Content Analysis of an Educational YouTube Channel for Secondary School Students in Terms of Design and Program Elements[1]

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Article Info	ABSTRACT
	This study employed a qualitative research methodology to examine the design features and program elements utilized in the videos of a popular educational YouTube channel called "Basfi ile Deneysel Bilim" (Experimental Science with Basfi). The primary objective was to identify these features and elements by analysing the top ten videos on the channel, based on view counts, likes, and comments. Data collection was conducted using a thematic analysis matrix as the instrument. During the initial phase of data analysis, a descriptive examination of the videos was performed in terms of Mayer's principles of multimedia learning. Subsequently, content analysis was conducted to analyse the program elements present in the videos. The findings of this research revealed that the educational videos on the YouTube channel partially adhered to Mayer's multimedia design principles and incorporated some program elements. Therefore, it is recommended that multimedia design principles and program elements be taken into account when creating educational content for YouTube. Additionally, it is suggested that elements tailored to the nature of the YouTube platform should be included. Finally, the study provides recommendations to content developers regarding factors to consider in video production. This research holds significance for individuals involved in producing educational content for YouTube, as well as researchers working in the domains of content production processes and content design.

[1] This study has been produced from a postgraduate study done by Çiğdem Ceylan, under the management of Assoc. Prof. Dr. Özden Şahin İzmirli and second consultancy of Assist. Prof. Dr. Gökçe Becit İşçitürk titled "Content analysis and viewers opinions of an educational YouTube channel for secondary school students with respect to design and program elements".

INTRODUCTION

The rapid development of technology brings about significant changes in our social lives. It enables us to accomplish a wide range of tasks, from the most mundane to the most essential, through digital platforms. Moreover, this transformation has also had a profound impact on learning habits. Nowadays, accessing digital content has become almost necessary when seeking information on a subject, preparing for exams, or observing the application phase of a practical subject. Expressions like "I watched this question" are now more frequently encountered than "I saw this question", indicating a growing preference for video content in this context. Consequently, there is an arising need to restructure educational tools and content in instructional environments in a way that can address the requirements of the digital age. In this process of change, videos are considered to be one of the preferred tools among the new generation. Given the younger generation's interest and inclination towards digital technologies, it is crucial to examine their reasons and opinions for choosing these learning environments during the process of designing effective learning environments (Ata & Atik, 2016: 314). When the affinity of individuals at secondary school level with digital technologies is examined, the following statements can be made.

- A total number of 94.2% of children in the age group of 6 to 15 in Türkiye, who use internet regularly, spend about three hours a day on social media (TÜİK, 2021).

- The majority of secondary school students begin to use social media in the third and fourth grades of primary school, the ages of whom are 8 or 9 (Altayef & Karacı, 2019). Their most preferred social media platform is YouTube (Tutgun Ünal, 2020).

- Secondary school students, who spend almost all their time on the internet for YouTube, take YouTubers as role models (Ergen, 2018: 132-144).

- It is widely recognized that a majority of primary school children, aged 9 to 13, have been avid viewers of YouTube from a very young age, resulting in a profound and intimate bond with YouTubers, who hold a significant role in the lives of these children (Özuz, 2018).

- Children are at the forefront of YouTube's most loyal users, and there is YouTube content on numerous topics that interest children (Atalay, 2019: 184).

As in different subject areas, the number of channels established for teaching purposes and appealing to users from all levels is increasing on the YouTube platform (Ceylan, 2023:2). On the platform, there are many educational channels with high number of subscribers, such as "Rüştü Hoca ile Türkçe", "Hocalara Geldik", "Tunç Kurt Matematik", "Tonguç Akademi", "LGS & Lise Hocam". However, the majority of these channels predominantly cater to subjects pertaining to school exams or directly align with the school curriculum. Consequently, it is widely believed that these channels are primarily sought after for exam preparation purposes. Nevertheless, there has been notable scholarly interest in YouTube channels that can captivate viewers for educational intent beyond explicit exam preparation. Hence, this study is motivated by the following inquiry: "What distinguishing characteristics can a YouTube channel possess to attract a substantial audience without specifically focusing on facilitating exam preparation?" To address this question, the researchers opted to scrutinize the content and design elements of a YouTube channel exhibiting the aforementioned characteristics.

Presently, the notion of content has evolved beyond plain text and is now perceived as a multifaceted phenomenon. For instance, Khan Academy, a renowned YouTube channel recognized as the world's largest free online learning platform, boasts 7.2 million subscribers (as of 20.03.2023). Similarly, the Türkiye-based Tonguç Akademi YouTube channel has amassed 3.71 million subscribers (as of 20.03.2023). These figures indicate a preference for video-based content among a significant audience. Consequently, there arises a need to examine the educational content presented in these videos. However, there is a lack of sufficient criteria to evaluate the quality of such educational content

on YouTube (Shoufan, 2019). The absence of clear evaluation criteria further contributes to the uncertainty surrounding the quality of content available on the platform. This situation renders preteen users, who are still developing their ability to discern right from wrong, particularly vulnerable. Moreover, YouTube has been observed to have significant effects on children (Özuz, 2018). Considering the foresight that YouTube will increasingly become a substantial part of children's lives in the near future (İlhan & Aydoğdu, 2019), it becomes evident that this domain warrants serious attention. In summary, the escalating preference for YouTube as a learning environment, the uncertainty surrounding content quality, and the significant impact on children, who represent a key target audience, have prompted researchers to investigate YouTube as a learning platform (Erdoğan, 2020). Despite the uncertainty surrounding evaluation criteria for YouTube content in terms of educational value, YouTube remains an effective medium for enhancing learning experiences (Taşdelen, 2019), facilitating effective concept attainment in children (Gülmez, 2019), supporting foreign language education (Küçükyılmaz, 2016), and even serving as a primary teaching resource in higher education (Ata, 2017). All these factors emphasize the profound influence of the widely accessible YouTube platform, which cannot be overlooked. This pervasive platform necessitates examination from various perspectives, including practical environments, user opinions, and producer viewpoints. Numerous studies in the literature have conducted content analyses of YouTube videos (e.g., Aksu, 2020; Ergün Özdel, 2019; İç, 2017; Kaynak, 2020; Ökmen, 2021; Öztürk, 2020; Saurabh & Gautam, 2019; Shoufan, 2019; Salkaya, 2020). However, no study has specifically focused on content analysis of educational videos on YouTube with regard to Mayer's multimedia design principles. Therefore, this research makes a valuable contribution to the literature in this regard.

This study aimed to investigate the design features and program elements employed in the videos of a highly viewed educational YouTube channel. To fulfil the research objective, the study sought answers to the following questions.

RQ1. What are the design features of the educational videos on the "Experimental Science with Basfi" YouTube channel?

RQ2. What are the program elements of the educational videos on the "Experimental Science with Basfi" YouTube channel?

RQ2.1. How is the intro editing of videos?

RQ2.2. How are the learning outcomes presented in the videos?

RQ2.3. What is the video content like? Is it theoretical or applied (i.e., base field)?

RQ2.4. What are the instructional strategies and methods in the videos?

RQ2.5. How is the process of assessment and evaluation undertaken in videos?

RQ2.6. What are the video durations?

RQ2.7. How are the closing edits of the videos?

METHOD

In this section, information was provided about the design of the research, the study group, data collection tools, and the procedures for data collection and analysis.

Research Design

This research, which examined the video contents of an educational channel that stands out on the YouTube platform, was carried out using the descriptive analysis method, one of the qualitative research approaches in terms of the subject and the process followed. Descriptive analysis, in this regard, is a type of qualitative data analysis that includes summarizing and interpreting the data

obtained by various data collection techniques according to predetermined themes (Yıldırım & Şimşek, 2003).

Study Group

The YouTube platform awards the silver reward level to channels that surpass 100,000 subscribers, indicating their popularity. For this research, it was assumed that exceeding 100,000 subscribers serves as a criterion for popularity on YouTube. Therefore, the selected channel for investigation in this study showcased numerous educational videos with a substantial number of views, likes, and comments. This particular channel consistently shared broadcasts and educational content centred around scientific experiments that appealed to children.

To analyse the video contents, a total of 10 videos from the YouTube channel "Experimental Science with Basfi" with the highest number of views, comments, and likes were chosen. The videos for analysis were selected using the criterion sampling method, the selection process of which relied on the rankings of the channel's video contents on the website Socialblade.com (SocialBlade, 2022). The number of likes, comments, and views of the videos guided the selection of suitable videos for the research. From the top 50 most viewed videos of the channel, the first 10 videos that achieved the highest number of views, comments, and likes in the shortest period were chosen for analysis. Table 1 presents the interface information of the analysed videos.

Table 1. *Interface information of the analysed videos*

Video Content Title (Translated)	Upload Date	Duration	Views	Likes	Comments	URL	Video's Monthly Income
Hydrophobic Material (V1)	November 13, 2020, Friday	12 minutes 50 seconds	718,818	26k	1,335	https://www.youtube.com/watch?v=fI1p2ahrIbI	239.67-1963.43 $
I Made a Giant Plastic with Just 2 Materials (V2)	May 17, 2019, Friday	13 minutes 05 seconds	961,570	22k	1,457	https://www.youtube.com/watch?v=w4R9Onsjj Nw	325,66-2572.77 $
The Fastest Foaming Soap Experiment – With the Audio Support of Barış Özcan (V3)	March 21, 2017, Tuesday	06 minutes 50 seconds	845,570	38k	2,551	https://www.youtube.com/watch?v=_Sle2LW8u GM	286.44-2302.33 $
Today's Menu: Green Egg (Try it at home!) (V4)	September 20, 2019, Sunday	12 minutes 48 seconds	694,173	17k	1,493	https://www.youtube.com/watch?v=wdtpjNzGQ 88	234.97-1896.03 $
I Experimented with the World's Hardest Liquid (Try it at Home!) (V5)	September 18, 2020, Friday	12 minutes 40 seconds	587,084	15k	972	https://www.youtube.com/watch?v=upi_8yFTPE c	199.08-1557,46 $
5 Accidentally Discovered Inventions You'd Be Surprised By (V6)	December 25, 2020, Friday	12 minutes 15 seconds	504,027	16k	1,529	https://www.youtube.com/watch?v=vnzEFWdFz Do	170.64-1354.31 $
What Happens If Ink Is Dropped into Cold Water? (Try it at Home!) (V7)	June 12, 2020, Friday	11 minutes 42 seconds	341,664	12k	1,092	https://www.youtube.com/watch?v=FCq38QisqP o	115.79-948.02 $
Why Are Jeans Blue? (V8)	September 28, 2017, Thursday	03 minutes 50 seconds	1,066,696	8,8k	1,361	https://www.youtube.com/watch?v=Drq5yI8Rkc 4	360.92-2911.77 $
Why Are Coins Round? (V9)	December 05, 2017, Tuesday	02 minutes 56 seconds	908,098	6,9k	225	https://www.youtube.com/watch?v=aHlGkp5_i3 I	307.43-2437.76 $
Why Is There a Statue of Nikola Tesla in Front of Niagara Falls? (V10)	October 25, 2017, Wednesday	03 minutes	725,650	4,7k	154	https://www.youtube.com/watch?v=spXzXehEm n4	245.81-1963.75 $

The selection of videos for analysis involved three stages. In the first stage, the top 50 most viewed videos of the channel were identified based on data from SocialBlade. In the second stage, among these highly viewed videos, the ones that received the highest number of comments and likes were selected. Lastly, the most recently published video was chosen from the videos with a similar number of views and a significant number of comments. To further refine the selection process, the number of views for each video was divided by its duration. This calculation allowed for the

identification of videos that achieved the highest number of views, comments, and likes within the shortest timeframe. It was assumed that a high number of comments and likes indicated a high level of interaction with the videos. Therefore, the video selection process involved considering both the overall popularity of the videos (views) and the level of engagement (comments and likes) to ensure a comprehensive analysis.

Data Collection and Analysis

The thematic analysis matrix developed by the researcher was used for the content analysis to be conducted in the research. The use of the thematic analysis matrix enabled the data to be processed within a logical framework according to the themes used in descriptive analysis and content analysis. The thematic analysis matrix is provided in Table 2.

Table 2. *Thematic analysis matrix*

Themes	Codes	Descriptions
General Features	YouTube Platform Interface Units	Video content title Upload Date Duration Views Likes Comments URL Video's Monthly Income
Content Features	Design features (Mayer's design principles)	Multimedia Principle The Coherence Principle Signalling Principle Redundancy Principle Spatial Contiguity Principle Temporal Contiguity Principle Segmenting Principle Pretraining Principle Modality Principle Personalization Principle Voice Principle Image Principle Embodiment Principle Generative Activity Principle
	Program elements	Intro Editing Presentation of Learning Outcomes Base Field (Theoretical or Applied) Instructional Strategies and Methods Assessment and Evaluation Video Durations Closing Edits

The general properties section of the matrix was constructed based on the analysis conducted by Çomu and Halaiqa (2014). It encompasses the interface elements of video content on the YouTube platform. The content features section of the matrix comprises two categories: design features and program elements. The design features category incorporates Mayer's (2021) multimedia design principles. The program elements category was developed using the "Educational Features" section of the Electronic Educational Contents Guide, created by the Board of Education and Discipline to provide guidance to content developers. Additionally, the items of Intro Editing, Video Durations, and Closing Edits were added to this category after analysing the videos of the channel and identifying common characteristics.

For data analysis, a combination of descriptive analysis and content analysis methods was employed. Qualitative research allows for flexibility, enabling researchers to develop new methods and approaches as needed throughout the research process and make adjustments to the setup (Creswell & Plano-Clark, 2007; Karataş, 2015: 66). In this context, Table 3 presents the data collection tools and analysis techniques utilized to address the research questions.

Table 3. *Pairing of the research questions with data collection tools and analysis techniques*

Research Question	Data Collection Tool	Data Analysis
What are the design features of the educational videos on the "Experimental Science with Basfi" YouTube channel?	Thematic Analysis Matrix	Descriptive Analysis
What are the program elements of the educational videos on the "Experimental Science with Basfi" YouTube channel?	Thematic Analysis Matrix	Content Analysis

In the study, the videos selected from the contents of the "Experimental Science with Basfi" channel were analysed. In the first research question, the study aimed to determine the design features of videos according to Mayer's principles. The second research question aimed to determine the program elements of the videos.

FINDINGS

In this section, the findings obtained from the content analysis of the videos of the YouTube channel "Experimental Science with Basfi" are presented. The findings of the research were examined under two headings: "Design features of the educational videos on the YouTube channel" and "Program Elements of the Educational Videos on the YouTube Channel".

Design Features of the Educational Videos on the YouTube Channel

In the study, an initial analysis was conducted on a total of 10 YouTube videos, examining their compatibility with multimedia design principles. Table 4 presents the evaluation of each video based on the four-point scale: compatible, partially compatible, incompatible, and not evaluated. The table indicates which design principles each video aligns with or, in cases where evaluation was not possible, the videos were marked as not evaluated.

Table 4. *The compatibility of the videos with the multimedia design principles*

Principles	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
Multimedia	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible
Coherence	Partially	Partially	Partially	Partially	Partially	Partially	Partially	Compatible	Compatible	Compatible
Temporality	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible
Spatiality	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible
Redundancy	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Partially	Compatible
Signalling	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible
Pretraining	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible
Modality	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible
Segmenting	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible
Personalization	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible
Image	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible
Voice	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible
Embodiment	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Not evaluated	Not evaluated	Not evaluated
Generative Activity	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible

Legend: Compatible (green), Partially compatible (yellow), Incompatible (red), Not evaluated (grey)

The analysis revealed that the videos demonstrated successful compliance with several

multimedia design principles, including multimedia, signalling, redundancy, spatial and temporal proximities, pretraining, personalization, voice, modality, image, and embodiment. However, partial compliance was observed regarding the principle of consistency, and non-compliance was noted for the principles of segmentation and generative activity. It is important to note that the embodiment principle could not be evaluated since the animated videos lacked a physical narrator.

The analysis indicates that the analysed videos align with the multimedia principle. These videos effectively incorporate visual elements, such as animations and pictures, to enhance the content, while also utilizing sound elements in an impactful manner. Additionally, the principle of spatial proximity is observed as the videos present text and images in close proximity to each other, ensuring that relevant information is visually connected. Furthermore, the simultaneous presentation of text and visuals during narration and animation demonstrates adherence to the principle of temporal proximity.

In the animation sections of the videos, the integration of visuals and audio narration is observed, while written narratives are not presented. This approach ensures compliance with the principle of redundancy, as information is conveyed through both visual and auditory channels simultaneously. The videos also follow the pretraining principle, as they initially focus on introducing the main subject and its key features rather than directly presenting information or conducting experiments. Additionally, the character Basfi captures the audience's attention by showcasing the experimental materials using his hand, while important points are emphasized through visual effects in the animation or visuals. This demonstrates the utilization of the signalling principle to draw attention to significant aspects of the content.

The videos feature oral narration delivered by the main character, Basfi, and do not incorporate written expressions. This adherence to oral narration without written presentation indicates compliance with the modality principle. Additionally, Basfi plays an active role in the videos by conducting experiments, maintaining eye contact with the audience during narration, engaging in humorous interactions with the shooting crew, and utilizing gestures and facial expressions that convey emotional states such as surprise, curiosity, and amusement. However, it should be noted that the embodiment principle could not be evaluated in the analysis of videos consisting solely of animation, as there was no visually active narrator or instructor. Nevertheless, it was observed that the principle of embodiment was employed in the experimental videos.

Basfi communicates with the audience using colloquial language instead of academic terminology. He addresses the audience as "friends" and uses singular pronouns like "me" and "you" during his interactions with the shooting crew. This approach demonstrates the utilization of the personalization principle, aiming to establish a more relatable and friendly connection with the viewers. Furthermore, Basfi narrates the entire video using his own voice, and real human voice is employed throughout, indicating compliance with the voice principle. In the animation or visual sections, only Basfi's voice is utilized, and there is no inclusion of the narrator's image as a picture or video. Therefore, it can be concluded that the videos adhere to the image principle.

Based on the analysis of the videos, it is observed that the animated videos comply with the principle of coherence, while the experimental videos only partially adhere to it. The animated sections effectively present the experiment by including only the necessary materials in the environment and incorporating relevant texts and images that explain the concepts. The background music also harmonizes with the flow of events, contributing to the coherence of the content. However, in the experimental videos, the presence of decorative elements and visuals in the background decor, which are unrelated to the subject, hinders full compliance with the principle of coherence. Furthermore, while Basfi suggests conducting experiments suitable for home settings probably due to safety concerns, the inclusion of a test question with two options in the experimental videos contradicts the principle of generative activity in that although the audience is encouraged to write their answers in the comments

section, they are not directed towards engaging and productive educational activities. Lastly, the videos maintain an uninterrupted narrative and image format throughout without employing strict segmentation through titles or images, so there is no compliance with the segmenting principle, as the content lacks clear divisions or sections.

Program Elements of the Educational Videos on the YouTube Channel

The study also involved analysing the program elements present in the 10 YouTube videos from Basfi's channel. The analysis yielded the identification of specific program elements, which are presented in Figure 1 as the outcome of the analysis.
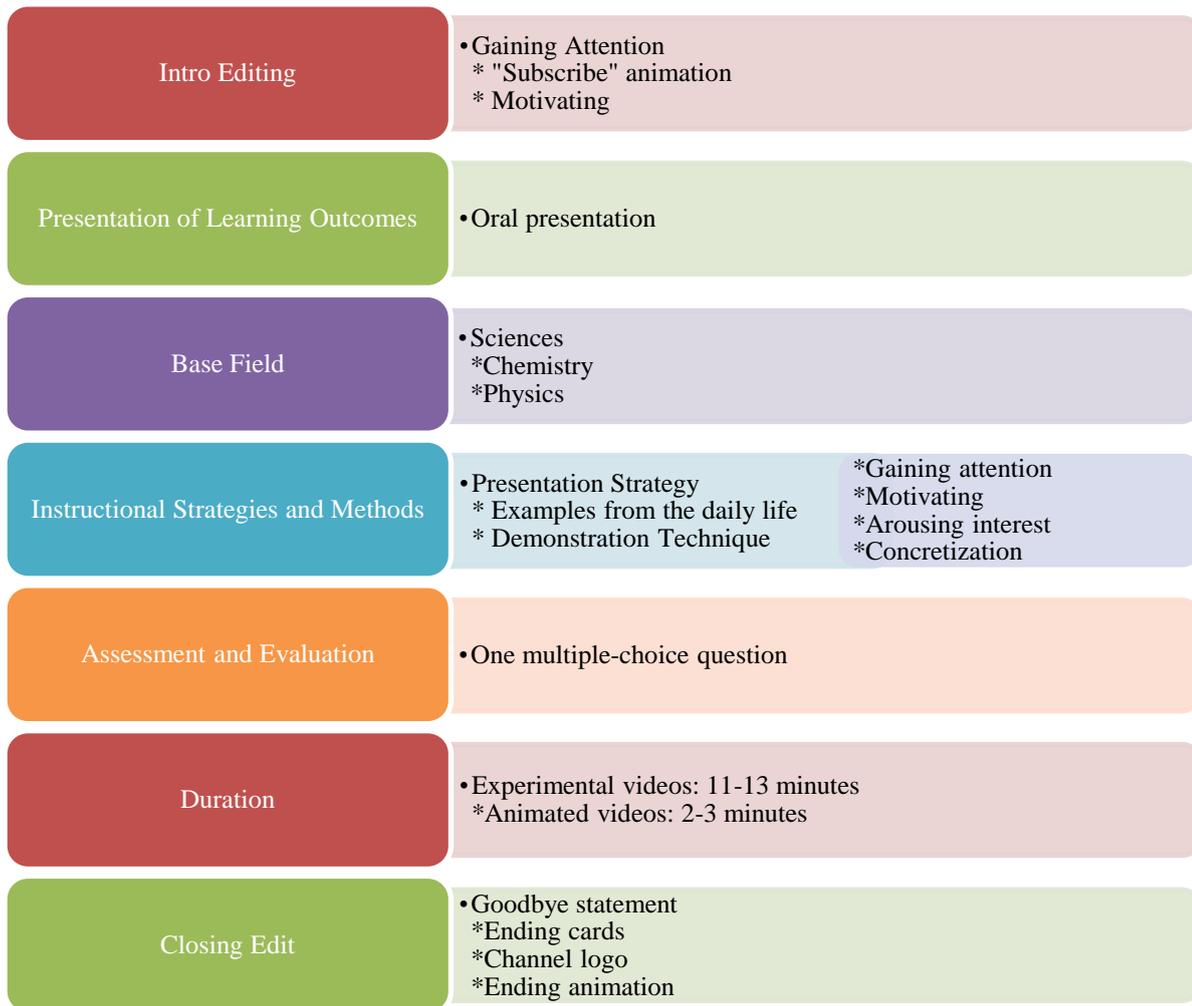

Intro Editing	• Gaining Attention
	  * "Subscribe" animation
	  * Motivating

Presentation of Learning Outcomes	• Oral presentation

Base Field	• Sciences
	  *Chemistry
	  *Physics

Instructional Strategies and Methods	• Presentation Strategy
	  * Examples from the daily life
	  * Demonstration Technique
		*Gaining attention
		*Motivating
		*Arousing interest
		*Concretization

Assessment and Evaluation	• One multiple-choice question
Duration	• Experimental videos: 11-13 minutes *Animated videos: 2-3 minutes

Closing Edit	• Goodbye statement
	  *Ending cards
	  *Channel logo
	  *Ending animation

Figure 1. *Program elements contained in the YouTube videos*

As seen in Figure 1, introductory arrangements, outcome presentations, base field contents, instructional strategies and methods, assessment and evaluation, duration, and video completion elements were determined in YouTube videos. The findings regarding which program elements each YouTube video has are exhibited in Table 5.

Table 5. *The presence of program elements in the YouTube videos*

Program Elements	Videos									
	V1	**V2**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**V9**	**V10**
Attention	+	+	+	+	+	+	+	+	+	+

grabbing										
Oral presentation	+	+	+	+	+	+	+	-	-	-
Sciences field	Phys	Chem	Chem	Chem	Phys	Chem	Chem	Chem	Phys	Phys
Presentation strategy	DT	DT	DT	DT	DT	DT	DT	LT	LT	LT
Assessment and evaluation	MCQ	MCQ	MCQ	MCQ	MCQ	MCQ	MCQ	-	-	-
Video type and duration	Exp. 12 mins	Exp. 13 mins	Exp. 6 mins	Exp. 12 mins	Exp. 12 mins	Exp. 12 mins	Exp. 11 mins	Anim. 3 mins	Anim. 3 mins	Anim. 3 mins
Goodbye statement	+	+	+	+	+	+	+	-	-	-

Note. Phys = Physics. Chem = Chemistry. DT = Demonstration Technique. LT = Lecturing Technique. MCQ = Multiple-choice Question. Exp = Experimental. Anim = Animated. "+" = Present. "-" = Absent.

Table 5 provides an overview of the program elements identified in the YouTube videos. It indicates that there is an oral presentation of outcomes in the videos, typically presented after the experimental phase, within the theoretical section accompanied by real-life examples. The base field of the videos revolves around science, with a focus on experiments in the fields of chemistry and physics, although there appears to be a greater emphasis on the former. The videos encompass both theoretical explanations and practical demonstrations. Theoretical presentations discuss the properties of substances or events under investigation, their corresponding chemical or physical states, and the practical applications of this conceptual knowledge in daily life. The instructional methods employed in the videos include lecturing and demonstration techniques, utilizing an expository teaching strategy. During the lectures, elements such as attention-grabbing, curiosity stimulation, motivation, real-life examples, and concretization are incorporated. Animations and visuals are also employed throughout the presentations. In terms of assessment and evaluation, towards the end of the videos, a single multiple-choice question with two options is posed, and viewers are encouraged to write their answers in the comments section.

The intro edits of the videos do not have a special introductory animation or image. From the analysed videos, introductory animation is used in older videos, while the content is started instantly without animation in subsequent videos. The videos begin directly with Basfi's remarkable introduction. The character starts the video lively and energetically, making statements and using materials that arouse interest in the subject, employing a humorous language, and joking with the filming crew. Depending on the situation, suitable background music is occasionally used. Throughout the videos, the channel-specific "subscribe" logo stands out in the lower right corner. Then, usually a minute or two after the start of the video, there is a small animation showing the subscribe button in the lower left corner. Finally, when the content is considered in terms of average duration, experimental videos take between 11 and 13 minutes, while animated videos last between 2 and 3 minutes.

DISCUSSION AND CONCLUSION

The aim of this research was to analyse the design features and program elements utilized in the videos of an educational YouTube channel that is popular on the platform. The findings from the analysis of the videos revealed that they generally align with Mayer's multimedia design principles. The videos demonstrate compatibility with principles such as multimedia, signalling, redundancy, spatial proximity, temporal proximity, pretraining, personalization, voice, modality, image, and embodiment. However, they do not adhere to the segmentation and generative activity principles. In terms of coherence, the videos show partial compliance. This study provides insights into the extent to which educational content on the YouTube platform adheres to multimedia design principles. Similar research exists, including this study, that examines the level of compliance with multimedia design principles in educational content across different digital platforms (Bulduk, 2015; İşbulan et al. 2020; Kaleli 2022; Özerbaş et al., 2021; Taş Alicenap & San, 2019; Ülker 2021). Furthermore, Mayer, the creator of the

multimedia principles, continues to research and develop design principles for effective educational videos (Mayer, 2021). Therefore, there is an ongoing interest in exploring the applicability of multimedia design principles to educational videos across various digital platforms. By analysing a prominent educational channel's videos on YouTube, which has a large audience, this study aimed to determine the compatibility of these videos with multimedia design principles. The findings of this research can serve as a guide for other educational video content creators who intend to publish their content on digital platforms.

Numerous studies have highlighted the positive impact of instructional activities based on multimedia design principles on students' academic success and learning (Akyol & Çiftçi, 2020; Coşğun & Seller, 2017; Eitel et al., 2013; Issa et al., 2011; Özerbaş & Yalçınkaya, 2018; Rey & Steib, 2013; Taş Alicenap & San, 2019; Yünkül, 2019). Therefore, it is recommended to develop educational materials in digital learning environments while considering the principles of multimedia design (Taş Alicenap & San, 2019; Yünkül, 2019). Experts are encouraged to evaluate these learning environments based on multimedia design principles, and application developers are advised to incorporate these principles into their educational content production processes (Özerbaş et al., 2021). In accordance with these statements, although the importance of multimedia design principles in designing educational materials for digital media is widely acknowledged, the exact impact of these principles on the production, evaluation, and effectiveness of educational videos is not fully understood. In light of the current research conducted to address this research gap, it has been observed that the design features of the videos from a prominent educational channel on YouTube are mostly compatible with multimedia design principles.

In the YouTube videos of the analysed channel, the outcome presentation is delivered orally, typically following a theoretical section that includes examples from daily life after the experimental phase. Presenting the learning outcomes of a course, as determined by the program evaluation of educational software such as Vitamin, positively impacts students' understanding of their purpose and their engagement in the course (Yıldız & Sarıtepeci, 2013: 524). The primary field explored in the YouTube videos of this research is science, specifically focusing on experiments in the fields of chemistry and physics. It is evident that there are more videos related to the field of chemistry, aligning with the channel's objective of fostering a love for chemistry among children. Additionally, physics experiments are included in relation to the field of chemistry. This situation reflects the idea that objectives and achievements can be interconnected across multiple learning areas, facilitating transferability (Ateş et al., 2015: 112). Both theoretical and practical explanations are included in the videos, in which content at the level of knowledge and comprehension and the place thereof in daily life are presented in the theoretical part, whereas practical demonstrations showcase the execution of experiments.

The teaching techniques employed in the analysed videos involved lecturing and demonstrating, with the content delivered through expository teaching. During the lecturing segments, various elements were utilized to engage the audience, such as attracting attention, arousing curiosity, motivating the viewers, providing examples from daily life, and offering concrete explanations. The presentations also incorporated animations and visuals to enhance the learning experience. It is worth noting that including real-life activities in educational videos, rather than relying solely on animations, has been found to increase student motivation. As a result, the expectation is for the videos to cover both the knowledge and experiences that students will require in real-life situations (Şentürk & Kurşun, 2021: 176).

Including authentic examples in educational materials promotes long-term learning and the transfer of knowledge to new problem situations (Yıldız & Sarıtepeci, 2013: 503). Similarly, the fact that the videos are visually rich allows pupils to like and be driven by them (Bakırcı & Kılıç, 2021: 697). However, the incorporation of pictures in learning materials is also useful in boosting learning

persistence (Kana & Saygılı, 2016: 21). It can be noted that the program elements chosen to be employed in the YouTube videos analysed within the scope of the research are consistent with the literature.

A single multiple-choice question is asked near the end of the videos to address assessment and evaluation, and the audience is requested to post the answer in the comments section. While a limited assessment of learning is made in this context, requesting the audience to write their answers in the comments section ensures interaction and audience participation. According to some studies that examine the video content for various EBA courses in the literature, there is no assessment and evaluation stage in Turkish course videos, and the efficiency of including the teaching stages in the videos for this situation can be increased (Ateş et al., 2015: 114). Furthermore, an examination of the science video lectures in EBA reveals that science instruction is shallow, and no feedback is provided for solving the questions asked in the courses (Bakırcı & Kılıç, 2021: 697).

The video intro edits do not include any special beginning animation or images. According to the videos that were analysed, the material starts out immediately without animation in later videos, whereas older videos use animation for the opening. The videos begin immediately with Basfi's outstanding introduction, who begins the video in a vibrant and energetic manner, makes remarks and uses materials that will raise the viewer's interest in the issue, employs witty language, and shares jokes with the shooting crew. Depending on the occasion, appropriate background music is also played. The channel-specific "subscribe" logo appears in the lower right corner throughout the videos. Then, generally a minute or two after the movie begins, a small animation displays with the subscribe button in the lower left corner. When looked at a study on university lecture videos on the YouTube platform, introductory credits, end credits, and movie credits are observed to be effectively used (Ata, 2017: 437), indicating a partial congruence of the present study with the literature in that the videos analysed in this research have a closing animation, but most lack introductory credits.

The videos last from 11 to 13 minutes if they are experimental and from 2 to 3 minutes if animated. According to a study on Turkish lesson videos in EBA, it is known that 83% of the lesson videos are under 11 minutes, which is stated to be an insufficient duration considering the intended learning outcomes and course procedures (Ateş et al., 2015: 110). Similarly, it was reported that there was a disunity in the lessons due to the shortness of the sciences videos in EBA (Bakırcı & Kılıç, 2021: 697). Contrary to these statements, when teachers were asked about their video preferences, it was revealed that videos longer than 5 minutes were not watched enough by students (Şentürk & Kurşun, 2021: 180). Similarly, in some studies on the process of developing educational videos, it is emphasized that the videos should be as short as possible due to the negative impact of long video duration on the learners in that they get lost in the subject (Ozan, 2015: 70) and be distracted (Aydemir, 2018; Thiele et al., 2017). It is observed that the duration of the lecture videos uploaded by universities to the YouTube platform varies between 02:00-05:00 and 05:01-10:00 (Ata, 2017: 310). Also, in enriching the e-books developed for tablet computers with audio visual materials, videos between 2 and 12 minutes are more accepted by the general audience, who stated that they cannot concentrate on the lesson in shorter videos and break away from the lesson in longer videos (Yıldırım, 2014: 225). At this point, the finding that the average video duration of this research is 3 minutes for animation videos and 12 minutes for experimental videos is in line with the literature.

This study aimed to determine the design features and program elements adopted in the videos of an educational YouTube channel that has reached a high number of views. The design elements of the videos of a prominent educational channel on the YouTube platform were determined according to the multimedia principles and program elements. Determining the design elements and program elements adopted in educational videos, which can be used as an effective learning material in learning environments, holds significance for overall instructional processes. In this study, it is recommended to

consider multimedia design principles and program elements in the production process of YouTube educational video contents. In addition, elements such as an attention-grabbing introduction, maintaining interaction with the audience, presence of a channel logo, and a striking ending animation that can adapt to the nature of the YouTube platform should also be included. It can be suggested that the use of these elements contributes positively to the interaction of the viewers with the video and to keeping the viewers in the video. In this respect, the research is important for content producers. In this context, the research has a characteristic that will guide future research for educational video designs on digital platforms.

IMPLICATIONS

In the process of producing educational videos for the YouTube platform, multimedia design principles should be considered, and program elements should be included. In addition, the educational videos to be prepared should be compatible with the nature of the YouTube platform. In this context, the recommendations for educational video design are listed below, taking into account the multimedia principles, program elements, and the nature of sharing on the YouTube platform.

- The video should start directly with the attention-grabbing introduction. At the end of the video, a closing statement, a short channel-specific ending animation, ending cards, and the channel logo can be used.

- Narration in videos can be supported by visuals, animation, text, and sound elements related to the subject. In addition, important places should be highlighted with audiovisual effects.

- When deemed necessary, smooth and non-verbal background music can be used in light tones that do not interfere with the video subject content.

- The outcome presentation should be included in the videos. Theoretical and practical explanations should also be given. Preliminary information about the subject should be provided in the videos, which are to be supported with examples from daily life and the elements of concretization and motivation.

- In order to ensure interaction, questions can be asked to the audience in the video to be answered in the comments section.

- Supporting the findings of the literature, the duration of the videos can be between 11 and 13 minutes on average, while the videos consisting only of animation can be between 2 and 4 minutes on average.

- By examining more educational content channels on YouTube, scale development studies can be carried out to examine educational videos.

- On the YouTube platform, the impact of channels that produce educational content for exam preparation on academic success and motivation variables can be investigated in terms of their effectiveness.

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