guide are preferred instead of the methods and applications in which only learning is active in educational activities. Since modular learning provides a student-oriented teaching opportunity, it directly affects the cognitive processes of the students. Starting from here, in this research; it was aimed to determine the perception levels of university students regarding increasing the cognitive activities of students by using modular learning technologies. As a result of the research; it has been determined that university students participating in the research have a moderate perception of the modular learning technologies sub-dimension, cognitive activity sub-dimension and increasing cognitive activities through modular learning technologies. A significant difference was determined according to the gender variable in the perceptions of university students participating in the study about increasing cognitive activities through modular learning technologies. It is seen that male students' perceptions of increasing cognitive activities through modular learning technologies are higher than female students. There was no significant difference in the perceptions of university students participating in the study about increasing cognitive activities through modular learning technologies, according to the variable of the department they studied.

6. Recommendations

In parallel with the results obtained from the research, the following recommendations are presented.

1. Course contents for students should be arranged in order to increase the perception levels of university students about modular learning technologies.

2. The perceptions of university students regarding the development of cognitive activities with modular learning technologies are still at a moderate level, and cognitive skills training should be given to students through modular learning technologies.

3. The management of the modular learning system to be offered to university students by experienced educators and the creation of qualified content will allow students to increase their cognitive activities by using modular learning technologies.

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Appendix 1. Perception scale for increasing cognitive activities through modular learning technologies

	Perception scale for increasing cognitive activities through modular learning technologies Explanation: Please rate the following items in one of the options 'Strongly Agree', 'Agree', 'Partly Agree', 'Disagree' and 'Strongly Disagree'.	I strongly agree	I agree	Partially agree	I disagree	I strongly disagree
	Modular learning technologies					
1	The student is active in the learning environment in modular teaching					
2	Modules guide and motivate students					
3	Modules allow students to progress at their own pace.					
4	Modules give the student the opportunity to self-assess.					
5	Teachers and students do not have any problems in obtaining the modules.					
6	If all the modules are ready, the teaching process will be easier.					
	Cognitive activity					
7	It is possible to increase cognitive awareness with modular learning technologies					
8	Modular learning technologies make it easier to avoid cognitive errors					
9	Modular learning technologies provide cognitive flexibility					
10	Modular learning technologies facilitate cognitive assessment					
11	Modular learning technologies enable cognitive achievement					
12	Modular learning technologies facilitate cognitive behaviour acquisition					
13	Modular learning technologies provide cognitive control					
14	Modular learning technologies improve cognitive ability					