i.e.: inquiry in education

Volume 13 | Issue 1 Article 13

The Effect of the Layered Curriculum on Students' Academic Achievement and Retention of Learning

Gülçin Zeybek
Karamanoğlu Mehmetbey University, Turkey, gulcinzeybek@kmu.edu.tr

The Effect of the Layered Curriculum on Students' Academic Achievement and Retention of Learning

Cover Page Footnote

This study was made from a doctoral dissertation titled "Effects of the Layered Curriculum on Students' Achievements and Permanence" which was presented in 2016 in Turkey Necmettin Erbakan University Graduate School of Education.

The Effect of Layered Curriculum on Students' Academic Achievement and Learning Retention*

Gülçin Zeybek
Karamanoğlu Mehmetbey University, Karaman, Turkey

Introduction

In the current century, there have been important changes in education in both the approaches toward and the use of different teaching methods and techniques: from a teacher-centered education approach to a student-centered education approach; from receiving the information prepared to structuring the information; from an approach that limits learning to school to an approach that is based on lifelong learning; from the role of the teacher as an authority, to the role of the teacher who is a guide and learns with his students. Since 2005, Turkey has also adopted the constructivist approach in line with this vision and has tried to regulate its curricula in accordance with constructivism (Öner et al., 2014). The educational reform taking place is about not what students learn or what teachers should teach but how students learn and how teachers should teach (Kim Suk, 2005). The objective of contemporary education is to raise individuals who have problem-solving skills, who know the methods of accessing knowledge, who have gained analytical thinking and questioning skills, and who can transfer their knowledge to life. It is extremely important to create a learning environment in which students are truly responsible for their own learning, gained by researching, observing, and interpreting the topics they will learn (Oktay, 2001). To achieve this objective, student-centered theories and models, such as multiple intelligence theory, cooperative learning, constructivism, critical thinking, reflective thinking, and project-based learning, can be followed in the classroom environment (Öner et al., 2014). One of the new points of view of our education system is layered curriculum, which aims to educate learners who access information, obtain what is necessary, produce new information, and have the power to think critically and creatively (Başbay, 2005b).

Layered Curriculum

Layered curriculum, based on the assumption that learners have different ways of learning and different interests, is an approach in which learners take on individual responsibilities, acquire knowledge, use the knowledge gained in solving problems, analyze the events in light of the data, think critically, and create new ideas (Başbay, 2005b). Layered curriculum is based on the approach that each learner's learning style, intelligence dimension, level of readiness, and thinking system are different from those of other learners. Every learner who

* This study was created from the doctoral dissertation titled "Effects of Layered Curriculum on Students' Achievements and Permanence" presented at the Institute of Educational Sciences, Necmettin Erbakan University, Turkey, in 2016.

comes to the school environment is unique. In other words, learners have different structures in terms of all their characteristics (Nunley, 2004a).

Within the framework of this approach, activities to be carried out in and out of school are handled in three steps, ordered as C, B and A, based on the level of difficulty. These steps are as follows:

> Step C: This is built on basic knowledge and meanings. Learners constitute their basic knowledge in this step.
>
> Step B: The knowledge learned in step C is implemented and regulated. Learners perform problem solving and other high-level tasks at this level.
>
> Step A: Critical thinking and designing original ideas or products are realized at this step. This step requires the highest and most complex level of thinking (Goad & Kelly, 2002). Learners fulfill different tasks in these steps and carry out activities by taking responsibility on the topics they are interested in through multitasking preferences (Nunley, 2004a).

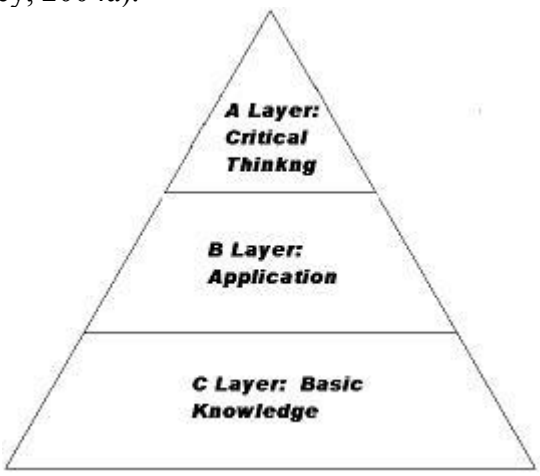

Figure 1. Steps of layered curriculum (Nunley, 2004a).

The cascading relationship of layered curriculum shows a similar structure to Bloom's taxonomy. The knowledge, comprehension, application, analysis, synthesis, and evaluation steps in Bloom's taxonomy are seen in steps C (knowledge and comprehension), B (application, analysis), and A (synthesis, evaluation) in the layered curriculum approach (Vyborny & Trowbridge, 2005). By differentiating these steps, students can choose activities that suit their abilities or interests. This also encourages students to try to reach the peak their talent. Using layered curriculum, teachers can differentiate their teaching according to students' needs and learning styles (Fiore, 2007). The work to be done in layered curriculum is given below in steps. These five simple steps form the basis for planning the teaching process based on the layered curriculum.

> Step 1: Students are offered different tasks to complete within a certain time frame. There is a point value determined depending on the complexity of the task.
>
> Step 2: The unit is divided into three steps, where the depth or level of work done on the subject is represented at each step. The lowest level is called step C. Students work to earn points specified at level C. Students are free to choose the tasks they

want from the prepared task list. Different score values are determined according to the complexity of the tasks. Students must complete these tasks to pass step C.

Step 3: In step B, where more sophisticated thinking skills are required, students need to organize, apply, and take the information they have learned one step further. At this stage, students deal with information, build, design, use, apply, solve problems, and create new information.

Step 4: Step A is the last step, requiring more comprehensive and critical thinking. Here, students compare their personal and moral judgments with traditional research. Often, students have discussions on the subject about the situations they encounter in their lives at several points.

Step 5: In the assessment dimension, which is the most important step of layered curriculum, the students' tasks are evaluated in terms of "oral defense." When students complete their tasks, they discuss "what they learned," and they are evaluated by this means. At this stage, face-to-face communication is established to ensure that students learn in depth by asking a few key questions based on pre-planned goals (Başbay, 2005a).

Although it seems that the teaching-learning process has come to the fore in layered curriculum, the objectives are very important because objectives contribute to determining students' learning levels. While the objectives help to identify students' learning needs, they also guide them in realizing more learning by pushing their limits. Thus, alternative ways of reaching students who have different levels of learning, different interests, and different expectations in the same classroom are found through the determined goals (Demirel et al., 2006).

An important point in the layered curriculum approach is the assessment step. According to this approach, the main goal in the assessment process is to determine that learning has taken place rather than that the activities have been completed. Assessment is based on portfolios and oral defense, and rubrics are used to make the process effective. Oral defense is an assessment technique that is used very often in this approach in selecting and evaluating activities. Students are asked several questions about what they have learned has after they have finished the activity. Oral defense, which allows students to test their knowledge about a subject, is a tool to reveal to what extent the student has mastered the subject (Demirel, 2007).

Layered curriculum is based on planning and maintaining teaching in accordance with learning or thinking styles. It allows students to learn with the learning style that suits them. Lessons can include all kinds of activities, and the content cannot be limited. Students choose the activities that suit them from the ones offered (Brosnan et al., 2007).

Caine and Caine (2002) state that the incentive for complex and real studies related to students' personal interests has an important place in teaching. They argue that the student should be exposed to different activities related to the subject of the lesson and note that this teaching tool may be connected with different disciplines.

Nunley (2003) argues that students cannot be controlled by teachers for 12 years and that if they do not learn how to take responsibility at school, learning in life will be more difficult.

For this reason, she argues that, because it gives students the chance to choose their own ways of learning and holds the students responsible for their own learning, layered curriculum is a learning model that is close to life, and thus, learning in this way will be faster and will contribute to lifelong learning.

Purpose and Importance of the Research

Current studies on layered curriculum have revealed many positive aspects of the method. One of these positive aspects is academic success and the permanence of what has been learned. With the layered curriculum method, researchers have observed that students' comprehension increased (Maurer, 2009) and that students achieved permanent retention of what they learned (LaSovage, 2006). Brosnan et al. (2007) found that students successfully completed the activities they chose according to their learning style. Colding (2008) found that layered curriculum increases students' motivation and has a positive effect on their success. Noe (2008) and Ritter (2008) found that layered curriculum applications increased students' academic success of. Beckham (2010) found that learners were more successful academically in layered curriculum, and the program positively affected students' attitudes toward the course. Aydoğuş and Ocak (2011) conclude that layered curriculum–based teaching method is more successful than traditional teaching methods. Gömleksiz and Biçer (2012) determined that layered curriculum had a positive effect on students' achievement and attitudes toward the course. Koç and Şahin (2014) conclude that the layered curriculum approach supported by the theory of multiple intelligences is more effective than learning approaches in the current program in increasing academic achievement and ensuring the permanence of academic knowledge. Kılınçaslan and Şimşek (2015) found that the layered curriculum method positively affected students' academic achievement and long-term success. In a study conducted by Üzüm and Pesen (2019), the layered curriculum applications positively affected the academic success of the students and increased their success levels.

Studies have shown that in groups where layered curriculum is applied, the participants generally express positive perceptions about the program. In Beckham's study (2010), according to the perceptions received, the students wanted this method to be used in other classes. Gömleksiz and Biçer's (2012) interview and observation findings revealed positive results. Kılınçaslan and Şimşek (2015) found that students' interest in the course increased with the method applied according to the information they obtained from qualitative data collection tools. According to the participants in Caughie's study (2016), activities such as presenting options for assignments, dealing with students one-on-one, giving clear expectations, and providing feedback from the teacher positively affect students' participation and performance in the course.

In addition to these, other studies have shown that students' thinking skills improve with the layered curriculum method; they gain their attention more easily, and they have more gains with activities that are carried out more efficiently (Overstreet & Straquadine, 2002; Nunley, 2003; Demirel et al., 2006; Yılmaz, 2010). Başbay's (2005b) findings revealed that project-based learning activities supported by the layered curriculum method brought positive contributions to the learning process; the layered curriculum approach has a contributing role in increasing the awareness of responsibility. Similarly, Johnson (2007) found that students' problem-solving skills and responsibilities such as taking part in activities increased with layered curriculum. Maurer (2009), on the other hand, reveals that with layered curriculum, the learners' ability to understand and use technology increased. Miller and Trach (2011) found that students actively participate in the course thanks to layered curriculum and that

students use critical thinking skills while learning information. Duman and Özçelik (2017) show that the layered curriculum application was more effective in improving students' attitudes toward the course than the current curriculum. Gencel and Saracaloğlu (2018) found that layered teaching has positive effects on participants' reflective thinking and self-directed learning.

An examination of current literature found a limited number of studies at high school level. However, that high school students also want to learn by exploring and having fun, they enjoy learning in line with their personal interests and learning in social communication, and they like fast access to information and thus want to use technology while researching and learning and prefer graphics over texts. Based on the idea that learner-centered approaches can be useful at different school levels and in different courses, I implemented layered curriculum in the programming basics course of the information technologies field in a vocational and technical high school.

One of the professional fields of education in vocational and technical education institutions, which aim to train the technical manpower needed in business life, is information technologies. As technology progresses and businesses in our country are rapidly institutionalized, the need for people competent in the field of information technologies has increased. Information technologies aims to train qualified professionals who have the necessary professional competencies in line with the needs of the sector and with scientific and technological developments. In this field, several methods and techniques are used to help students gain competence, and these mainly support individual learning. Today in the field of information technologies, as in all fields, students are expected to access information by researching, question the information they have accessed, structure and share the information, apply the knowledge and skills they have acquired in their daily lives, and solve the problems they encounter. Therefore, as vocational and technical education focuses on applied skill acquisition, learning environments where students can demonstrate their performances in practice are important.

Based on what these realities, I thought that layered curriculum would make the programming basics course more productive. The aim of this study was to determine the effects on students' academic achievement of the activities organized within the framework of layered curriculum in the simple codes unit of the tenth grade programming basics course in the information technologies field in a vocational and technical high school, as well as the students' perceptions about the applied program. Below are the hypotheses developed for this aim.

Hypotheses

1. Posttest mean scores of the experimental group in which learning activities based on the layered curriculum are applied will be significantly higher than pretest mean scores.

2. Posttest mean scores of the control group in which the current program-based activities are applied will be significantly higher than the pretest mean scores.

3. Posttest mean scores of the experimental group in which learning activities based on the layered curriculum are applied will be significantly higher than posttest mean scores of the control group in which existing program-based activities are applied.

4. Retention test mean scores of the experimental group in which learning activities based on the layered curriculum are applied will be significantly higher than retention test mean scores of the control group in which the existing program-based activities are applied.

Sub-Problems Related to the Qualitative Dimension of the Research

1. What are the students' views regarding the teaching and learning process organized within the framework of the layered curriculum?

2. What are the students' views regarding assessment methods and criteria applied in the layered curriculum?

3. What are the students' views regarding the contribution of the layered curriculum to learning?

4. What are the students' views regarding the contribution of the layered curriculum to the development of personal and social skills?

5. What are the students' views regarding the effect of the layered curriculum on friendship relationships in class?

6. What are the students' views regarding the effect of the layered curriculum on their interest in the course?

Method

This section includes information about the design of the research, the study group, data collection tools, the data collection process, and data analysis.

Research Model

This study used a random experimental model with pretest-posttest control group. However, after collecting quantitative data, the author also collected qualitative data to interpret, deepen, and enrich the quantitative data. For this purpose, the author held semi-structured interviews with the participants.

Participants

To form the study group, first of all, I selected 24 students studying information technologies in the tenth grade of a vocational and technical school in the center of Karaman in Turkey in the 2014–2015 academic year. Then, I formed two groups of 12 students from the determined students using random sampling. I determined one of the groups as the experiment and the other as the control group randomly. Since the school where the study was conducted is a girls' high school, all participants were female, and since all the participants were tenth grade students, their age range was 14–15. This class was a "typical" class for the school. The school where the study was conducted was not only a school that prepares individuals for the professions but also an institution that enables students to prepare for university.

I applied the independent samples t-test to determine whether there was a significant difference between pretest mean scores of the experimental and control group students, so as to reveal whether the groups were equivalent in terms of their academic achievement levels in the programming basics course. Table 1 displays the t-test results of the pretest scores of the students according to groups.

Table 1
Independent Samples t-Test Results of Pretest Scores of Students According to Groups

Level	Group	n	$\overline{X}$	S	sd	*t*	*p*
Knowledge	Experimental	12	3.42	1.83	22	0.585	0.564
	Control	12	3.00	1.65			
Comprehension	Experimental	12	2.58	1.38	22	0.457	0.652
	Control	12	2.33	1.30			
Application	Experimental	12	5.25	3.77	22	1.748	0.094
	Control	12	2.92	2.68			
Total	Experimental	12	11.25	4.41	22	1.628	0.118
	Control	12	8.25	4.62			

$p \leq 0.05$

Table 1 shows that there was no significant difference between the scores of the experimental and control group students in the pretest. Based on this finding, the experimental and control group students were equivalent in terms of pretest scores.

Materials

Academic Achievement Test

I developed an achievement test for the simple codes unit of the programming basics course consisting of 48 questions to apply to the experimental and control groups as a pretest, posttest, and retention test. Since the test was multiple choice, I believed that there would be no biases in scoring. The test contained 14 questions at the knowledge level, 13 questions at the comprehension level, and 21 questions at the application level, according to Bloom's taxonomy. To ensure content validity when creating the questions for the test, I scanned the relevant literature and created an item analysis table. Three faculty members who are experts in their fields evaluated the test questions in terms of their adequacy in measuring the characteristic to be measured. As a result of the evaluations, I modified some of the questions in the test. To examine the language comprehensibility of the test questions, I collaborated with language experts. To determine the reliability of the test, I applied the test to 207 students studying in the tenth and eleventh grades of the information technologies field of a vocational high school in Turkey. Based on the data obtained in this pre-application, I calculated test statistics and made question analyses. While scoring the achievement tests applied to the students participating in the study, I scored each correct answer as 1 point, and I scored the wrong answers and the items left blank as 0 points.

I calculated the reliability coefficient of the scale developed as r=0.94 according to the KR-20 method. The question analysis revealed that easy questions were not included in the test; 21 questions were of medium difficulty, and 27 questions were difficult. The average difficulty of the test was 0.34., indicating that the it is a difficult test in general. Question analysis and a calculation of question discrimination values showed that 23 questions were "very good" and 12 were "good." The final test included these 35 questions without modification and nine

revised questions. Two questions were excluded from the final test since they were negative questions, and a further two were removed since they were very weak. After these changes to the test, 44 questions remained: 14 at the level of knowledge, 10 at the level of comprehension and 20 at the level of practice. After the changes, I recalculated the reliability of the test with the KR-20 method, finding the reliability coefficient to be r=0.94. This value is considered quite good for an achievement test.

Semi-Structured Interview Form

To ensure data and method diversity, I used interviews as a qualitative data collection method. The students in the experimental group were the participants, and I conducted standardized open-ended interviews with them. While preparing the interview form, I wrote open-ended questions that are easy to understand, and I made efforts to ensure that the questions were subject-oriented but did not direct the respondent. I avoided multidimensional questions to make it easier for the interviewed individual to respond fully to the questions, to prevent some important questions from being forgotten and to prevent an unnecessary burden on the individual. To increase the likelihood of successful interviews, I attempted to arrange the questions rationally. For this purpose, I prepared an introduction that would create confidence for the interview, I chose the first questions in an easy-to-answer manner, and I listed the questions from specific to general. I did all this in collaboration with curriculum development and language experts.

Procedure

I carried out the experimental process as the teacher of the programming basics course. The experimental process occurred in the simple codes unit, which is the second unit of the tenth-grade programming basics course. At the beginning of the process, the experimental and control group students took the achievement test described above as a pretest. The process lasted 12 weeks. To begin the experimental process, I divided the learning units related to the subject into three steps according to Bloom's taxonomy. Step C comprised target behaviors at the level of knowledge and comprehension, step B focused on target behaviors at the level of application, and step A included target behaviors at the level of analysis and evaluation. As its name signifies, the simple codes unit, in which the experimental process was carried out, teaches students to write programs at a simple level. Since it does not include content aimed at providing a unique product, as required by the synthesis level, the process did not include an activity at the synthesis level. Students chose 14 activities related to step C, each with a value of 5 points. I provided at least three different options for each event. The activities at this level were worth a total of 70 points. The first activity, which included the introduction of the unit and the basic concepts in the unit, was a mandatory activity and had no point value. Other activities related to step C included banner/poster, brochure, newsletter, flyer, catalog, advertisement, presentation, table, concept map, and exam preparation. I asked students to choose one activity from four options in step B and one activity from two options in step A. The activity scores of both steps were 15. Writing a program that allows a university student to enter midterm and final exam grades into the programming software and to calculate a passing grade, or writing a program that prints the results by calculating the circumference, areas, and volumes of geometric bodies whose dimensions are given, are examples of activities in step B. Separating the items of a particular computer program and examining the relationships between these items, or evaluating a given program according to the basic features that a software program should have, are examples of activities in step A.

In the layered curriculum method, since step C is the most extensive step, I kept the number of activities and options high, and I also kept the total score to be obtained from these activities high. After I had determined the learning activities, I created graded scoring keys for these activities. While I was dividing the learning units into steps, determining the activity lists, and creating the scoring instructions, I received feedback on their suitability for layered curriculum from three faculty members who are experts in their fields. As a result of the expert evaluations, I made some revisions. The degree of agreement among the experts' evaluations (Miles & Huberman, 1994) was calculated as 0.89. Then, I informed the students about layered curriculum, I explained the purpose and importance of the study, and I enumerated the experimental processes to be applied. I made a short presentation about the concepts related to the unit at the beginning of each lesson and gave students time to choose activities. I asked students to explain the reasons affecting their choice of activities and to write these on their task selection forms. Thus, I had the opportunity to determine the extent to which the students had mastered the subject and were able to reveal their knowledge and thoughts on the subject. I presented different activity options for each level to the students, and they were free to choose the activities they wished. Students freely performed learning tasks related to a particular topic. Meanwhile, I observed the students' work, guided them, and evaluated the completed activities. In addition, the students presented their completed studies in the classroom and discussed them. In this way, I determined the students' learning deficiencies or needs. Students stored their electronic media activities as electronic portfolios and other activities in portfolios. During the assessment, I used portfolios, e-portfolios, oral defenses, and rubrics. At this stage, students first performed self-assessments by taking into consideration the rubrics given to them, and I then evaluated the students' work. Furthermore, I informed the students in the experimental group about how to use rubrics while scoring their work. While I carried out all these processes in the experimental group, I continued the existing program-based activities in the control group. Within the scope of the tenth-grade curriculum in the field of information technologies, I explained the subject of the lesson at the beginning of each lesson, and if any, I created practice exercises and demonstrations in the programming software, and then I gave students time for their own practice. After the experimental process ended, I held semi-structured interviews with the participants. To make the interview process more effective and productive, I created a confidence-building intervention sharing with the participants the purpose, importance, and scope of the research, as well as where the data obtained from the research will be used. Participants took the retention test one month after the end of the experimental process. When determining the time period between the posttest and the retention test, I took into consideration class level, content of the course, and the related literature.

Data Analysis

I analyzed quantitative data of the study using a statistical software program. I tested whether the students in the experimental and control groups were equivalent in terms of their pretest scores and whether the posttest and retention test mean scores differed significantly. For this purpose, I first applied the Shapiro-Wilk test to determine whether the measurements related to the dependent variable showed normal distribution in both groups. The significance values calculated for the pretest, posttest, and retention test scores were higher than $p=0.05$, and accordingly, the scores were suitable for normal distribution. In addition, I applied the Levene F-Test to determine whether the variances related to the distribution of the measurements in the experimental and control groups, whose mean scores were to be compared, were equal. The groups had equal homogeneity since the significance values calculated for the pretest, posttest, and retention test scores were above $p=0.05$. Considering

these findings, I applied the independent samples t-Test and paired samples t-Test, which are parametric statistical techniques.

The data obtained in this approach are summarized and interpreted according to previously determined themes. The data can be arranged according to the themes revealed by the research questions, or they can be presented by considering the questions or dimensions used in the interview and observation processes. In descriptive analysis, direct quotations are frequently used to reflect the views of the interviewed individuals in a striking way. The purpose of this type of analysis is to present the findings to the reader in an organized and interpreted form (Yıldırım & Şimşek, 2018). In this study, I analyzed the qualitative data I obtained through the interview method with the descriptive analysis technique. First, I recorded the interview data with audio. For this, I obtained the oral consent of the participants at the beginning of each interview. On the day of the interview, I listened to the interview data and transferred the data to a word processing program. After I had transcribed all the qualitative data, I created a framework for descriptive analysis and determined under which themes the data would be organized and presented according to this framework. I then processed the data according to the thematic framework, interpreted it, and supported it with direct quotations.

Findings

In this section, to find the answers to the quantitative and qualitative sub-problems of the research, I give the findings of the data collected and make interpretations according to these findings.

Quantitative Data

Comparison of the Experimental Group's Pretest and Posttest Mean Scores

Table 2 shows the paired samples t-test results comparing the experimental group students' achievement test scores before and after the layered curriculum experiment.

Table 2

Paired Samples t-Test Results of Experimental Group Pretest and Posttest Mean Scores

Level	Test	n	$\overline{X}$	S	sd	*t*	*p*
Knowledge	Pretest	12	3.42	1.83	11	-6.298	0.000
	Posttest	12	8.75	1.91			
Comprehension	Pretest	12	2.58	1.38	11	-6.575	0.000
	Posttest	12	6.67	1.30			
Application	Pretest	12	5.25	3.77	11	-7.376	0.000
	Posttest	12	14.17	3.07			
Total	Pretest	12	11.25	4.41	11	-9.922	0.000
	Posttest	12	29.58	4.94			

$p \leq 0.05$

Upon examining Table 2, one can see a significant increase in the experimental group students' mean scores in the Basic Codes module achievement test after the layered curriculum invervention ($t_{knowledge}$=-6.298, $t_{comprehension}$=-6.575, $t_{application}$ =-7.376, t_{total}=-9.922, $p \leq 0.01$).

Comparison of the Control Group's Pretest and Posttest Mean Scores

Table 3 shows the paired samples t-test results comparing the control group students' achievement test scores before and after the layered curriculum intervention.

Table 3

Paired Samples t-Test Results of Control Group Pretest and Posttest Mean Scores

Level	Test	n	$\overline{X}$	S	sd	*t*	*p*
Knowledge	Pretest	12	3.00	1.65	11	-6.791	0.000
	Posttest	12	6.75	1.77			
Comprehension	Pretest	12	2.33	1.30	11	-4.980	0.000
	Posttest	12	5.08	1.83			
Application	Pretest	12	2.92	2.68	11	-10.137	0.000
	Posttest	12	11.08	4.14			
Total	Pretest	12	8.25	4.62	11	-11.779	0.000
	Posttest	12	22.92	5.60			

$p \leq 0.05$

Table 3 shows that there was a significant difference in favor of the posttest between the control group students' pretest and posttest mean scores in the Basic Codes module of the Programming Basics course ($t_{knowledge}$=-6,791, $t_{comprehension}$=-4,980, $t_{application}$=-10,137, t_{total}=-11,779, $p \leq 0.01$).

Comparison of Posttest Results of Experimental and Control Groups

Table 4 displays the independent samples t-test results of the posttest conducted to determine the differences in knowledge, comprehension, application level, and total mean scores between the experimental group students and the control group students.

Table 4

Results of Students' Posttest Scores t-Test by Group

Level	Group	n	X	S	sd	t	p
Knowledge	Experimental	12	8.75	1.91	22	2.662	0.014
	Control	12	6.75	1.76			
Comprehension	Experimental	12	6.67	1.30	22	2.440	0.023
	Control	12	5.08	1.83			
Application	Experimental	12	14.17	3.07	22	2.071	0.050
	Control	12	11.08	4.14			
Total	Experimental	12	29.58	4.94	22	3.092	0.005
	Control	12	22.92	5.60			

$p \leq 0.05$

As Table 4 reveals, there is a significant difference in favor of the experimental group in knowledge, comprehension, application level, and total mean scores obtained in the posttest ($t_{knowledge}$=2.662, $t_{comprehension}$=2.440, $t_{application}$=2.071, t_{total}=3.092, $p \leq 0.05$). Based on this finding, one may conclude that in the simple codes unit of the tenth-grade programming basics course, layered curriculum is more effective than the existing program in gaining target behaviors at the levels of knowledge, comprehension, and application.

Comparison of Retention Test Results of Experimental and Control Groups

Table 5 contains the independent samples t-test results of the retention test conducted to determine the differences in knowledge, comprehension, application level, and total mean scores between the experimental group and the control group students.

Table 5

Results of Students' Retention Test Scores t-Test by Group

Level	Group	n	X	S	sd	t	p
Knowledge	Experimental	12	7.42	2.07	22	2.446	0.023
	Control	12	5.67	1.37			
Comprehension	Experimental	12	6.37	2.21	22	1.914	0.043
	Control	12	4.63	1.27			
Application	Experimental	12	14.33	3.42	22	3.733	0.001
	Control	12	8.42	4.29			
Total	Experimental	12	27.92	6.36	22	3.652	0.001
	Control	12	18.92	5.70			

$p \leq 0.05$.

Table 5 shows that there was a significant difference in favor of the experimental group in knowledge, comprehension, application level, and total mean scores obtained in the retention test ($t_{knowledge}$=2,446, $t_{comprehension}$n=1,914, $t_{application}$=3,733, t_{total}=3,652, $p \leq 0.05$). This result indicates that in the simple codes unit of the tenth-grade programming basics course, layered curriculum is effective in ensuring the retention of the target behaviors at the levels of knowledge, comprehension, and application.

Qualitative Data

According to the analysis of the data from the participant interviews, the qualitative findings fell under seven themes. Table 6 presents these themes and the views under each.

Table 6

Themes and their Respective Views

Themes	
Contribution to learning	Being useful and efficient, concretizing the subject, facilitating understanding, reinforcing the learned material, ensuring permanence, achieving success in exams, recognizing mistakes, improving the ability to interpret, gaining speed while performing applications, using the computer for learning, computer usage level, etc.
Attitude toward the lesson	Creating excitement, increasing interest, increasing active participation, preventing boredom with the lesson, having difficulty in the beginning, not being afraid of the lesson, etc.
Contribution to personal development	Self-achievement, not being afraid of making mistakes, self-confidence, social skills, etc.
Contribution to the classroom environment	Helping, developing friendships, making the learning environment enjoyable, etc.
Choosing tasks	Different types of activities, easy-to-do activities, challenging activities, etc.

Assessment style	Being different and interesting, trying to be objective, allowing to see mistakes, etc.
Suggestions	Use in different lessons, use in difficult lessons, etc.

Theme 1: Contribution to learning

This theme includes the students' views on the layered curriculum's contribution to learning. The students participating in the study stated that the layered curriculum activities were useful and efficient in terms of learning, concretized the subjects, facilitated the understanding of the lesson, reinforced and made permanent what was learned, brought success in exams, made it easier to notice mistakes, and improved their interpretation skills. In addition, students stated that thanks to the layered teaching activities, they gained speed in doing computer applications, they used the computer more for learning, and their level of computer use improved. Quotes showing these thoughts and views are as follows:

S1: "We have reinforced what we have learned by doing practice."

S3: "We learned the subjects better and succeeded in the exam."

S4: "As we have practiced, what we learned has become permanent."

S5: "Thanks to the application step, we were able to see and evaluate the screen output of the programs we wrote and find our mistakes easily."

S7: "I had a hard time doing activities at first. As I did some things, my experience increased, and I completed the activities in a shorter time. So it was useful."

S9:"We used programs that we hadn't used on the computer before. We made mistakes from time to time and went back. This enabled us to reinforce what we learned."

S11: "The activities I did were reinforcing, especially since I worked at step C, I understood the subject better and I did better in writing. In step A, we explained and interpreted some things ourselves. I had no ability to interpret, so it improved a bit."

S12: "I also used the computer outside of social media."

S2: "My purpose in using of the computer and level of use of the computer have changed."

Theme 2: Attitude toward the lesson

This theme comprises students' views on the layered curriculum's effect on their attitudes towards the course. The participants stated that the layered curriculum activities created excitement and increased their interest and active participation in the lesson. They did not get bored with the lesson, and though they had difficulty in the beginning, they later relaxed. Quotes showing these thoughts and views are as follows:

S4: "I used to think this lesson was a difficult lesson before, but I saw it getting easier as I did something myself."

S5: "When I first started this course, I thought that I could not succeed. As I practiced with the layered curriculum, the lesson started to become easier to me, and my interest in the lesson also increased."

S6: "In the previous lessons, I was bored and sleepy, especially when you were explaining the subject. After we started the practice with the layered curriculum, I started to go to the class more excitedly thinking about what we would do that day."

S12: "I participated more actively in the course together with the layered curriculum activities."

Theme 3: Contribution to personal development

This theme includes the students's views regarding the layered curriculum's contribution to their personal development. The participants stated that they saw that they could achieve something on their own thanks to the layered education; they were not afraid of making mistakes over time, and thus, their self-confidence increased; and their social skills improved due to their cooperation during the applications. Quotes showing these thoughts and views are as follows:

S8: "I have seen that I can do many things on my own."

S9: "Since I did something on my own and tried not to avoid being wrong, my self-confidence has increased."

S5: "It has contributed to my social skills to do something with my friends."

Theme 4: Contribution to the classroom environment

This theme students' views on the contribution of the layered curriculum to the classroom environment. The students participating in the study stated that group work in the layered curriculum process increased in-class cooperation, improved friendship relations and made the learning environment enjoyable. Quotes showing these thoughts and views are as follows:

S8: "We created groups in steps A and B and worked together. In this way, I started building better relationships with my friends."

S10: "We did some activities in groups. We got close to each other and we learned solidarity."

S4: "These activities contributed a lot to the classroom environment, because we got help from each other from time to time while doing the activities."

S7: "It was fun to do some activities in a group."

Theme 5: Choosing tasks

This theme comprises the views of the students regarding what they pay attention to while making their activity choices in the layered curriculum. Some participants preferred different types of activities; some preferred activities that they could easily complete; and others chose challenging and developing activities. Quotes showing these thoughts and views are as follows:

S4: "I tried to choose different activities each time."

S1: "I chose the kind of activities I could easily accomplish."

S10: "I tried to choose activities that were not easy, but difficult, so that I would make more effort and learn more."

S8: "At first I determined activities that I could easily do. Then, I tried to find out how I could complete more difficult activities than those that I did."

Theme 6: Method of assessment

This theme includes students' views on the method of assessment applied in the layered curriculum. The participants stated that self-assessment in particular was different for them; furthermore, they saw their mistakes, and they tried to evaluate their work objectively. Quotes showing these thoughts and views are as follows:

> *S11: "We have evaluated ourselves and you have evaluated us. In this way, we have seen that some of the things that we thought were right are in fact wrong."*
>
> *S7: "I assessed the events in the way I think I deserve. It wouldn't be useful to give myself more points because the purpose is to learn here."*

Theme 7: Recommendations

This theme covers the students' suggestions regarding the layered curriculum. Students suggested the use of layered education in different lessons, and they stated that it might be especially beneficial to use it in difficult lessons. Quotes showing these thoughts and views are as follows:

> *S2: "We will have exams soon. If we practice with the layered curriculum, what we learn remains in our minds."*
>
> *S7: "I think this method will be more efficient if it is applied in other courses. It can be especially useful because we have difficulty in some classes."*
>
> *S11: "It could be more effective to practice in other lessons, and we evaluate ourselves in those lessons."*

Results and Discussion

The research findings show that there was a significant increase in the experimental group students' knowledge, comprehension, application level, and total mean scores after the layered curriculumAlso, between the pretest and the posttest, there was a significant difference in favor of the posttest in the knowledge, comprehension, application level, and total pretest and posttest mean scores of the control group students. In line with these findings, statistical analyses between groups gain importance.

There was a significant difference in favor of the experimental group in knowledge, comprehension, application level, and total mean scores obtained in the posttest between the experimental group students and the control group students. This result indicates that the layered curriculum applied in the programming basics course was more effective than the existing program in increasing academic achievement. The qualitative findings also support this finding. In addition, this finding is similar to the findings of various studies. Başbay (2005b) determined that project-based learning supported with layered curriculum contributed positively to the teaching process. LaSovage (2006) observed that education based on layered curriculum achieved successful results. Aydoğuş and Ocak (2011) concluded that the layered curriculum–based teaching method was more successful than traditional teaching methods. Gömleksiz and Biçer (2012) found that layered curriculum favorably affected students' achievements and their attitudes toward the course. Increasing students' understanding with the layered curriculum method is also among the positive results obtained (Maurer, 2009). Due to the individual differences of the learners, learning processes cannot be expected to be the same. Therefore, it is not possible to talk about a common

learning strategy, method, or technique for each individual. With the layered curriculum applied in the current study's experimental group, learners had the opportunity to choose their own ways of learning, and in this way, the learning environment was made meaningful for each learner. In executing the activities, students were distanced from failure and time anxiety by considering their learning speed. In addition, during the activities, learners had the opportunity to recognize their interests and abilities, to discover their strengths and weaknesses, to control their own learning, and to evaluate their own practices as well as their friends' practices by participating in the learning process through the activities they determined in line with their individual preferences. Layered curriculum practices thus motivate learners by providing a collaborative learning environment from time to time, one which is not competitive, and this increases students' academic achievement. According to the students' views on the process, layered curriculum increases learners' attention and motivation, positively affects the interaction in the classroom, relieves the teaching of monotony, and offers students an individualized, free, and democratic learning environment. Therefore, this positive learning environment is considered to be effective in increasing student achievement.

According to another finding of the research, there was a significant difference in favor of the experimental group in knowledge, comprehension, application level, and total mean scores obtained in the retention test. Based on this finding, the layered curriculum applied in the programming basics course was more effective than the existing program in ensuring the retention of learning. The qualitative findings also support this finding. In addition, this finding is similar to the findings of various studies. Koç and Şahin (2014) found that the layered curriculum approach supported by the theory of multiple intelligences was more effective than the learning approaches in the current program in both increasing academic success and ensuring the retention of academic knowledge. Kılınçaslan and Şimşek (2015) observed that the layered curriculum method positively affected students' academic achievement and learning retention.

In the layered curriculum process, the students chose their learning paths in line with their interests, wishes, and abilities. They were able to maintain their attention and motivation for a long time and experience more in the learning environment. The learners were actively involved in the learning process, and the interaction in the classroom was high. The knowledge learned is retained due to these positive features of layered curriculum.

The participants stated that the layered curriculum activities were enjoyable because they were different, they facilitated learning, and they ensured that what was learned was retained. They stated that they learned some computer programs that they did not know, and they practiced what they knew thanks to the activities. They also stated that they had difficulty in completing the activities in the beginning but that they did the activities more easily in the course of time. While some of the participants stated that no activity was difficult for them, others stated that they had difficulty in doing some activities. Some of the students stated that doing activities on their own improved their self-confidence; others stated that doing the activities by cooperating improved their social skills. The participants stated that the layered curriculum activities increased interest and participation in the course and removed their prejudices about the difficulty of the course and that this approach could be effective if applied in other courses.

As a result, similar to the results of many studies on layered education, in this study, the students expressed positive perceptions about the layered curriculum process, such as the

assessment methods and criteria applied, the effects on the interest in the lesson, learning the subject, interpersonal-social skills, and friendship relations. The results show that the students preferred this program to other programs and that most of them wanted layered curriculum to be applied in different courses.

Suggestions

In twenty-first-century education, student-centered approaches have gained weight instead of teacher-centered approaches. To create a learner-centered learning environment, both teachers and students have to add new aspects to their traditional roles in the classroom. To this end, first, the teaching strategies and methods applied in the classroom must change. The features of layered curriculum, which is one of these methods, are parallel to the teaching and learning approaches that place the individual at the center. Numerous studies have demonstrated the effectiveness of student-centered approaches in providing high-level and permanent learning. Layered curriculum and similar modern approaches can be adopted and tried by teachers.

While applying any teaching method, the responsibility of the teacher is great, and the effectiveness of the method varies depending on the teacher's approach to the method and his knowledge and skill related to the method. For this reason, studies should be conducted to introduce layered curriculum to teachers and to encourage them to apply it. The layered curriculum method leads students to perform behaviors such as making choices, taking responsibility, conveying their knowledge and thoughts, reflecting on what they do and learn, discussing, criticizing, tolerating criticism, and evaluating objectively. To demonstrate these behaviors, it is important for the teacher to create an appropriate classroom atmosphere.

In this study, layered curriculum was applied as a method alone. Research can be carried out in which students' thinking styles, learning styles, and dominant intelligence areas are identified and integrated into the application. This study applied layered curriculum in a computer course in the field of vocational high school information technologies. Similar studies can be conducted in different school types, grade levels, fields, and courses. In addition, administrators' and teachers' level of knowledge about this method can be researched, and studies in which teacher behaviors are examined during the layered curriculum process can be conducted.

Gülçin Zeybek is an Assistant Professor in the Educational Sciences Department of the Faculty of Education, Karamanoğlu Mehmetbey University, Turkey. The author's subjects of study include instructional technologies, curriculum development, and teacher training.

References

Aydoğuş, R., & Ocak, G. (2011). Effect to academic achivement of using layered curriculum in primary schools' 6th and 7th degree science lesson. *The Journal of Turkish Educational Sciences, 9*(2), 343–368. https://dergipark.org.tr/en/pub/tebd/issue/26100/275002

Başbay, A. (2005a). Basamaklı öğretim programı [Layered curriculum]. In Ö. Demirel (Eds.), *Eğitimde yeni yönelimler [New trends in education]* (2nd ed., pp. 241–252). Pegem Academy Publishing.

Başbay, A. (2005b). The effects of project based learning approach supported by layered curriculum on learning process. *Ege Education Journal, (6)*1, 95–116. https://dergipark.org.tr/tr/pub/egeefd/issue/4918/67300

Beckham, H. (2010). Student perceptions of layered curriculum vs. traditional coursework on class grades for 11th-12th grade economics and government students. *Culminating Experience Action Research Projects, 17,* 5–15. https://dergipark.org.tr/tr/pub/ijem/issue/38910/454830

Brosnan, C., May, B. & Blackwood, M. (2007). Layered curriculum lessons, aligned with the Ohio science content standards, for use in the high school science classroom. http://edhd.bgsu.edu/~sbanist/611/final/mikebranchristine/mikbranchristine.pdf

Caine, R. N., & Caine, G. (2002). *Beyin temelli öğrenme [Brain-based learning]*. Nobel Publishing.

Caughie, B. D. (2016). *The perceived ımpact of the layered curriculum instructional model on student engagement.* (Unpublished doctoral dissertation). Holy Family University, Philadelphia. ProQuest LLC UMI Microform 10011442.

Colding, H. D. (2008). Integrating a layered curriculum to facilitate differentiated instruction. *ASCD Express, 8*(3). http://www.ascd.org/ascd_express/vol3 /324_toc.aspx

Demirel, Ö. (2007). Kuramdan uygulamaya eğitimde program geliştirme [Program development in education from theory to practice]. Pegem Academy Publishing.

Demirel, Ö., Şahan, H. H., Ekinci, N., Özbay, A., & Begimgil, A. M. (2006). The evaluation of layered curriculum in terms of process and outcome. Journal of National Education, 172, 72–90. http://dhgm.meb.gov.tr/yayimlar/dergiler/Milli_Egitim_Dergisi/172/172/06.pdf

Duman, B., & Özçelik, C. (2017). The effect of layered curriculum use for the 7th grade circle and circular region subject on academic success and attitude towards mathematics. *Bartın University Journal of Faculty of Education, 6*(3), 1293–1308. http://doi.org/10.14686/buefad.339559

Fiore, C. (2007). *Differentiated ınstruction and the layered curriculum.* http://www.associatedcontent.com/article/168970/differentiated_instruction_and_the_pg2.html?cat=4

Fraenkel, J. R.,& Wallen, N. E. (2006). *How to design and evaluate research in education* (6th ed.). McGraw-Hill International Edition.

Gencel, İ. E., & Saracaloğlu, A. S. (2018). The effect of layered curriculum on reflective thinking and on self-directed learning readiness of prospective teachers. *International Journal of Progressive Education, 14*(1), 2018, 8–20. http://doi.org/10.29329/ijpe.2018.129.2

Goad, M. D., & Kelly, L. (2002). The layered curriculum: "How to engage all learners." University of Tamucc. http://ecdc.tamucc.edu/Induction/Seminars/lc.ppt

Gömleksiz, M. N., & Biçer, S. (2012). Effects of the layered curriculum on student's success, permanence and attitudes in Science and Technology Course. *International Journal of Human Sciences, 9*(2), 1657–1683. https://j-humansciences.com/ojs/index.php/IJHS/article/view/2092/1025

Johnson, K. J. (2007). *Layered curriculum for the construction trades: A mathematics curriculum to teach trade students basic math skills to be successful apprentices.* Southern Illinois University. http://ehs.siu.edu/wed/Public1/department

Kılınçaslan, H., & Şimşek, P. Ö. (2015). The effect of stepwise teaching method and creative drama method on reach, attitude and permanence in 6th grade "force and motion" unit. *Education and Science, 40*(180), 217–245. https://doi.org/10.15390/EB.2015.4380

Kim Suk, J. (2005). The effects of a constructivist teaching approach on student academic achievement, self-concept, and learning strategies. *Asia Pacific Education Review, 6*(1), 7–19. https://files.eric.ed.gov/fulltext/EJ728823.pdf

Koç, E. S., & Şahin, A. E. (2014). The effect of the layered curriculum supported by multiple intelligence theory on student access and retention. *Education and Science, 39*(174), 286-296. http://doi.org/10.15390/EB.2014.2424

LaSovage, A. J. (2006). Effect of using a layered curriculum format of ınstruction in a high school environmental science energy unit (Unpublished master's thesis). Michigan State University. ProQuest Dissertations and Thesis database UMI Microform 1425162.

Maurer, L. A. (2009). Evaluating the use of layered curriculum and technology to increase comprehension and motivatıon in a middle school classroom. (Unpublished master's thesis). Michigan State University. ProQuest LLC UMI Microform 1471872.

Miles, M. B., & Huberman, A. M. (1994). *An expanded sourcebook qualitative data analysis.* Sage Publications.

Miller, G., & Tratch, R. (2011). Curriculum improvement plan. https://gregmiller21stcenturyleadership.files.wordpress.com/2012/08/ubd-unit-using-layered-curriculum.pdf

Noe, B. (2008). The effects of a layered curriculum versus traditional teaching methods on academic achievement of fourth graders in the science content are (Unpublished master's thesis), Columbia College, USA.

Nunley, K. F. (2003). Layered curriculum brings teachers to tiers. *Principal Leadership, 69*(1), 31–36. http://wp.cune.org/jordanstirtz/files/2014/03/10736373.pdf

Nunley, K. F. (2004a). Layered curriculum. http://www.help4teachers.com

Nunley, K. F. (2004b). Simple steps to build layered curriculum. http://www.help4teachers.com

Oktay, A. (2001). *21. yüzyılda yeni eğilimler ve eğitim* [New trends and education in the 21st century]. In Oğuz, O., Oktay, A., & Ayhan, H. (Eds.). *21. yüzyılda eğitim ve Türk eğitim sistemi [Education and Turkish education system in the 21st century.]*. Sedar Publishing.

Overstreet, M., & Straquadine, G., S. (2002). An examination of a high school horticulture curriculum process designed for diverse student learning styles. Paper presented at the meeting of the Western Region Agricultural Education Research Conference Annual Research Conference, Washington. https://envs.ucsc.edu/internships/overstreetstraquadine.pdf

Öner, G., Ünsal, S., Meşe, N. N., & Korkmaz, F. (2014). A sample of layered curriculum application in secondary education sociology course. *Gaziantep University Journal of Social Sciences, 13*(1), 229–243. https://doi.org/10.21547/jss.256840

Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences.* Sage Publishing.

Üzüm, B., & Pesen, A. (2019). Do the learner-centered approaches increase academic performance? Effect of the layered curriculum on students' academic achievement in English lesson. *International Journal of Instruction, 12*(1), 1585–1608. https://files.eric.ed.gov/fulltext/EJ1201246.pdf

Vyborny, T., & Trowbridge, B. (2005). Layered curriculum. http://pt3.sbu.edu/students5/vvyborny/layered%20curriculum.ppt

Yıldırım, A., & Şimşek. H. (2018). Qualitative research methods in the social sciences (Sosyal bilimlerde nitel araştırma yöntemleri). Ankara: Seçkin Publishing.

Yılmaz, F. (2010). Layered curriculum practices in science and technology course (Unpublished doctoral dissertation). Higher Education Council National Thesis Center Database, Thesis No: 263140.

Appendix 1: Information Technologies Area Tenth Grade *Programming Basics* Course *Simple Codes* Module Achievement Test

1) What are the expressions that represent the storage areas of data in a programming language? (Knowledge)
A) data B) variable C) constant D) operator

2) Which of the following is the required code to open a 4 byte region in the memory named "i"? (Knowledge)
A) int i; B) i = 4; C) i = i + 4; D) const i;

3) Which of the following code will write the value 5 in the memory region represented by the name "i"? (Knowledge)
A) int i; B) 5 = i; C) i = 5; D) i = i + 5;

4) Which of the statements below about the variable definition operation is false? (Knowledge)
A) Assigning a value to a variable can be done when defining.
B) Variables of different data types can be defined in the same line of code.
C) Different variables can be defined with more than one name under a data type.
D) Assigning a value to a variable can be done in any line in the program.

5) int number;
Console.WriteLine (number);
Console.ReadKey ();
Why do these program codes fail when they run? (Comprehension)
A) Since the variable "Number" is defined in the wrong data type.
B) Since the "Number" variable is not initially assigned.
C) Since it is necessary to use the "Write" method instead of "WriteLine".
D) The ReadKey method is used incorrectly.

6) {int a = 10;
}
{int a = 20;
}
Console.WriteLine (a);
Why do these program codes fail when they run? (Comprehension)
A) The variable "a" is defined in the wrong data type.
B) The "a" variable has been assigned a wrong value.
C) The variable "a" is valid only in its own block.
D) Since the "Write" method should be used instead of "WriteLine".

7) Which of the following variable names is wrong? (Comprehension)
A) studentNo1 B) _Student Name C) student_surname D) student class

8) Which of the following local variable definitions is correct? (Knowledge)
A) int16 number! B) text name C) byte age D) float 12

9) Which of the following data types is not a value type? (Knowledge)
A) int B) byte C) object D) float

10) Which of the following data types are reference types? (Knowledge)
A) double B) string C) bool D) char

11) Which of the following statements about constants is false? (Knowledge)
A) Constant value cannot be changed during the program.
B) We use the keyword const to define a constant.
C) When defining constants, initial value assignments must be made.
D) Assignment of values to constants can be made anywhere in the program.

12) Which of the constant definitions given below is correct? (Knowledge)
A) double pi; B) double pi = 3.14; C) const double pi; D) const double pi = 3.14;

13) What are the characters or character groups that enable us to perform operations on constants and variables defined in programming languages? (Knowledge)
A) Variable B) Constant C) Operator D) Exception

14) const double pi = 3.14159265;
pi = 2 * pi;
Console.WriteLine (number);
Console.ReadKey ();
Why do these program codes fail when they run? (Comprehension)
A) The “const” statement is used incorrectly.
B) The constant value “pi” is defined in the wrong data type.
C) The value of the constant “pi” has been changed.
D) Since the “Write” method should be used instead of “WriteLine”.

15) int x = 0, y = 0, z = 0;
x + = 5;
y + = 7;
z + = x;
Operation result: What will be the x, y and z values respectively? (Application)
A) x = 5, y = 7, z = 5 B) x = 7, y = 5, z = 7
C) x = 4, y = 6, z = 4 D) x = 6, y = 8, z = 6

16) int x = 0, y = 0, sum;
x ++;
y ++;
sum = x + y;
The result of the operation: what will be x, y and sum? (Application)
A) x = 1, y = 1, total = 2 B) x = 0, y = 1, total = 1
C) x = 1, y = 0, total = 1 D) x = 0, y = 2, total = 2

17) int x = 0, y = 0, sum;
x = y ++;
sum = x + y;
The result of the operation: what will be x, y, and sum? (Application)
A) x = 1, y = 0, sum = 1 B) x = 0, y = 1, sum = 1
C) x = 1, y = 1, sum = 2 D) x = 0, y = 2, sum = 2

18) int x = 0, y = 0, sum;
x = ++ y;
sum = x + y;
The result of the operation: what will be x, y, and sum? (Application)
A) x = 1, y = 0, sum = 1 B) x = 0, y = 1, sum = 1
C) x = 1, y = 1, sum = 2 D) x = 2, y = 0, sum = 2

19) int x = 50, y = 50, z = 100;
x - = 5;
y - = 7;
z - = x;
Operation result: What happens to x, y, and z? (Application)
A) x = 45, y = 43, z = 55 B) x = 43, y = 45, z = 55
C) x = 55, y = 43, z = 45 D) x = 45, y = 47, z = 55

20) int x = 20, y = 10, extraction;
x--;
y--;
extraction= x - y;
The result of the operation: what are x, y, and the extraction? (Application)
A) x = 99, y = 19, extraction= 10 B) x = 10, y = 9, extraction= 19
C) x = 19, y = 9, extraction= 10 D) x = 20, y = 9, extraction= 11

21) int x = 10, y = 10, extraction;
x = y--;
extraction = x - y;
The result is: x, and what's the extraction? (Application)
A) x = 9, y = 10, extraction = 1 B) x = 11, y = 10, extraction = 1
C) x = 10, y = 11, extraction = 1 D) x = 10, y = 9, extraction = 1

22) int x = 10, y = 10, extraction;
x = --y;
extraction = x - y;
The result of the operation: what are x, y, and the difference? (Application)
A) x = 9, y = 9, extraction = 0 B) x = 10, y = 10, extraction = 0
C) x = 11, y = 11, extraction = 0 D) x = 10, y = 9, extraction = 1

23) int x = 2, y = 3, z = 2;
x * = 2;
y * = 2;
z * = x;
Operation result: What happens to x, y, and z? (Application)
A) x = 8, y = 6, z = 4 B) x = 4, y = 8, z = 6
C) x = 6, y = 8, z = 4 D) x = 4, y = 6, z = 8

24) int x = 4, y = 10, z = 64;
x / = 2;
y / = 2;
z / = x;
Operation result: What happens to x, y, and z? (Application)
A) x = 2, y = 5, z = 32 B) x = 4, y = 5, z = 32
C) x = 2, y = 10, z = 32 D) x = 2, y = 5, z = 16

25) The code that will give the screen output "Hello world" is which one? (Comprehension)
A) Console.Write ("Hello World");
B) Console.WriteLine ("Hello World");
C) Console.WriteLine ("\ n \ nHello World");
D) Console.WriteLine ("\ p \ pHello World");

26) string name1 = " Information";
string name2 = "Technologies";
Console.Write (name1 + " " + name2);
What will be the screen output of the program part? (Comprehension)
A) Information Technologies B) Information Technologies C) Information Technologies D) IT

27) The code that will give the screen output "x + y sum = 8" is which one? (Comprehension)
A) Console.WriteLine ("x + y sum =" + x + y);
B) Console.WriteLine ("x + y sum =" + (x + y));
C) Console.WriteLine (sum of x + y = + x + y);
D) Console.WriteLine "x + y sum =" + x + y;

28) Console.Write ("{0: (###) ### ## ##}", 2123552154);
Which of the following will be the screen output of the program code? (Comprehension)
A) 2123552154 B) 212 3552154 C) 212 355 21 54 D) (212) 355 21 54

29) int x;
Console.Write ("Enter A Number:");
x = Convert.ToInt16 (Console.ReadLine ());
Console.ReadKey ();
If the program part is run and "trial" statement is entered, what value returns? (Comprehension)
A) Returns the value "16". B) It gives a division by zero error.
C) String-int conversion fails. D) It gives an error because a value is not entered in the desired range.

30) Console.WriteLine ("{0} / {1} = {2}", x, y, x / y);
What kind of error can be encountered when the line of code runs? (Comprehension)
A) May cause a division by zero error.
B) String-int conversion may fail.
C) It may cause an error because a value is not entered in the desired range.
D) It may cause an error because the variable is not initialized.

31) Which of the statements given below regarding the explanation lines is false? (Knowledge)
A) They are not included in the file while the program is being compiled.
B) They increase the size of the resulting file, slow down its work.
C) If we want to add comments on a single line, we write comments after the // characters.
D) If we want to add comments to more than one line, we write a comment between the / * * / characters.

32) Which character is used for modding? (Knowledge)
A) # B) $ C) * D)%

33) Which of the following is the code that will result in "2"? (Comprehension)
A) 8% 5 B) 9% 3 C) 10% 2 D) 10% 4

34) What value does 1! = 3 return back? (Application)
A) True B) False C) 0 D) -1

35) What value does 3> 3 return back? (Application)
A) True B) False C) 1 D) 2

36) What value does 1 <3 return back? (Application)
A) True B) False C) 0 D) -1

37) What value does 3> = 3 return back? (Application)
A) True B) False C) 0 D) -1

38) What value does 3 <= 3 return? (Application)
A) True B) False C) 0 D) -1

39) int x = 10, y = 4;
string str1 = "megep";
x == 10 && y == 4 && true == true
What value does the piece of code return back? (Application)
A) True B) False C) 0 D) -1

40) int x = 10, y = 4;
string str1 = "megep";
x == 4 || y == 10 || true == false
What value does the piece of code return back? (Application)
A) True B) False C) 1 D) 2

41) Which operator means "not" but reverses the value? (Knowledge)
A) && B) || C)! D) ==

42) What is the result of (5 + 2) * 4-6 / 2? (Application)
A) 9 B) 16 C) 25 D) 36

43) What is the result of (5 + 3) * 4-6 / 2 * 3- (2 * 3)? (Application)
A) 33 B) 17 C) 25 D) 19

44) What is the result of (8/2 * 4) + 4-10 * 2? (Application)
A) 0 B) -15 C) -4 D) 15

Appendix-2: Example of Rubrics for Step C Activities

Scoring Range: The scores obtained as a result of the grading made by the course teacher and the student will be added up and divided into two. The resulting average score:

Represents low skill level in the range of 0-1 points.
Tells that the student shows acceptable performance in the 2-3 point range.
Indicates that the activity was completed with high success if it is between 4-5 points.

Scoring Guidelines for Concept Map

Measurements	Total Score	Points Earned	
		Student	Teacher
Concepts related to the subject are included.	0-1		
The concept map is well organized.	0-1		
Attention was paid to grammar and spelling rules.	0-1		
The concept map is clean and organized.	0-1		
Visual elements (shape, color…) are used properly.	0-1		
Total Score			

Average Score:

Example of Rubrics for Step B Activities

Scoring Range: The scores obtained as a result of the grading made by the course teacher and the student will be added up and divided into two. The resulting average score:

Represents low skill level in the range of 0-5 points.
Tells that the student has an acceptable performance in the range of 6-10 points.
Indicates that the event has been completed with high success in the range of 11-15 points.

Program for Entering Midterm and Final Grades of a University Student and Printing their Average on the Screen:

Measurements	Total Score	Points Earned	
		Student	Teacher
Required variables have been correctly defined.	0-3		
The codes that will enable the user to enter notes are written correctly.	0-3		
The codes to calculate the average of the grades are written correctly.	0-3		
The codes that will print the result on the screen are written correctly.	0-3		
Try, Catch, Finally Blocks and Comment lines are used correctly.	0-3		
Total Score			

Average Score:

Example of Rubrics for Step A Activities

Scoring Range: The scores obtained as a result of the grading made by the course teacher and the student will be added up and divided into two. The resulting average score:

Represents low skill level in the range of 0-5 points.
Tells that the student has an acceptable performance in the range of 6-10 points.
Indicates that the event has been completed with high success in the range of 11-15 points.

Evaluating a Given Program According to the Basic Features of a Software:

Measurements	Total Score	Points Earned	
		Student	Teacher
It is explained whether the software meets the specified needs.	0-3		
It is explained how precisely the software can fulfill the required function.	0-3		
The ease of learning, running, input preparation and output interpretation of the program is explained.	0-3		
The ease of locating and correcting the error is described.	0-3		
The ease of making changes in the software is explained.	0-3		
Total Score			

Average Score:

Appendix-3: Interview Questions

1. What do you think about the layered curriculum activities in the Programming Basics course?
2. What did you pay attention to while choosing the activities given in the layered curriculum?
3. Which activities did you have the most difficulty in doing in the layered curriculum? What could be the reasons for this?
4. What activities do you like and do not like during the layered curriculum implementation process? Can you explain that?
5. What are your perceptions about the evaluation method and criteria in the layered curriculum?
6. Did the layered curriculum help you learn the subject? If you think it did, what contribution did it make?
7. Has this practice contributed to the development of some personal-social skills in you? If you think it did, what contribution did it make?
8. What do you think was the effect of the layered curriculum application process on classroom atmosphere and friendships?
9. How did the layered curriculum affect your interest in the programming basics course?
10. What can you say about the programming basics lessons you taught with the layered curriculum?
11. If you compare the programming basics course in which we used the layered curriculum activities with other lessons, what can you say was different?
12. Would you like this program to be applied in other courses?
13. What other perceptions and suggestions do you want to express on this issue?