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The pedagogical effectiveness of the programmed learning of English tenses: A pedagogical experiment

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ABSTRACT

The current study aims to investigate the effectiveness of a programmed approach to teaching English verb tenses. This approach is essential for enhancing grammar instruction in the classroom. A total of 23 first-year students from Toraighyrov University participated in both studies. Before the experiments, the participants were divided into two groups. During the first stage of the experiment (2021–2022), both groups started with a similar level of English proficiency assessed through admission exams. There was a noticeable difference in the initial proficiency between the two groups during the second stage (2022–2023). After completing the learning process, the participants underwent a post-assessment to measure their progress in using tense forms. In a second experiment, the order of events was reversed. In this study, the criterion measures method, statistical method, statistical analysis of the test, and data collection and analysis were employed. Based on the preliminary findings, students experienced enhanced learning and engagement when studying English grammar using programmed learning methods compared to traditional approaches. It was concluded that programmed learning helps students to memorize and comprehend grammar concepts more efficiently through structured progression and immediate feedback, indicating that it is a viable approach to teaching grammar.

Contribution/Originality: The findings of this research greatly advance our knowledge of how programmed learning can help learners acquire the rules of English tenses. For teachers looking to maximize grammar education, the study offers insightful information by specifically looking at how learners' understanding of tenses is affected by programmed training.

1. INTRODUCTION

The behaviorist theories of education are the foundation of programmed learning, a technique widely implemented in various educational settings. This kind of training gives students rapid feedback and divides the learning material into digestible chunks. Empirical research is needed to determine whether teaching English tenses or other grammatical constructions is beneficial, despite its theoretical underpinnings and practical uses. This study fills this gap by assessing the efficacy of programmed learning in this domain using a pedagogical experiment. Comparative studies on the effectiveness of programmed learning as an instructional method have mainly focused on comparing linear versus branched programs or programmed versus expository learning methods. Studies comparing traditional teaching with programmed learning have primarily used tests that focus on retaining factual book knowledge rather than practical application. Assessments that prioritize memorizing facts from textbooks over applying newly learned content in a practical setting have been used in studies contrasting traditional instruction versus computerized learning.

Effective communication in a foreign language requires the ability to select an appropriate lexical unit for an idea and correctly combine it with other units in spoken discourse, as well as the automated perception and comprehension of meaning in receptive discourse. Rogova, Rabinovich, and Saharova (1991) recommended that two types of lexical exercises should be used to enhance lexical proficiency: memorization of words and their definitions along with pronunciation and grammatical forms, and the creation of word combinations based on semantic features. In their research, Lebedeva and Maslovets (2015) identified some aspects of the implementation of programmed learning techniques to improve the lexical competence of high school students. Russian and Kazakh educators have also described this approach, including the use of various information and communication technologies in foreign language classes (Golubkova, Masalimova, & Bírová, 2017).

Nevertheless, sufficient attention has not been given to the integration of programming into the learning process for developing lexical skills in foreign language classrooms. In modern times, an important aspect is the utilization of information and communication technologies to increase the interest and motivation of high school students to learn a foreign language. The works of numerous foreign researchers discuss various aspects of programmed learning. The American psychologist Burrhus F. Skinner is widely regarded as the founder of behaviorism, which was outlined in his seminal work "The Science of Learning and the Art of Teaching." Based on this theory, a system for pedagogical support of children's learning was developed. This system continuously assesses correct responses and is founded on behavioristic principles. Under this approach, programmed instruction can be understood as a technique that maximizes the reinforcement associated with the successful management of the learning process.

According to Skinner (1969) the learning environment comprises factors that determine the nature of responses and allows for the rational management of behavior through the use of incentives. Skinner's training machine, a mechanical precursor to the modern computer, proposed that verbal behavior could be taught through the use of initiation, prompting, and the fading of prompts. In this approach, students take small steps, with their behavior carefully initiated or prompted to ensure success. Reinforcement is then provided for correct responses. The initiated and prompted data are faded as quickly as possible to create a successful learning environment that is accessible to all students. The scientist believed that creating such a situation was a universal principle that all teachers could apply. Skinner (1989) described the computer as an ideal training tool because it can simulate real-life operant interactions in the learning process, albeit in a schematic manner. This necessitates the careful preparation of educational programs.

Programmed learning can be defined as a form of instruction that follows a predetermined path or plan. This type of learning is typically facilitated through the use of specific tools, such as digital textbooks or modular online courses. In a virtual environment, it may also involve courses designed using platforms such as Telegram.

There are some of the benefits of programmed learning within online environments:

1. Individualization: Programmed learning enables students to progress at their own speed, allowing them to choose a convenient time to complete training materials. This personalizes the learning experience and adapts it to individual needs.

2. Independence: Technologies utilized in programmed learning foster independence, which can be crucial for adult learners' motivation. These technologies enable students to take responsibility for their learning and choose how they approach it.

3. Measurement of outcomes: Programmed learning incorporates control points, such as assessments, which allow for measuring how well students have grasped the material. These measures assist in monitoring progress and providing feedback to students regularly.

3. Dosing of educational information: In this form of instruction, information is delivered in small portions, allowing students to avoid becoming overwhelmed and learn the material more efficiently.

However, there are also some disadvantages of programmed learning within an online environment. The first is a lack of evaluation of knowledge acquisition phases. To ensure the effectiveness of programmed learning, it is essential to develop materials based on students' learning styles, such as utilizing Bloom's digital taxonomy. Accurately assessing students' ability to apply knowledge in practical situations through technology alone can be challenging (without the assistance of a teacher/expert).

The inability to monitor students' internal mental processes during the learning experience is a significant challenge. It is crucial to observe students' behaviors, as this enables the tracking of positive and negative responses to specific educational materials. In other words, it is important to focus on accurate answers in the learning process and the pathways that lead to those answers. This prevents a rigid, programmed approach to education. Another challenge in the training process is the absence of immediate feedback. Although programmed learning allows for a high degree of independence, it also implies that students have varying levels of knowledge. Some students may require additional support and guidance to master new learning materials, which can present a challenge in a programmed learning environment.

2. REVIEW OF RELATED LITERATURE

2.1. Scholar Contribution

Many educators have turned to the study of programmed instruction. Pedagogical technology teaching manuals reveal the structure of educational programs that clearly define and regulate the algorithm for programmed learning (Li, Pyrkova., & Ryabova, 2017; Masalimova et al., 2017; Santhanasamy & Yunus, 2022; Simamora, 2020; Sivasakthi & Pandiyan, 2022). The manual examines three types of instructional programs: linear, branching and mixed, and discusses their benefits and drawbacks. Silkina and Sokolinsky (2016) provide an overview of adaptive e-learning models, arguing that their foundation was established by Crowder (1968) who proposed an algorithm for branching programming. The second phase of its development involved the utilization of hypertext and multimedia technology.

COVID-19 has altered instructional strategies and influenced the success of online learning. Consequently, educators have been compelled to provide online courses and instruct remotely. Considering the global experience, it has been demonstrated that students face substantial challenges due to internet accessibility issues in addition to psychological and behavioral issues (Saputra et al., 2021). Treve (2021) explores the perceptions of Indonesian students regarding online and programmed learning during the COVID-19 pandemic. The findings indicate that students view online learning as unpleasant and ineffective, and they believe it will not contribute to their development as independent learners or enhance their self-actualization in the classroom.

Duraku and Hoxha (2021) suggest that a lack of technological resources, such as computers and stable mobile networks, constitutes a significant obstacle to online learning amid the coronavirus outbreak (Duraku & Hoxha, 2021). Darmody, Smyth, and Russell (2021) reveal that students from higher-income households have better access to high-speed internet and other learning resources, as well as a greater likelihood of having parents who worked from home during COVID-19 lockdowns (Darmody et al., 2021). Sadykov, Kokibasova, Minayeva, Ospanova, and Kasymova (2023) define programmed learning as a form of instruction delivered through the use of pre-written materials or computer-based teaching aids, which utilize content similar to that found in traditional instructional methods (Sadykov et al., 2023).

Vishtenetsky and Krivosheev (1998) discuss the objectives of integrating information technology into modern teaching methodologies, including foreign language instruction. Information and communication technologies (ICT) are extensively employed in these educational settings. ICTs support the objectives of programmed learning, which includes promoting students' critical thinking, facilitating various cognitive activities for acquiring knowledge, enhancing and reinforcing skills, and implementing individualized learning principles. Some common information and communication technologies utilized in modern teaching include computers as learning aids, interactive whiteboards, audiovisual materials, and the internet. The internet is a global network that enables virtual communication, access to search engines, and a vast amount of information from diverse fields of knowledge.

Computers, interactive whiteboards, and audiovisual tools allow for personalized learning and the implementation of differentiated teaching methods. Multimedia technologies, such as Microsoft PowerPoint, enhance students' learning experience by providing diverse options for information presentation, making it more engaging and interesting.

Visibility, accessibility, and personalized learning are critical components of modern education. Incorporating these technologies into classrooms enhances effective learning and student engagement, as demonstrated by Belyaeva and Ivanov (2008) among others. They highlight the advantages of PowerPoint presentations, such as their interactive nature and the ability to incorporate multimedia and information integration, which distinguish them from traditional methods. She emphasizes the importance of discrete elements, compatibility with software, and accessibility when using this tool for presentations.

Shamov (2011) on the other hand, defines communicative competence as the ability to improve communication skills through four basic modes of speech. This is directly linked to a student's level of vocabulary development. Passov and Kuznetsova (2002) define lexical proficiency as automated processes that allow students to effectively communicate in a foreign language. Skinner (1989) advocates for a linear approach to instructional programming, which precludes the possibility of errors. Another American educator, Crowder (1968) identifies the linear structure as a major disadvantage of Skinner's approach and developed an alternative method known as branched learning. He implemented this approach in what he referred to as "scrambled textbooks" and created a range of textbooks and computer programmes. Crowder (1968) believes that learners should be permitted to make errors during the learning process and argues that it is essential to monitor their progress and provide timely feedback. This allows for the identification of common errors and the refinement of the training programme to create a more effective version.

Although the theoretical foundations of Crowders's approach were similar to those proposed by Skinner, some differences exist. The course material is divided into multiple segments, each covering a specific topic. The length of each segment corresponds to the depth of knowledge covered for each subject. To achieve the learning goals, each segment is followed by a question requiring students to choose the correct answer from a list of incomplete or incorrect options. If the student provides an incorrect response, they will be directed to additional information presented in blocks known as "corrective frames." The most advanced students do not require guidance through these frames, as their learning is customized to their requirements.

The difficulty level of educational content increases progressively, following the principle of "simple to complex." Questions and answers are designed accordingly, with increasingly complex concepts being introduced as the student advances. Analyzing the concepts of programmed learning, Kupisiewicz (1986) a Polish scientist, proposed general principles that include breaking down the material into smaller, interrelated parts, making student tasks more active and immediately assessing each response. Kupisiewicz proposed pacing and personalizing the content of the training, as well as verifying the programmed materials empirically.

The programmed training algorithm developed by American scientists allows modern researchers to regard it as a technology. This technological aspect, which is a crucial factor in shaping contemporary society, was carefully addressed by the British scholar Webster in his work (Webster, 2004). He also highlighted the spatial aspect, which is particularly significant in foreign language classes, for creating a suitable language environment.

Many foreign researchers who employ various information and communication technologies emphasize this aspect in their studies. Their investigations reveal the role of computers as a vital tool for educators. For instance, Beatty (2004) explores the fundamental principles of computer utilization in teaching, monitoring and research. Chapelle (2001) offers practical guidelines for instructors on utilizing the internet in the classroom. Dudeney (2007) provides practical advice on how to efficiently utilize the internet in educational settings. At the same time, researchers from various countries are exploring innovative methods for teaching foreign languages. For example, Abdyhalikova (2016) and Busse and Krause (2016) work on enhancing intercultural communication by identifying the benefits, drawbacks and principles of programmed learning, as laid out by Lin and Zhang (2014).

The recent literature emphasizes the use of information technology in language instruction, although this is not directly linked to the specific features and techniques of programmed learning.

3. METHODOLOGY

3.1. Procedure

3.1.1. Subjects

In both research studies, the sample comprised 23 first-year students enrolled in the Foreign Philology Department at Toraighyrov University. The students were allocated to distinct academic groups before the commencement of the experiments.

During the first experiment (2021–2022), the two groups were relatively similar in terms of their initial proficiency in English, with the results of the entrance assessments serving as the basis for the allocation. Group I (11 students) was designated as the control group, while Group II (12 students) was identified as the experimental group.

In the second experiment (2022–2023), the academic groups were disparate in terms of their initial English proficiency. Group I comprised graduates from English-focused secondary schools, whereas Group II comprised graduates from standard secondary schools. Once again, Group I (11 students) was designated as the control group, while Group II (12 students) was identified as the experimental group.

The level of expertise and motivation among the participants in each group varied. At the outset of the study, the participants in the experimental group demonstrated a slight reduction in motivation and performance compared to the control group. Additional research is required to assess the efficacy of programmed learning for various language abilities and proficiency levels.

3.2. Materials

In both research studies, the control groups utilized "English Grammar in Use" by Murphy (2019) (Unit 1-24, Tenses in the Active Voice) (3), while the experimental groups were supplied with the programmed book "My GrammarLab Advanced C1/C2" by Foley and Hall (2012) (2). The control groups were given a series of traditional exercises on each tense form, whereas the experimental groups completed the required exercises from the programmed book and several programmed exercises in the language laboratory. The experimental groups did not have formal grammar classes, while the control groups received traditional instruction in the classroom and worked independently at home.

3.3. Time Measures for Independent Work

The students were permitted to take as much time as they needed to work through the assigned tense forms (units); however, they were asked to indicate the amount of time it took them to complete the units.

3.4. Criterion Measures

Before commencing the first experiment, the students in both groups underwent an assessment of their initial knowledge of English tense forms using a 50-item pre-test (Test No. 0). Following the learning process, the students underwent a post-test (Test No. 5) to evaluate their improvement in using English tense forms, with Test No. 0 serving as the baseline. Throughout the study, the students also completed two additional tests: Test No. 1 after learning the Indefinite and Continuous tenses, and Test No. 2 after learning the Perfect and Perfect Continuous tenses.

In the second experiment, the test order differed: The pre-test (Test No. 0) was re-administered after revising the tense forms it contained (Test No. 1). Subsequently, the study of the tense forms not previously covered by the experimental group at secondary school commenced. Following this section, Test No. 2 was conducted. The experiment concluded with a post-test for the entire program (Test No. 5).

3.5. Statistical Method

3.5.1. Simple Two-Sample Problem

In comparing the effects observed in two distinct groups of students, the key objective is to evaluate the significance of the variance in mean effects between these groups. While the Student's t-test is a widely utilized method for this purpose, its applicability is largely limited to data sets that conform to a normal distribution. Notably, in the realm of pedagogical experiments, data often deviates from normal distribution, particularly in the case of smaller group sizes, thereby undermining the reliability of the Student's t-test.

To address this limitation, non-parametric tests, such as the Wilcoxon, Mann–Whitney, and Van der Waerden X tests, offer a more robust alternative, as they are capable of accommodating diverse data distributions. Of these, the Van der Waerden X test was deemed most suitable for the current study due to its computational efficiency and robust statistical power, which approximates that of the Student's t-test in normal distributions and surpasses it in non-normal scenarios. A comprehensive exposition of the Van der Waerden X test can be referenced in the relevant literature.

3.5.2. Statistical Analysis of Tests

In the conventional framework of post-test evaluation, a multitude of statistical metrics are employed to assess the efficacy of testing procedures. These metrics encompass reliability, validity, coherence, and discriminatory capacity. The comprehensive evaluation of a test's performance is predominantly gauged through two fundamental indices: reliability and validity.

Reliability pertains to the stability of scores acquired through a test, serving as an indication of whether a particular individual would consistently generate similar results if they were to undergo the assessment again within a brief period without any further language instruction. A dependable test would yield similar outcomes when administered twice under similar circumstances. There are various methods for assessing reliability, each with its own level of complexity and precision. One such method that is relatively straightforward and efficient is the Half-Reliability Coefficient (HRC), which evaluates the correlation between the initial and subsequent halves of an assessment.

To calculate the HRC, one must first determine the correlation coefficient for each half of the assessment separately. These two coefficients are then averaged to obtain a combined score.

Here is a step-by-step guide for calculating the HRC:

1. Divide the assessment sample into two groups, one containing odd numbers (1, 3, 5, and so on) and the other containing even numbers (2, 4, 6, and so forth). Record the results for each group in distinct tables.

2. Calculate the scores for each group.

3. Assign two rankings to each participant, one based on the performance of the odd group and the other based on the performance of the even group.

4. Utilize the following formula to calculate the correlation coefficient p between the two sets of rankings:

$$p = 1 - \left(\frac{6\sum d^2}{N(N^2 - 1)}\right)$$

Where d represents the difference between the ranks of each participant in the two groups, and N represents the number of participants. The correlation coefficient is denoted as p and represents the statistical measure of the relationship between two variables. The absolute difference between the ranks, denoted as d, is calculated by comparing the rankings of the variables in question.

This coefficient serves as a metric for evaluating the reliability of a test when it is extended to twice its original length. To determine the overall reliability of the HRC test, the following equation can be employed:

$$HRC = \frac{2r_{hh}}{1 + r_{hh}}$$

Where HRC represents the reliability, and r_{hh} denotes the Spearman–Brown coefficient. By following these steps and computing the relevant metrics, one can assess the level of reliability of a given test.

The second aspect of a test's quality is its validity. Validity determines how accurately the test measures the intended concept or construct, such as assessing the comprehension and perception of spoken language rather than solely focusing on grammatical knowledge. The concept of validity is of paramount importance for test developers, as it offers valuable insights into the distribution of scores obtained in the test and the degree of difficulty inherent in the assessment. The calculation of the validity coefficient involves measuring the correlation between two datasets and then squaring the result. This metric serves as an indicator of how effectively the test evaluates the intended linguistic proficiency.

3.5.3. Method for Data Collection and Analysis

The method of data collection and analysis employed in this research is particularly suitable for working with substantial volumes of data. In this approach, data fragments are selected randomly from a predetermined number of segments of equal size.

This method constitutes a specific perspective on the phenomenon under investigation, encompassing a range of scientific and technical procedures that enable us to delve deeper into the subject matter. Consequently, it can be regarded as a comprehensive system, comprising a series of interconnected techniques aimed at achieving the desired outcome. It is important to note that no single technique can fully represent the entirety of the research method.

3.5.4. Levelling Problem

The nature of this problem necessitates a comprehensive introduction. We have conducted two tests with two comparable groups: A pre-test administered before instruction and a post-test conducted after instruction. We represent the pre-test result as "*po*" and the post-test result as "*pt*" for each student in terms of a percentage of the highest possible score.

The measure of instructional effectiveness for each student is denoted by a number "η" derived from the values of "*po*" and "*pt*" according to a predefined rule. This number "η" can be referred to as the index of instructional effectiveness, or "effect," as it is known in the field of economic statistics.

The simplest method to select the index of effect is as follows:

$\eta o = pt - po$.

For more adept students, ηo is generally smaller than for less adept students. If the level of knowledge varies between the control group and the experimental group, there will be a difference in the indices of effect in the groups, even if the groups are instructed similarly. This necessitates a reevaluation of the problem.

The objective is to ascertain an expression for the index of effect that renders it independent of the student's level. The computed indices are termed "*levelled indices.*" Subsequently, the basic two-sample problem is addressed using the levelled indices.

To gauge the level of a student, we calculate the arithmetic mean of the results of the two tests:

$p = (po + pt) / 2.$

The following formula for the index of effect has proven to be effective:

$\eta = \lambda / (\lambda - p)(pt - po),$

Where λ is chosen such that the empirical correlation between the indices η and p in the combined group formed from the control group and experimental group is zero. It has been observed that a new value for λ must be chosen for each new post-test. To this end, an equation requiring the correlation to be zero is solved using a computer.

This research employs a carefully designed cross-sectional method to pinpoint knowledge gaps, evaluate students' academic performance, and delve into their specific needs with the aim of providing tailored support. Moreover, we intend to conduct further studies to bridge these knowledge gaps.

The statistical approach adopted involves posing general questions and collecting, measuring and analyzing statistical data in both quantitative and qualitative forms.

3.6. Notes

To address the issue of standardization, the common correlation coefficient was utilized for computational efficiency, although rank methods should have been employed for subsequent non-parametric analysis. The coefficient η was replaced by its absolute value to simplify the correlation computation. It is believed that these adjustments do not significantly impact problem solving. The constant λ was determined as an integer. For the simple two-sample problem, the Van der Waerden X test (1) was utilized at three two-sided confidence levels: 95%, 98%, and 99% (significance ḓ = 0.05, 0.02, and 0.01, respectively).

In the description of specific experiments, the effect index sometimes yields a negative value. This negative value does not signify a negative impact on the instruction; rather, it indicates that the post-test is more challenging than the pre-test.

An increase in the negative index (i.e., a decrease in the absolute value) indicates an improvement in the instructional method.

When the absolute values of $\eta o = pt - po$ were greater for brighter students compared to duller students (a rare case), we assigned $\lambda = \infty$, considering the non-standardized index ηo as the effect index.

A problem similar to the one described in 3.2 can also be presented differently by separately explaining the influence of the instructional method and the group level on a non-standardized index. Standard methods of multi-factorial variance analysis can be applied in this scenario. In this study, the standardization method was preferred for its simplicity and its ability to provide valuable intermediate results (tables of standardized indices) that support the investigator's intuition and have intrinsic value.

4. DISCUSSION

4.1. Principals and Objectives of Programmed Learning

Programmed learning is defined as a structured sequence of learning phases based on a meticulously designed algorithm. In essence, programmed learning is a personalized learning process that follows a predetermined learning path. The order in which learning sessions are conducted must be tailored to each individual to create a conducive learning environment.

If individualized consultations with a tutor are available to each student, learning in an offline setting can be highly effective. However, when consultations occur in a group setting, it may cause confusion, as each student's level of understanding differs, and some questions may go unaddressed.

Programmed learning presents several advantages, including the ability to absorb small amounts of information effortlessly, the flexibility to tailor the learning process to individual needs, the potential for achieving high levels of proficiency, and the development of logical thinking abilities. However, this approach also has some drawbacks:

- It does not fully foster independence in the learning process.
- It may take a considerable amount of time to complete.
- Its effectiveness is limited to algorithmic cognitive tasks.
- The knowledge acquired through this method is embedded in an algorithm rather than being acquired as new knowledge.

In the 1960s and 1970s, during the heyday of programmed learning, several programming systems, instructional machines, and educational tools were developed.

Reinforcement-based instruction is inferior to that based on intellectual engagement. Contrary to claims made by some American scholars, programmed instruction is not innovative but rather conservative, relying heavily on textbooks and verbal instruction. Programmed learning falls short of providing a comprehensive understanding of a subject, resembling a haphazard accumulation of knowledge akin to learning by crumbs. In recent years, there has been a resurgence of interest in programmed learning based on new technological advancements, such as computers, television systems, and microcomputers. This technological shift has allowed for the near-complete automation of the learning process, resulting in a more interactive and adaptable approach between the learner and the learning system.

In this context, the role of the instructor shifts toward developing, adjusting, and refining the training program, as well as integrating individual components of the machine-learning process. Decades of research have shown that programmed learning, particularly when supported by computer technology, not only provides a high level of learning but also fosters student development and sustained interest in the subject matter.

4.2. The Subject of Discussion

The present research is dedicated to exploring the efficacy of programmed learning in teaching English grammar, with a particular emphasis on the mastery of grammatical tenses. The study involves two cohorts of first-year students at Toraighyrov University, allowing for a comprehensive qualitative and quantitative assessment of their progress in developing grammatical proficiency and their motivation to learn the English language.

The primary objective of this investigation is to implement this methodological approach and enhance the quality of grammar instruction at the university level. Additionally, it aims to elevate the proficiency levels of first-year learners, ultimately evaluating the efficacy of this pedagogical strategy.

4.3. The Prerequisites for Carrying Out the Experiment

The following conditions were in place for the conduct of the experiment:

1. Approval from Toraighyrov University in Pavlodar.
2. The participants were divided into two groups: a control group and an experimental group.
3. The same teacher taught both groups.
4. The same topics were covered in both groups.
5. The overall content of the educational material was within the standard time limit for lessons.
6. The working conditions were practically the same, including one shift and approximately the same class schedule.
7. For the control group, the lessons were conducted using conventional methods. The sessions began with a theoretical overview, followed by hands-on practice for each topic. During these practical sessions, students were guided through the use of necessary tools and techniques. Afterward, they worked independently on their computers.

4.4. The Phased Procedure of the Experiment

The experimental group received instruction differently to the control group. Students were provided with the topic and objectives of the lesson before beginning practice with algorithms presented on computer screens. These algorithms outlined the steps required to achieve the desired outcome and included relevant theoretical information. The first experiment involved 23 participants, who were divided into two groups: a control group (11 participants) and an experimental group (12 participants). The level of knowledge and motivation among the participants in each group varied. At the beginning of the experiment, the participants in the experimental group were, on average, slightly less motivated and productive than those in the control group. Despite this, their performance was still higher than the average performance of the entire sample of participants.

5. RESULTS

5.1. Preliminary Results

5.1.1. Experiment I

Table 1 presents the scores, means and standard deviations of the four tests for the two study conditions. All values have been rounded. Students who missed two of the four tests were excluded from the sample. For students who missed one test, the table was adjusted using a specialized interpolation, with approximately one percent of the figures being interpolated.

Table 2 displays the effect indices for tests 1–3 compared to test 0, along with their signed means. Tests 1 and 2 were administered during the learning process, while test 3 was conducted after the completion of learning. The significance of differences is provided at three confidence levels. A positive value of X indicates that Group II outperformed Group I on average. A higher value of X denotes a more significant difference. "O" indicates that the difference is not significant at the given two-sided level, while "+" indicates a significant difference.

Table 3 presents the time spent on independent study of the learning tasks (LT). Column LT 1 for Group II includes the time spent on studying the "Note to the Student" and "General Introduction" in the programmed booklet, rendering it incomparable to the corresponding column for Group I. The signs + or – indicate whether the difference is significant: + shows an increase, while – shows a decrease. The frequent occurrence of – indicates a decrease in the time spent on studying a task, which may be influenced by the difficulty of the task. Group II demonstrates a considerable gain in study time.

Table 1. Scores, means and standard deviations of the four tests for the two study conditions.

Group I					
Student	**Test O (50 items)**	**Test 1 (12 items)**	**Test 2 (18 items)**	**Test 3 (50 items)**	**Mean (Tests 1–3)**
1	92	83	89	94	91
2	92	75	78	90	85
3	88	50	67	86	76
4	88	67	44	94	79
5	86	67	56	90	79
6	84	42	72	90	79
7	80	67	61	86	78
8	80	50	56	72	65
9	72	58	44	80	69
10	70	58	28	82	66
11	62	50	50	88	74
Mean	81	61	59	87	76
S.D.	10	12	17	7	8
Group II					
1	100	100	83	100	96
2	100	92	78	100	94
3	98	92	72	100	93

Group I					
Student	**Test O (50 items)**	**Test 1 (12 items)**	**Test 2 (18 items)**	**Test 3 (50 items)**	**Mean (Tests 1–3)**
4	96	92	83	100	95
5	96	92	78	96	91
6	96	100	78	100	95
7	92	100	83	98	95
8	90	92	61	88	83
9	88	92	78	94	90
10	84	75	72	94	86
11	68	50	61	84	74
12	24	50	44	38	41
Mean	86	85	73	91	86
S.D.	21	18	12	17	16

Table 2. Indexes of impact based on three assessments and their weighted averages for two research conditions.

Group I				
Student	**Test 1**	**Test 2**	**Test 3**	**Mean**
1	-54	-10	19	-5
2	-84	-39	-17	-32
3	-112	-50	-13	-43
4	-82	-86	48	-35
5	-72	-64	26	-27
6	-106	-29	37	-19
7	-45	-40	30	-9
8	-80	-50	-31	-42
9	-37	-49	30	-9
10	-31	-67	45	-10
11	-27	-21	93	29
Mean	-66	-46	24	-19
S.D.	30	22	34	21
Parameter λ	105	136	104	114
Group II				
Student	Test 1	Test 2	Test 3	Mean
1	0	-52	0	-28
2	-96	-65	0	-43
3	-66	-70	42	-34
4	-42	-38	69	-7
5	-42	-51	0	-28
6	60	-51	69	-7
7	93	-25	69	17
8	12	-66	-15	-32
9	25	-27	48	9
10	-38	-29	69	9
11	-42	-14	59	15
12	40	27	20	24
Mean	-8	-39	36	-9
S.D.	55	27	33	23
Parameter λ	105	136	104	114
Van der Waerden significance:				
Significance	Test 1	Test 2	Test 3	Mean
ḍ = 0.05	+	0	0	0
ḍ = 0.02	+	0	0	0
ḍ = 0.01	0	0	0	0
X:	5.35	0.72	2.18	2.24

Note: X = Van der Waerden statistic.

Table 3. Duration of study for learning tasks (In minutes).

Group 1									
Student	**LT 1**	**LT 2**	**LT 3**	**LT 4**		**LT 5**	**LT 6**	**LT 7**	**LT 8**
1	45	65	40	35		30	30	60	70
2	40	60	30	40		30	45	35	40
3	60	60	60	60		45	45	45	45
4	75	75	90	90		40	40	35	35
5	45	45	50	55		20	20	25	25
6	75	60	45	45		40	40	35	45
7	90	70	60	60		45	45	45	45
8	75	50	35	35		45	45	30	30
9	60	30	45	45		45	45	45	45
10	60	60	60	60		40	40	30	40
11	60	45	45	45		50	55	50	50
Mean	62	56	51	52		39	41	40	43
S.D.	15	13	16	16		9	9	10	12
Student	LT 9	LT 10	LT 11	LT 12	LT 13	LT 14	LT 15	LT 16	SUM
1	60	60	40	40	30	25	25	10	665
2	40	40	35	40	25	25	25	15	565
3	30	30	30	30	30	30	30	30	660
4	60	60	45	45	20	20	10	10	750
5	30	40	30	30	30	30	30	20	525
6	50	50	40	40	30	30	30	30	685
7	30	30	40	40	45	45	45	45	780
8	30	30	40	45	30	30	30	30	610
9	50	40	60	60	25	25	25	15	660
10	60	60	45	45	40	40	40	30	750
11	45	45	50	45	30	30	30	30	705
Mean	44	44	41	42	30	30	29	24	669
S.D.	13	12	9	8	7	7	9	11	79
Group 2									
Student	LT 1	LT 2	LT 3	LT 4		LT 5	LT 6	LT 7	LT 8
1	105	105	75	45		22	23	100	20
2	60	50	70	45		30	10	25	7
3	80	40	60	45		30	15	20	15
4	80	45	60	40		30	10	35	10
5	60	55	40	35		35	8	25	8
6	70	40	50	40		35	10	35	20
7	80	40	72	42		40	10	30	15
8	114	37	61	33		35	11	26	8
9	95	40	45	30		35	10	25	10
10	55	35	70	35		40	40	35	35
11	70	45	60	30		35	15	35	7
12	100	35	40	30		30	11	20	15
13	105	55	65	35		25	15	20	8
Mean	83	48	59	37		32	14	33	14
S.D.	20	18	12	6		5	9	21	8
Student	LT 9	LT 10	LT 11	LT 12	LT 13	LT 14	LT 15	LT 16	SUM
1	45	30	60	60	35	15	15	10	765
2	45	20	35	25	30	7	10	5	474
3	35	20	30	25	30	8	10	5	468
4	40	20	30	25	40	10	10	5	490
5	40	20	25	20	60	6	10	6	453

6	25	15	20	15	30	10	5	5	425
7	45	20	30	30	35	8	6	3	506
8	45	15	25	15	20	6	6	3	460
9	35	20	25	30	25	7	8	7	447
10	20	20	15	15	40	15	10	10	490
11	45	15	30	30	40	5	7	5	474
12	30	15	25	20	30	6	8	4	419
13	40	25	25	25	30	10	12	5	500
MEAN	38	20	29	26	34	9	9	6	490
S.D.	8	4	11	12	10	3	3	2	87
Van der Waerden significance:									
Significance	LT 1	LT 2	LT 3	LT 4		LT 5	LT 6	LT 7	LT 8
ḍ = 0.05	+	0	0	-		-	-	-	-
ḍ = 0.02	+	0	0	-		0	-	0	-
ḍ = 0.01	0	0	0	-		0	-	0	-
X:	5.31	-4.12	3.58	-6.09		-4.52	-8.22	-4.61	-8.43
Significance	LT 9	LT 10	LT 11	LT 12	LT 13	LT 14	LT 15	LT 16	LT 17
ḍ = 0.05	0	-	-	-	0	-	-	-	-
ḍ = 0.02	0	-	-	-	0	-	-	-	-
ḍ = 0.01	0	-	-	-	0	-	-	-	-
X:	-3.05	-8.53	-6.50	-6.85	2.21	-8.68	-8.22	-8.48	-7.33

Both groups were introduced to the Grammatical Tenses section of the curriculum. Before commencing the experiment, a preliminary assessment was conducted to ascertain the baseline level of proficiency of each participant. This assessment comprised a task related to the content covered in the aforementioned section. A benchmark of 90% completion was set as the criterion for success.

Table 1 illustrates the percentage of individuals who successfully completed the task. To establish their initial level of knowledge, both groups were tasked with completing a written exercise on a previously covered topic before the commencement of the experiment. The performance of the control group was 64%, whereas that of the experimental group was 43%.

During the initial experiment, it was evident that there was a notable lack of autonomy among the participants. Out of the 23 individuals involved, approximately 37% were capable of successfully completing the task (see Table 1). Nevertheless, in the subsequent session, the performance indicators improved in comparison to the initial baseline (see Table 2). The time spent by students on completing the study tasks, as outlined in Table 3, varies between the control and experimental groups. The control group demonstrated a significant advantage in terms of time management, suggesting that their language proficiency and level of preparation were superior to those of the experimental group.

This discrepancy can be attributed to the fact that secondary schools typically allocate only 2–3 hours per week for foreign language instruction, whereas schools specializing in English may dedicate 6–7 hours per week, as illustrated in Table 3. Therefore, it can be inferred that this approach requires time for adaptation, particularly when it is implemented without prior preparation.

The duration of this adaptation phase varies depending on individual student characteristics and the extent of their engagement.

5.1.2. Experiment II

Tables 4–6 present the results of the second experiment. The symbols and signs used correspond to those in Tables 1–3. In Table 5, the value of $\lambda = \infty$ means that $\frac{\lambda}{\lambda - p} = 1$.

Table 4. Data on the scores' means and standard deviations of the four tests under the two study conditions.

Group I					
Student	**Test O (50 items)**	**Test 1 (50 items)**	**Test 2 (25 items)**	**Test 3 (20 items)**	**Mean (Tests 1-3)**
1	94	96	88	75	89
2	90	96	92	70	89
3	88	96	88	75	89
4	88	96	96	85	94
5	88	98	88	75	91
6	86	94	80	70	85
7	82	94	64	85	84
8	80	92	100	80	92
9	74	88	100	75	88
10	68	86	60	65	75
11	64	90	60	70	78
Mean	82	93	83	75	87
S.D.	10	4	15	6	6
Group 2					
1	94	100	92	75	93
2	90	92	80	65	83
3	88	96	88	70	88
4	86	94	88	65	86
5	84	94	92	70	88
6	82	88	80	70	82
7	74	98	80	55	84
8	72	86	84	70	82
9	70	90	88	75	86
10	64	84	76	40	73
11	42	78	88	45	68
12	38	72	44	45	59
Mean	74	89	80	62	81
S.D.	18	8	13	13	10

Table 5. Indices of effect according to the three tests and their weighted means for the two study conditions.

Group I				
Student	**Test 1**	**Test 2**	**Test 3**	**Mean**
1	29	-21	-20	-103
2	68	7	-21	-9
3	82	0	-14	19
4	82	27	-4	106
5	113	0	-14	36
6	68	-18	-17	8
7	87	-42	3	16
8	77	65	0	109
9	68	79	1	94
10	73	-17	-4	26
11	106	-9	6	53
Mean	78	-7	-8	31
S.D.	22	37	9	61
Parameter λ	102	130	∞	96
Group II				
Student	Test 1	Test 2	Test 3	Mean
1	122	-8	-20	-50
2	19	-30	-26	-71
3	82	0	-19	5
4	68	6	-22	3
5	78	25	-15	43
6	36	-6	-13	1
7	153	15	-20	58

8	62	30	-3	51
9	93	46	5	88
10	73	26	-25	30
11	87	45	3	62
12	74	9	7	42
Mean	79	13	-13	22
S.D.	35	22	12	46
Parameter λ	102	130	∞	96
Van der Waerden significance:				
Significance	Test 1	Test 2	Test 3	Mean
ḍ = 0.05	0.07	1.86	-1.96	-0.77
ḍ = 0.02	0	0	0	0
ḍ = 0.01	0	0	0	0
X:	0	0	0	0

Table 6. Duration of study for learning tasks (In minutes).

Group 1									
Student	**LT 1**	**LT 2**	**LT 3**	**LT 4**	**LT 5**	**LT 6**		**LT 7**	**LT 8**
1	45	55	34	24	48	15		30	20
2	40	60	40	40	50	25		20	10
3	50	30	30	60	60	60		20	15
4	60	80	65	30	30	25		15	20
5	70	75	45	35	10	10		10	5
6	75	70	30	40	10	10		10	15
7	60	60	20	15	20	20		20	12
8	40	45	50	45	30	35		10	15
9	45	45	60	60	25	25		60	15
10	50	45	45	60	25	25		60	15
11	40	30	36	24	12	17		9	20
12	40	30	60	60	35	40		12	20
MEAN	51	52	43	41	30	26		23	15
S.D.	12	18	14	16	16	14		18	5
Student	LT 9	LT 10	LT 11	LT 12	LT 13	LT 14	LT 15	LT 16	SUM
1	29	48	43	38	31	50	20	15	545
2	70	50	45	40	30	50	25	20	615
3	60	30	60	30	60	40	30	20	655
4	80	50	75	45	25	15	20	15	650
5	80	40	60	45	10	15	25	15	550
6	90	60	60	45	99	30	20	20	684
7	60	50	60	15	80	40	30	20	582
8	30	30	70	30	90	75	60	60	715
9	60	45	90	30	60	30	30	40	720
10	50	40	40	30	40	15	30	35	605
11	30	10	38	9	25	6	15	30	351
12	40	15	40	10	30	10	15	30	487
Mean	57	39	57	31	48	31	27	27	597
S.D.	21	15	16	13	29	21	12	13	105
Group 2									
Student	LT 1	LT 2	LT 3	LT 4	LT 5		LT 6	LT 7	LT 8
1	90	50	85	45	40		10	50	10
2	85	90	75	110	90		25	90	25
3	185	50	80	85	45		10	45	15
4	120	45	40	30	30		15	25	30
5	70	45	45	60	35		10	45	10
6	105	45	105	30	65		20	40	20
7	75	60	105	105	50		15	40	15
8	75	60	65	50	50		15	60	10
9	100	40	60	50	35		10	50	10
10	64	50	50	60	45		20	45	10

11	80	45	120	80	70		15	60	20
12	90	60	45	30	15		10	20	10
Mean	95	53	73	61	48		15	48	15
S.D.	32	13	27	28	20		5	18	7
Student	LT 9	LT 10	LT 11	LT 12	LT 13	LT 14	LT 15	LT 16	SUM
1	65	35	45	40	30	10	10	10	625
2	95	55	60	50	50	10	10	10	930
3	90	30	60	45	60	20	15	10	845
4	29	28	20	15	13	5	8	7	460
5	60	40	25	40	30	10	10	10	545
6	65	30	55	70	35	10	10	10	715
7	50	25	55	25	60	25	20	15	740
8	55	30	30	50	30	20	10	20	630
9	55	30	35	30	35	5	10	8	563
10	30	35	30	30	30	5	10	10	524
11	120	75	30	25	45	7	10	5	807
12	50	40	30	15	20	10	15	10	470
Mean	64	38	40	36	37	11	12	10	655
S.D.	26	14	15	16	15	7	3	4	153
Van der Waerden significance:									
Significance	LT 1	LT 2	LT 3	LT 4		LT 5	LT 6	LT 7	LT 8
ḍ = 0.05	+	0	+	0		+	-	+	0
ḍ = 0.02	+	0	+	0		0	-	+	0
ḍ = 0.01	+	0	+	0		0	0	+	0
X:	8.28	0.76	6.39	4.15		5.06	-5.12	5.96	-0.44
Significance	LT 9	LT 10	LT 11	LT 12	LT 13	LT 14	LT 15	LT 16	LT 17
ḍ = 0.05	0	0	-	0	0	-	-	-	0
ḍ = 0.02	0	0	-	0	0	-	-	-	0
ḍ = 0.01	0	0	-	0	0	-	-	-	0
X:	1.24	-1.18	-5.74	2.13	-1.67	-6.19	-8.18	-8.06	1.75

In the second experiment, two cohorts were involved: a control group and an experimental group. After implementing a tested approach for the experimental group from the second session onwards, the results for the experimental group exceeded those of the control group. Specifically, the experimental group showed a 64% improvement compared to the 51% increase observed in the control group (see Table 4). During the adaptation period, the study did not observe any decline in performance, as the group had already been exposed to research techniques prior to the experiment. The trend persisted for the next two subjects. In the second subject, the experimental group scored 75% and the control group scored 51% (see Table 5). With regard to the third subject—Duration of Study for Learning Tasks in Minutes—the experimental group performed at 87% compared to 72% for the control group (see Table 6).

Unlike the control group, which saw growth primarily driven by exceptional students maintaining high academic performance, the experimental group demonstrated an improvement in performance from almost all participants. The results of the second study revealed that during training sessions using innovative methods, the experimental group outperformed the control group in both performance and time.

The participants in the experimental group often completed tasks within the same class period as the control group or even faster. Based on these findings, it can be concluded that this approach significantly enhances the intensity of learning, ensures the quality of acquired knowledge and skill development, and promotes personalized learning among students. Moreover, it fosters the development of independent learning abilities. This method can be successfully implemented in remote learning environments. By employing advanced techniques, educators can achieve optimal learning outcomes while minimizing mental strain and time investment.

6. CONCLUSION

After conducting an experiment on the efficacy of programmed learning among the control and experimental groups at Toraighyrov University and reviewing relevant literature, several conclusions have been drawn. Programmed learning plays a crucial role in modern education and is the subject of significant research. It is a method for acquiring knowledge and skills using learning tools such as computer programs, textbooks, and video tutorials, which allows students to study at their own pace and in accordance with their individual characteristics, such as learning speed and preferred learning style. In contemporary educational settings, both linear and specialized approaches to teaching are employed.

These techniques aim to tailor the learning experience to individual requirements. While these strategies can be efficient, the materials utilized may not always be optimal. This is due to the fact that information is frequently presented in a fragmented manner, making it challenging to comprehend the complete picture. Furthermore, the utilization of software-based learning technologies may restrict the development of creative thinking and the capacity to generate novel concepts. This study provides empirical evidence to support the effectiveness of programmed learning as an approach to teaching grammar tenses in the English language. The outcome of the experiment suggests that this method could be a valuable addition to language instruction, offering a systematic and engaging way to improve the efficacy of grammar teaching.

However, further research is required to evaluate its effectiveness with different language abilities and proficiency levels. Based on the results, the students' learning and engagement improved when learning English grammar tenses through programmed learning compared to more traditional methods. This indicates that programmed learning aids students in memorizing and understanding grammatical concepts more efficiently through structured progression and immediate feedback.

The initial findings of the study are encouraging, but further research on larger samples is required to validate the efficacy of this approach. According to the available data, it appears that the learning experience was beneficial for both the experimental and control groups to an equal extent. The background of the study delves into the research that demonstrates an inventive strategy that may be duplicated and modified for other linguistic aspects or languages, augmenting the overall methodological toolkit accessible to educators by implementing programmed learning techniques in the instruction of English tenses. The comparison was based on tests measuring the practical application of acquired knowledge and the time taken for learning. For this purpose, a linear program on the use of English tense forms in the active voice was developed. Two experiments were conducted in the fall (autumn) terms of the 2021–2022 and 2022–2023 academic years. One of the goals of the experiments was to determine the significance of the differences in achievement in comparable groups. As the trials progressed, initial findings were noted, and tables were created using the experimental data. In summary, the data obtained thus far indicates that the instructional procedure was equally successful for the experimental and control groups. On the other hand, the experimental group completed the tasks in a shorter amount of time.

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