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Research Article

# An Alternative Approach to Distance Education: Lightboard Design

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***Abstract*** – New approaches to distance learning can reshape the interaction between students and teachers, and these different approaches can help students engage with the course. This study examines the design and impact of using lightboards in distance learning instead of the commonly used whiteboards in traditional teaching. The aim of the study is to design, develop, implement and evaluate the Lightboard technology to alleviate the challenges in distance learning processes. For this purpose, the challenges in designing the lightboard technology as well as the reactions of students when they first encountered this technology were examined. The study was conducted using a design-based research design. 35 students took part in the study as part of the "Introduction to Scientific Research Methods" course at a university. These students watched a video recorded with a light board and then shared their opinions. An online evaluation form was used as a data collection tool and the qualitative data was evaluated using content analysis. The results show that Lightboard technology increases students' interest in class, makes knowledge more permanent, and has a positive impact on class participation. The integration of visual and auditory elements made the course material more engaging and comprehensible. This approach enhanced students' understanding of the presented content and improved their ability to retain the information. However, it was also noted that the technology presented some difficulties, such as ergonomic problems, the quality of the material used and the lighting. Students reported that the light board enhanced visual expression and facilitated the learning process. However, due to the one-way flow of information, some students were at risk of passive learning. In conclusion, it is emphasized that Lightboard technology can be used as an effective tool in distance learning, but the difficulties encountered in the design and implementation phases should be eliminated. The codes derived from student expressions are as follows: The Power of Visual Expression, Making Knowledge Permanent, Increasing Attention and Focus, Passive Learning Trap, and Tutorial and Facilitating Understanding.

*Keywords*: lightboard, video, distance education.

## Introduction

The "blackboard", which is an indispensable teaching tool within the scope of traditional education, is still used in education-teaching processes. The blackboard, one of the traditional educational tools, is considered an indispensable tool in education from past to present, facilitating teacher-student interaction. It can be said that the reason why it is preferred today is that it is cheap and easy to use (Özarslan, 2015). With the development of technology, interaction is increased by using smart boards in classroom environments and a rich learning environment is provided. The use of smart boards in classroom environments increases students' interest and participation in the lesson, thus providing a more effective learning environment. Thanks to these interactive smart boards, students' motivation, attention, focus and engagement to the lesson are positively affected (Kennewell and Beauchamp, 2007). Students' focus on the lesson and increased motivation contribute significantly to the learning process. While student-teacher interaction is easily provided with the innovations brought by technology in face-to-face education processes, it contributes to the learning processes. However, the situation may be different in distance education processes. Limited interaction between students and teachers in distance education can negatively affect learning processes. In distance education processes, the interaction and narration style changes in lessons where the use of traditional boards is required and can become more difficult compared to face-to-face environments. In courses that

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require the use of traditional blackboards, distance education may reduce students' interest in the course by making it more difficult to teach. In distance education, the instructor learns well when he shifts his gaze between the audience and the board instead of just looking at the audience or the board while teaching (Mayer, Fiorella and Stull, 2020). For example, in distance education courses where traditional board use is required, instructors are required to turn their backs to the camera while recording their lessons and the interaction between student and teacher can be negatively affected because eye contact is lost. This event appears as a situation that distracts the student's attention during the learning process and if the teacher loses eye contact with the students, it may cause the students to be distracted during the learning process (Fiorella, Stull, Kuhlmann and Mayer, 2019). Seeing the instructor drawing while teaching is seen as a social cue that fosters a sense of social partnership and leads to deeper learning (Robbins and Aydele, 2009). Therefore, ensuring that the instructor faces the students while teaching and can make the necessary writing and drawings during this time reveals the importance of educational video design for distance education. In this study, a video was created using Lightboard technology and qualitative research methods were preferred to enable in-depth analysis and the opinions of the participants who watched this video were collected. This study was conducted to conduct an in-depth analysis on the usability of lightboard technology in distance education processes. In light of these opinions, participants' comforts and difficulties with lightboard technology became clear. By applying this approach, considerations were given to its use in distance learning processes. With this method, the points to be considered for the use of lightboard technology in distance education were identified.

The importance of educational video design in courses requiring the use of traditional boards within the scope of distance education emerges at this point. In this context, effective design of the educational video plays an important role in increasing student achievement. Online learning processes continue synchronously and asynchronously. One of the most important components of asynchronous online courses is the course material. The most frequently used of these materials is educational video. In asynchronous education, video materials allow students to progress at their own pace, providing flexibility in education. When informal online learning platforms (Youtube, Udemy, Vimeo, etc.) are examined, it is seen that they consist of educational video designs. However, the instructor may need to use a board when designing an educational video. This has created a need for a solution that can replace traditional boards in particular. Therefore, it is a need for the instructor to be able to use the board and design the video without turning his back to the camera. In addition to being effective in terms of content, the presentation style of the training video should also be carefully designed. The use of video technology as course content can create original learning opportunities such as facilitating problem solving, helping to master learning, inspiring students, and increasing their interest in the course (Alpay et al., 2017). Mayer (2009) defines educational video as a type of multimedia teaching in which graphics are in the form of moving images recorded by a camera and words are in the form of speech and background sounds recorded by a microphone. However, several criteria need to be considered to design an effective training video. Designing an educational video is possible by setting out various criteria. For this reason, Mayer, Fiorella and Stull (2020) set out design principles for educational videos. These design principles are listed as dynamic drawing, gaze guide, productive activity, perspective, subtitles and striking details (Mayer, Fiorella and Stull, 2020). These principles are important factors that positively affect students' learning from video. The one that is most closely related to the lightboard can be described as gaze guide. According to this principle, when the instructor on the screen shifts his gaze between the audience and the board instead of just looking at the audience or the board while teaching, people learn better from a video lesson (Mayer, Fiorella and Stull, 2020). This interaction increases students' attention and contributes to the learning process. In order to achieve this, a lightboard should be used. When studies using a lightboard are examined, it is generally seen that students' learning performance is higher than in classes where traditional boards are used. The use of the lightboard provides a more effective learning environment by keeping the teacher interacting with both the board and the student. In a study conducted by Fiorella et al. (2020), a video lesson was designed and a group of students were shown videos using a lightboard and the other group was shown videos using a traditional board. At the end of the study,

it was observed that students who watched videos using lightboards transferred information more easily and exhibited higher learning performance. Stull et al. (2018) applied lightboards in a chemistry class. Eye movements of students watching the video were tracked using an eye-tracking device. As a result of the study, it was observed that students tended to look at the instructor's face. This shows that the visual connection students established with the teacher increased their interest in the course content. In addition, it was concluded that their learning performance was slightly higher than the control group. In these studies, it was seen that students were able to learn more from videos designed using lightboards, but more research is needed to generalize this (Mayer, Fiorella and Stull, 2020).

It is seen as a result of the literature review that educational videos designed using lightboards have the potential to make positive contributions to learning. An important issue at this point is the design of the lightboard. Lightboards are defined as a state-of-the-art solution used to record educational videos that focus on writing and drawing (McCorkle and Whitener, 2020). Lightboards are usually designed in such a way that LED strips are wrapped around the glass, trapping light inside the glass and causing the elements that the instructor writes and draws on the glass with a highlighter pen to shine. During the drawing, a video is recorded with a camera located opposite. Then, thanks to the software, the elements drawn on the glass are reversed using a mirror effect. In this way, those watching the video are allowed to see the writings and shapes straight. Figure 1 shows an example of a lightboard.

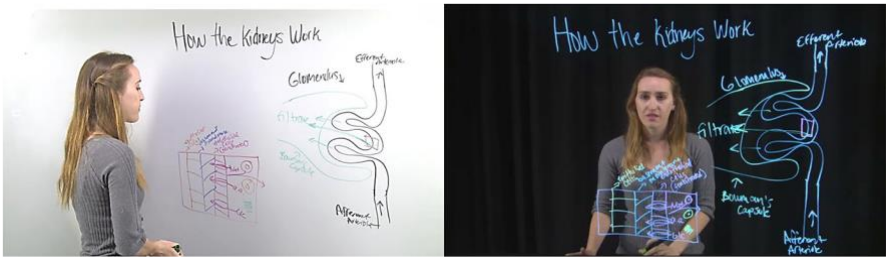


**Figure 1.** Example of An Educational Video Shot Using A Lightboard (right) and A Traditional Board (left) (Mayer, Fiorella & Stull, 2020)

In order to provide the output in Figure 1 and to reveal the educational outcome, it is necessary to design, develop, implement and evaluate the lightboard.

In summary, Lightboard technology stands out as an important innovation to improve the quality of education in distance education processes. Like the chalkboard used in traditional education, it allows teachers to support their lectures with written and visual materials. However, the biggest advantage of lightboard is that the teacher does not lose face-to-face interaction with students while writing or drawing on the board. Thanks to this technology, the teacher can both write on the board and continue his/her narration by looking directly at the student. This strengthens eye contact and communication between the student and the teacher, increases the student's interest in the lesson and keeps their attention focused. Lightboard also supports students' motivation to learn by reinforcing the social cues involved in the learning process in distance education. Educational videos prepared with this technology contribute to students' better understanding, knowledge transfer and in-depth learning. Therefore, lightboard technology has a great importance in terms of making teaching materials in distance education both more effective and more interactive. Although lightboard technology has educational benefits, the design and implementation of this technology also involves important factors and the design process is also important in terms of achieving educational outcomes. The design of the Lightboard technology was conceived to enable both teachers and students to have an interactive learning experience. The basic component of this technology is a transparent glass or acrylic panel on which the writing is easily visible to the students. In the design process, lighting and the visibility of the text are of great importance. LED lights placed on the edges of the glass panel make the writing visible, so that when the teacher writes or draws on the board, the writing glows and reaches the audience clearly. In addition, getting the camera and lighting angles right is crucial to maintain the balance between the teacher's face and the writing on the board. These design details make it possible

for the teacher to use the board effectively while still looking directly at the student. Finally, the recording equipment and ambient sound must also be carefully planned to ensure a clear sound quality in the video recording, maximizing teacher-student communication. This meticulously thought-out design of Lightboard technology aims to provide a near face-to-face experience in distance learning.

It is known that the blackboard has been an indispensable tool in traditional education processes for many years and facilitates teacher-student interaction. However, in distance education processes, especially in courses that require the use of chalkboards, the limited interaction between teacher and student can negatively affect the learning process. In this context, the use of Lightboard technology aims to fill an important gap in this field by both increasing teacher-student interaction and supporting learning performance in distance education. In particular, the fact that Lightboard technology allows teachers to lecture without losing face-to-face interaction makes this study an innovation that will contribute to the existing literature. This research aims to provide an in-depth analysis of the effectiveness and applicability of Lightboard technology by examining its use in distance education processes in detail.

## Literature Review

Lightboard technology stands out as an effective tool that has been evaluated in various contexts to increase engagement and interaction in education (Sola-Guirado, Comino, & Castro-Triguero, 2024; Perkins & Woods, 2023). Sola-Guirado, Comino & Castro-Triguero (2024) examined the potential of lightboard videos to promote self-regulated learning in engineering education. Their study shows that it improves students' ability to solve tasks independently, increases class attendance, and supports the self-assessment process. However, they also found that this method did not make a statistically significant difference in its impact on academic performance. This suggests that Lightboard technology not only increases engagement but also strengthens students' active participation in the learning process. Another study by Perkins & Woods (2023) explains how a lightboard studio can be cost-effectively set up in an office environment and highlights the impact of this technology in increasing student interest. Particularly in the context of chemistry didactics, studies show that students' interest in the content of the lecture increases significantly. Additionally, Lightboard videos have been found to be 74% more engaging than traditional videos (Perkins & Woods, 2023). This finding confirms that lightboard technology can be an effective tool to increase students' interest in learning.

Papadakis et al. (2023), who examines the potential of computer simulation and cloud-based smart technologies in education to support open learning processes. The study addresses the implications of innovative approaches such as computer simulations, artificial intelligence, augmented reality and big data processing in STEM education, showing how these technologies can be used to increase student achievement, make complex concepts tangible and personalize learning processes (Papadakis et al., 2023). It is also noted that cloud-based learning environments support individual learning pace, providing students with more flexible and effective learning experiences. By focusing on the potential of these technologies to increase accessibility, interactivity and motivation in open education, the research aims to both contribute to current processes and guide future applications (Papadakis et al., 2023).

Gedik et al. (2023), who examined the impact of using portable light boards in online education during the pandemic process, looked at the student-teacher interaction of the portable light board called ESBOARD and its potential to create a face-to-face learning-like environment. Their study emphasized that ESBOARD was particularly effective in formula and problem solving in engineering and science courses, thereby increasing student interaction (Gedik et al., 2023). At the same time, it was found to provide ease of use due to its portability and represents a cost-effective solution (Gedik et al., 2023). These features show that ESBOARD can be considered an important tool in online education.

Comparing the effectiveness of different types of videos used in teaching processes, Fidan & Debbag (2023) examined lightboard and green screen technologies and found that such videos are more effective when enriched with human presence and interaction elements. Elements such as teachers' facial expressions and hand gestures have been found to increase their contribution to the learning process and provide students with a more interactive learning experience (Fidan & Debbag, 2023). This study highlights the positive impact of lightboard technology on beginning teachers and suggests ways to create more effective video content in education (Fidan & Debbag, 2023).

Lubrick, Zhou & Zhang (2019), who examined the potential of lightboard technology to increase student performance, stated that this technology is useful for creating interaction by sharing teachers' gestures and facial expressions with students (Lubrick , Zhou & Zhang, 2019). However, Lubrick, Zhou & Zhang (2019) state that there are no clear conclusions in the existing literature about the effects of lightboard videos on student performance and that further empirical research is needed in this regard. Their study particularly highlights the potential of lightboard technology to create interactive learning environments; However, more data is needed to understand the direct impact of this potential on academic performance Lubrick, Zhou & Zhang (2019).

Rulino & Febriana (2022) evaluated the benefits of using lightboards in the context of nursing education, particularly in application-oriented courses. In their research, they found that Lightboard provides visual benefits in hands-on training and increases students' interest in the learning process (Rulino & Febriana, 2022). In areas such as nursing education, Lightboard technology is intended to help teach students practical skills (Rulino & Febriana, 2022). In this context, it was concluded that lightboard videos can be used as a supporting aid in training in both theoretical and practical courses. In general, lightboard technology is considered to have the potential to increase student engagement in various disciplines, provide an interactive learning environment, and increase interest in learning (Sola-Guirado, Comino, & Castro-Triguero, 2024; Perkins & Woods, 2023 ; Gedik et al., 2023; Fidan & Debbag, 2023; Lubrick, Zhou & Zhang, 2019; As can be seen from the literature review, it is noteworthy that lightboard technology has been studied in various disciplines The study focuses on the development, design and implementation processes of lightboard technology.

### Purpose of the Study

The aim of this study is to design a lightboard to eliminate the difficulties caused by the use of traditional boards in live lessons or in video design as distance education material within the scope of distance education. In line with this purpose, it is aimed to design, develop, implement and evaluate a lightboard. Within the scope of these goals, the following research questions will be answered:

- What are the lightboard design challenges?
- What are the opinions of students who experience educational videos shot using lightboards for the first time?

## Method

### Research Model

This study was conducted within the scope of the design-based research model. Wang and Hannafin (2005) define design-based research as a systematic and flexible research method consisting of analysis, design, development and implementation steps in a cycle framework in which participants collaborate. Therefore, within the scope of the study, the steps in the definition within the scope of the design-based research model were applied in order to present the lightboard as a product and obtain the implementation results. Design-based research is used to understand and improve complex and dynamic processes such as education. This method bridges the gap between theory and practice, providing practical and innovative solutions to real-world problems. It also provides the opportunity

to continuously improve the design with the data obtained throughout the process, which is why it was preferred in this study.

## Participants

The research was conducted within the scope of a unit titled “Introduction to Scientific Research Methods” within the scope of a university Research Methods and Techniques course. A faculty member used a lightboard to record a video within the scope of a unit. This video was shown to a total of 35 students within the scope of the course. Demographic information of the students is shown in the Table 1. In the process of determining the participants, purposeful sampling method was preferred to obtain rich and in-depth information. Criterion sampling was preferred among purposive sampling methods. In this context, taking the Research Methods and Techniques course was determined as a criterion.

**Table 1.** Demographic information

| Demographic Information | | n |
|---|---|---|
| Grade | 1st Grade | 23 |
| | 2nd Grade | 12 |
| Age | 18-20 | 16 |
| | 21-23 | 19 |
| Gender | Male | 21 |
| | Female | 14 |
| Department | Computer Technology | 22 |
| | Information Security | 13 |
| Average daily video watching time | 1-3 hours | 10 |
| | 4-6 hours | 20 |
| | 7-9 hours | 3 |
| | 10 or more | 2 |

## Data Collection Tool

Online Evaluation Form: Using this form, students were asked to evaluate the lightboard. With this form, it is planned to reach information about students' general thoughts about the video content presented using the lightboard, their perspectives on the course, their effects on learning, their effects on motivation and their difficulty levels. This form, consisting of a total of 17 questions, was finalized in the light of the feedback from 2 experts who have scientific studies in distance education. Table 2 shows the questions included in the online evaluation form.

**Table 2.** Online evaluation form

| No | Questions |
|---|---|
| 1 | Can you explain how these kinds of videos affect the way you follow the lessons? |
| 2 | How have such videos influenced your interest in the lessons? |
| 3 | What do you think about the presentation and understandability of visual elements? |
| 4 | Would you like to see more videos like this used in lessons? |
| 5 | What was the biggest challenge you faced in this kind of video lectures? |
| 6 | How did this video affect your overall learning experience? |
| 7 | How effective was it compared to other teaching materials? |
| 8 | How do you evaluate the lessons with Lightboard? |
| 9 | How did the use of Lightboard affect your understanding of the course content? |
| 10 | How did your focus time change during the lessons with Lightboard videos? |
| 11 | How effective were the Lightboard videos compared to other teaching materials? |
| 12 | What do you think about the comprehensibility of visual elements in lessons with Lightboard? |
| 13 | How easy was it to take notes during the Lightboard videos? |
| 14 | Would you like to use the Lightboard lessons in future lessons? |
| 15 | How do you evaluate your level of interaction in lessons with Lightboard? |
| 16 | How do you evaluate the speed of the lectures with Lightboard? |
| 17 | How did the Lightboard videos affect your overall learning experience? |

## Data Analysis

The qualitative data obtained with the data collection tool were analyzed using the content analysis method. Content analysis is a process that aims to reveal common themes, patterns and relationships in data. This method is particularly important in terms of making sense of the data and drawing meaningful conclusions from the participants' statements. After the data were analyzed in detail, they were divided into codes and themes. The qualitative data obtained were presented with various themes and codes within the scope of each research question. In addition, a consensus was reached between the researchers during the process of determining the themes and codes. The themes and codes that emerged were interpreted by tabulating. The findings are presented in tables and made more understandable. In addition, the qualitative data obtained at the end of the pilot study were analyzed using the content analysis method.

## Research Process

### *Pilot Study*

The research process first consists of a pilot study phase. This phase was presented in the project market held at a state university during the 2021-2022 academic year. In this presented project, a ready-to-use prototype was developed for a lightboard. Some difficulties were identified in terms of the usability of this developed prototype for faculty members and students. In this prototype obtained, since the cost was reduced by using products that were not used at home or at work, it was normal for some difficulties to arise. For this reason, a lightboard design with a different structure was realized as an upper version of this prototype. The prototype carried out within the scope of the pilot study and the output of this prototype are shown in Figure 2.


**Figure 2.** Prototype Design (left), Video Output (right)

### *Analysis*

At this stage, the data obtained during the pilot study phase was analyzed. According to the analysis results, some decisions were made on issues such as material supply, encountered problems, roadmap, and the design phase of the main application was started.

### *Design*

In this step, the development strategy was determined in line with the data from the analysis phase. The issue of how to achieve the goal was emphasized. Ideas that concern ergonomics, such as material selection and assembly, and that ensure the video is of high quality were put forward. The three-dimensional design of the lightboard that was targeted to be designed is given in Figure 3.

**Figure 3.** Planned lightboard 3D model

*Development*

At this stage, the model planned in the design phase was developed. The supply and assembly of all materials planned to be used were carried out at this stage. Attention was paid to the portable nature of the developed lightboard. Thus, it was ensured that every teaching staff could use it easily.

*Implementation*

At this stage, the lightboard was applied within the scope of the Research Methods and Techniques course. The videos were watched online by the participants. The videos were presented to the participants within the scope of 4 class hours and the evaluation phase was started.

*Evaluation*

It is the evaluation phase of the lightboard that was finalized and applied by the students. In addition, each phase has its own evaluation. In the evaluation phase, an online evaluation form was used. The qualitative data obtained from the form was evaluated with the content analysis method. Figure 4 shows all the steps of the research process.

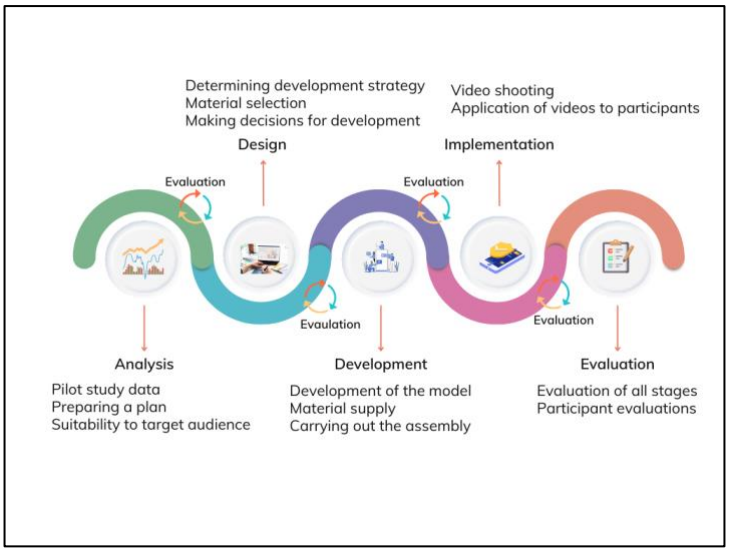


**Figure 4.** Research Process

## Findings

### Challenges in the Lightboard Design Process

This section presents the findings related to the first sub-problem. A prototype lightboard was designed during the pilot study phase. The qualitative data obtained were analyzed using content analysis method. This prototype designed by the researchers was made ready for use and the difficulties encountered during this process and the problems that arose during use were revealed. The challenges related to the lightboard design during the pilot study phase are shown in Table 3.

**Table 3.** Challenges in the Lightboard Design Process in the Pilot Study

| Category of Challenges | Challenges |
|---|---|
| Ergonomic Issues | - Ergonomic problems when teaching staff sit down and use the lightboard mounted on the table. |
| Material and Equipment Issues | - The problem of scratching the glass used for the lightboard.<br>- The shaking problem of the glass used for the lightboard.<br>- Poor quality of the pens used.<br>- Writings written on the lightboard cannot be completely erased. |
| Display Problems | - The texts are not fully visible in the video recording due to the inadequacy of the LED lights used. |

### Student opinions about Lightboard

This section presents the findings related to the second sub-problem. The qualitative data obtained were analyzed using content analysis method. 35 students answered the questions in the online evaluation form after watching the videos. Student responses were analyzed using the content analysis approach and various codes were created. These codes and sample student statements are shown in Table 4.

**Table 4**. Codes and Sample Students Expression

| Codes | n | Sample Student Expression |
|---|---|---|
| The Power of Visual Expression | 14 | "Presenting visual and auditory elements together made the subjects more vivid and interesting." (Student3) |
| | | "I think visuality always helps to memorize the things explained more permanently." (Student5) |
| | | "The narrator is facing me and I can see the writing clearly, it was more effective." (Student6) |
| Making Knowledge Permanent | 12 | "Thanks to its accessibility at any time, it is easier to keep the subjects in mind." (Student5) |
| | | "The more visual elements, the faster and more memorable the learning speed of the individual." (Student20) |
| | | "Video teaching is more permanent; the chance to watch again a place you missed or could not start." (Student21) |
| Increasing Attention and Focus | 11 | "I am more interested." (Student16) |
| | | "The way we follow the lessons has improved a lot because of the image and the information it provides." (Student14) |
| | | "Creating a suitable time to watch it again." (Student15) |
| Passive Learning Trap | 5 | "Since videos usually present a one-way flow of information, it can make active participation difficult." (Student3) |
| | | "That it is one-way." (Student28) |
| Tutorial and Facilitating Understanding | 11 | "It had a positive effect because it was a descriptive expression." (Student4) |
| | | "This video positively affected my learning experience in general." (Student3) |
| | | "It is more memorable and fun." (Student17) |

One of the biggest advantages of the lightboard is the effective use of visual elements. Many students stated that this visual narration contributed to making the lesson more vivid and interesting. For example, student S3 emphasized the impact of this technology by saying, "The combination of visual and auditory elements made the topics more vivid and interesting". Similarly, Student S5 emphasized

the effect of visual narration on memory by stating, “I think that the things explained visually are always recorded in the memory more permanently”. Student S6 stated, “The narrator is facing me and I can see the text clearly, it was more effective” and expressed how the interactive structure of the video increased the comprehensibility of the lesson. These statements show that the lightboard made the course content more interesting and understandable.

Lightboard videos play an important role in helping students memorize course topics. Student S5 expressed how the reproducibility of the videos increased retention by saying, “It is easier to remember the topics thanks to the fact that they can be accessed at any time”. Student S20 stated, “The more visual elements, the faster and more memorable the individual's learning speed becomes”, indicating how visual supports accelerate and reinforce the learning process. In addition, student S21 expressed how lightboard videos make the learning process flexible and accessible by saying, “Teaching in video is more permanent; having the chance to watch again a place you missed or could not start”. These student statements reveal how effective lightboard technology is in making knowledge permanent.

Lightboard videos have a significant impact on students' attention and focus on the lesson. Student S14 stated that this technology increased his/her interest in the lessons with the statement “The way we follow the lessons has improved a lot because of the image and the information it provides”. Student S16 stated, “I am more interested”, and expressed how the lightboard videos helped the student to pay attention throughout the lesson. Student S15 also stated that the flexible structure of the videos contributed to the focusing processes by saying “Creating a convenient time to watch again”. The statements of these students show that lightboard technology supports the learning process by increasing students' interest and participation in the lessons.

It is stated that Lightboard videos make active participation difficult for some students and lead to passive learning trap. Student S3 pointed out the possible disadvantage of this technology by saying, “Videos can make active participation difficult because they usually present a one-way flow of information”. Student S28 also drew attention to this problem arising from the lack of interactivity of the videos with the statement “Being one-way”. This situation reveals that lightboard technology can create a passive learning process for some students and therefore it should be designed carefully.

Lightboard videos are very effective in enabling students to understand the topics better. Student S3 emphasizes the instructive nature of the video and its ability to facilitate understanding with the statement “This video positively affected my learning experience in general”. Student S4 stated, “It had a positive effect because it was a descriptive narration” and emphasized how the clear and understandable presentation of the video increased the effect of the lesson. Student S17 stated that lightboard videos made the lessons both enjoyable and instructive with the statement “It is more memorable and fun”. These statements show how lightboard technology supports students' learning processes and provides a better understanding of the subjects.

## Conclusion

The findings obtained in this study show that lightboard technology supports learning by increasing student interest in education, makes knowledge permanent and positively affects participation in lessons. In particular, it was observed that the course material became more attractive and understandable thanks to the combination of visual and auditory elements. This provided students with a more effective understanding of the content presented and increased the retention of information. In addition, the fact that lightboard technology provides the opportunity to establish eye contact between the student and the instructor provides an in-depth interaction in the learning process and allows the instructor to convey his/her messages more effectively.

It was found that students demonstrated higher learning performance and were able to transfer knowledge more easily in courses delivered with lightboard technology compared to traditional methods. In addition, the instructors' explanation of the topic by drawing during the lecture serves as

a social cue that encourages in-depth learning in students. This interactive approach keeps students' attention and increases their motivation for the learning process.

However, lightboard technology also has some limitations. In particular, it was determined that the one-way flow of information provided by the videos posed a risk of creating passive learning in some students. This situation reveals that lightboard videos should be supported with elements that will increase interaction so that students can take a more active role in the learning process. In addition, ergonomic problems, material and equipment problems encountered during the design process are other important challenges that need to be solved in terms of efficient use of technology. For example, problems such as scratching the glass, not being able to erase the text completely, and inadequate lighting can affect the quality of the video recording and have a negative impact on the learning process.

Overall, these findings suggest that lightboard technology is a powerful tool for engaging students and increasing engagement in education, but it needs some technical and pedagogical improvements to reach its full potential. Based on the findings of this study, several suggestions can be made for more effective use of lightboard technology in education. First, it is suggested to add interactive elements in lightboard videos to minimize the one-way flow of information and increase student engagement. For example, certain parts of the videos could include questions or activities that encourage students' active participation. In addition, more attention should be paid to the quality of the materials used in the design phase of the videos. In particular, the use of protective coatings to prevent scratches on the glass and improved lighting would improve the image quality. Finally, further research on lightboard technology and testing its applicability in different courses will strengthen its place in education. However, in order for this technology to reach its full potential, improvements need to be made in the design and usage processes.

## Discussion

In this study, the findings show that this technology increases student interest, makes knowledge permanent and positively affects participation in lessons. In particular, it was determined that the course material became more attractive and comprehensible by presenting visual and auditory elements together. This coincides with the necessity of presenting educational videos, graphics as moving images and words as speech, as emphasized by Mayer (2009). Birdwell & Peshkin (2015) state that lightboards make the lessons both interesting and understandable. In addition, studies by Kennewell and Beauchamp (2007) show that the use of technology in the classroom environment positively affects students' attention, motivation and participation in the lesson. Sola-Guirado, Comino & Castro-Triguero (2024) stated that lightboard technology plays a role as an important tool to strengthen student engagement in engineering education. In addition, Lubrick, Zhou & Zhang (2019) found that Lightboard videos are both motivating and instructive for students.

One of the main reasons why lightboard technology is considered an effective learning tool is that the instructor can maintain eye contact with the students throughout the lesson. In a study conducted by Mayer, Fiorella, and Stull (2020), it was reported that students learn better from videos when the instructor makes eye contact with both the board and the students. In Gedik et al. (2023) study, Lightboards were found to be more effective than alternative tools such as graphic tablets and it was understood that Lightboard technology has the potential to make online education more interactive and efficient. This study also revealed that students who watched videos using lightboards were able to transfer knowledge more easily and exhibited higher learning performance compared to students who watched videos using traditional whiteboards. Perkins & Woods (2023) reported that lightboard technology significantly increased students' interest in video content. Robbins and Aydele (2009) emphasize that the instructor's drawing during the lecture encourages in-depth learning as a social cue. These findings also support the psychological and pedagogical foundations behind lightboard technology being more effective in lectures. However, lightboard technology also has some disadvantages. As noted in Fiorella et al. (2020), the one-way flow of information provided by the

videos can lead to a passive learning trap for some students. Feedback from students shows that this is especially evident in courses with low interactivity. Mayer et al. (2020) also state that the inclusion of attention-grabbing details and productive activities in videos supports learning. Therefore, it is important to develop strategies to encourage students' active participation when using lightboard technology. Gedik et al. (2023) emphasized that portable lightboard increases interaction in online courses.

The difficulties encountered in the design process of lightboard technology should also be taken into account. Ergonomic problems, material and equipment problems, especially the scratching of the glass and the inability to completely erase the writings are important issues that need to be solved in order to use the technology more efficiently. In addition, visual problems such as the inability to see some texts clearly in the video recording due to insufficient lighting are among the areas where lightboard technology needs to be improved. McCorkle and Whitener (2020) also emphasize that ergonomic and material issues should be considered in lightboard design. Rulino & Febriana (2022) stated in their study that lightboard provides visual advantages in applied trainings. Bindumadhavan & Anjani Srikanth (2022) emphasized that this technology is a suitable tool for delivering more interactive and effective content in education.

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