applied sciences

MDPI

Article

Framework for Preparation of Engaging Online Educational Materials—A Cognitive Approach

Žolt Namestovski [1] and Attila Kovari [2,3,4,*]

[1] Hungarian Language Teacher Training Faculty, University of Novi Sad, 24000 Subotica, Serbia; zsolt.namesztovszki@magister.uns.ac.rs
[2] Department of Natural Sciences, Institute of Engineering, University of Dunaújváros, 2400 Dunaujvaros, Hungary
[3] The Institute of Engineering, Alba Regia Technical Faculty, Óbuda University, 8000 Szekesfehervar, Hungary
[4] Department of Computer Science, GAMF Faculty of Engineering and Computer Science, John von Neumann University, 6000 Kecskemet, Hungary
* Correspondence: kovari@uniduna.hu

Abstract: This study examines the process of creating successful, engaging, interactive, and activity-based online educational materials, while taking the cognitive aspects of learners into account. The quality of online educational materials has become increasingly important in the recent period, and it is crucial that content is created that allows our students to learn effectively and enjoyably. In this paper, we present the milestones of curriculum creation and the resulting model, the criteria of selecting online learning environments, technical requirements, and the content of educational videos, interactive contents, and other methodological solutions. In addition, we also introduce some principles of instructional design, as well as a self-developed model that can be used to create effective online learning materials and online courses. There was a need for a self-developed, milestone-based, practice-oriented model because the models examined so far were too general and inadequate to meet the needs of a decentralized developer team, who work on different schedules, with significant geographical distances between them and do not place enough emphasis on taking cognitive factors into account. In these processes, special attention should be paid to having a clear and user-friendly interface, support for individual learning styles, effective multimedia, ongoing assistance and tracking of students' progress, as well as interactivity and responsive appearance.

Keywords: online educational material; cognitive aspects; instructional design; methodology; model

Citation: Namestovski, Ž.; Kovari, A. Framework for Preparation of Engaging Online Educational Materials—A Cognitive Approach. *Appl. Sci.* **2022**, *12*, 1745. https://doi.org/10.3390/app12031745

Academic Editor: Jing Jin

Received: 30 December 2021
Accepted: 1 February 2022
Published: 8 February 2022

1. Introduction

Teachers have a big impact on students' learning outcomes, so more support for teachers' work will also lead to better student outcomes [1]. A lot of education research shows that the best learning experiences are those that make direct connections to students' existing knowledge and their life experiences [2]. In many cases, there is a lack of tools that help teachers apply curricula and teaching methods that consider students' individual learning abilities, and thus set curriculum goals that also effectively support individual learning opportunities [3]. Although many teacher tools are available through social networking sites and reusable lesson plans or activities, etc., effective assimilation of these materials still requires a reasonable degree of customization. It is often a daunting task for teachers to customize learning materials, since it takes more time to reuse existing resources than to implement self-developed materials [4,5]. Laboratory experiments play a very important role in the teaching of technical knowledge, as they establish a link between, and provide experience in, how theory and practice relate to each other. The possibilities provided by IT tools can even be used to perform studies similar to laboratory experiments in the framework of online education, and one of the best ways to do this is to take advantage of the possibilities provided by simulation environments [6]. The proportion

of theoretical and practical knowledge in training varies from field to field, but practical and design-oriented education plays a role in developing analytical thinking skills [7]. Today, a number of up-to-date tools and methodologies are available to help students develop practical skills, such as taking advantage of active learning opportunities [8], the practical and team-oriented nature of project-based learning [9], the use of inverted classrooms [10], etc., which help in improving the effectiveness of the teaching–learning process [11]. Recently, online education has continued to spread rapidly, partly due to the mandatory introduction of online education in many countries as a result of the COVID-19 pandemic. With the growing popularity of online education, there is a great need for a pedagogically effective design model for online learning materials that facilitates the development and implementation of online learning environments [12]. Educational planning (ID), also known as educational systematic planning (ISD), is an exercise in creating educational experiences that should also be reflected in the developed online curriculum. A well-compiled online resource and the associated, appropriately selected teaching methodologies will make the acquisition of knowledge and skills more efficient, effective, and attractive [13].

Several models and methodologies can be adapted to designing online courses. One widely used model, the ADDIE model, offers five universal course design principles: analysis, design, development, implementation, and evaluation (ADDIE). Similar to any model, or design methodology, ADDIE has its advantages and disadvantages. The benefits of ADDIE are primarily that it provides structured guidance for planning and serves as a useful checklist for implementing the design process and course implementation, as well as placing a strong emphasis on the implementation process and evaluation. However, despite the advantages of ADDIE, there are some disadvantages as well. These include the fact that the analysis steps are not comprehensive enough in the design process and the model does not provide enough incentive for inspiration [14]. Huang's paper [15] summarizes guidelines for educational multimedia design from the Stanford University Virtual Labs Project and demonstrates the design of learning content that aims to develop interactive multimedia learning tools. In design, the emphasis depends on the visualization of learners on dynamic content and the control of what is learned. The paper points out that current methods for designing multimedia learning modules are not standardized and lack strong educational design [15]. Cognitive factors have been considered only to a limited extent during design and implementation.

Based on the above, we considered the development of a design methodology that takes cognitive skills into account during the design process and provides an opportunity to create inspiration in material development, while the steps of the implementation process can be broken down into elements that are easy to understand and implement. In order to develop successful online educational materials, the cognitive aspects of students need to be considered [16], for which the following theories and models are considered: Baddeley's model of working memory, cognitive load theory, Paivio's dual coding theory, individual learning styles, and situated learning. Baddeley's working memory model and Paivio's dual coding theory suggest that the information process of individuals is embedded in a dual channel: an auditory channel on the one hand, and a visual channel on the other [17].

2. Cognitive Theory in the Background

In order to produce effective online educational materials, it is necessary to know the factors influencing human cognitive abilities, such as working memory, cognitive load, dual coding theory, or individual learning styles, which are briefly summarized below.

2.1. Baddeley's Model of Working Memory

Working memory is a concept that emerged from the classical model of short-term memory [18], which was understood more as a set for the temporary storage of information before it was forwarded to long-term memory [19]. A more suitable model of short-term memory was finally projected, which was named working memory. The working memory

model was a sub-mechanism schema that not only contained transient information but also handled it in a way that many fragments of verbal or visual information could be stored and combined. Under this model, Baddeley [20] proposed that there is an element in working memory that controls subcomponents or slave systems. This central unit, the central executive element, was responsible for overseeing the entire system, contributing to problem-solving tasks, and directing attention. Baddeley speculated that the central executive could delegate storage tasks to the two slave schemas in working memory, leaving the central executive with the capacity to execute heavier data processing commands. The two slaves are called the visuo-spatial sketch pad system and the phonological loop system. The first is supposed to preserve and deploy visual images, while the second stores and reviews verbal information and has a similarly significant developmental function in the sense that it simplifies language acquisition by retaining a new word in working memory until it can be learned [21].

Later, Baddeley [22] added that the introduction of a third subsystem into the model might be necessary, which became known as the episodic buffer. This emerged from a task previously classified as the central executive, acting firmly as a storage element that acts as a system with limited capacity to mix information sources from other slaves. Cognitive load theory helps in understanding the limitations of working memory and points out that there is a limit to the amount of information that can be managed simultaneously, which provides significant ideas for suggestions when creating multimedia educational materials [23].

2.2. Cognitive Load Theory (CLT)

Cognitive load theory [24] points out that working memory is limited in its capacity to selectively handle and process incoming sensory information. CLT is an important theory for understanding how learners focus and use their cognitive resources in learning and problem solving. This suggests that for education and learning to be successful, care must be taken to ensure that students' information processing skills are not overburdened. In the case of multimedia-supported education and learning, attention should be paid to the fact that students only have a limited amount of information processing capacity. As a result, great care must be taken in compiling educational materials when developing multimedia educational materials that provide relevant knowledge in relation to the knowledge to be acquired, given their limited information processing capacity [17].

Due to the above, it is important to know how the cognitive load caused by certain external stimuli and information can affect the information processing of students and the storage of relevant information in the long-term memory. If the cognitive load reaches too high, it prevents actual and productive learning, thus hindering the transfer of information itself. Inadequate educational environments, systems, and methodologies, such as gamification [25,26] or project-based learning [27], can significantly affect the effectiveness of learning. In teaching–learning, each learning process should be designed to minimize any cognitive processing that is irrelevant to learning and optimize the cognitive processing associated with the acquisition of information, and the construction of knowledge, taking into account the cognitive limits [28].

In terms of how the previously mentioned important factors should be taken into account in the planning of multimedia education materials, the material parts and layout that convey the relevant information need to be visually appealing [29] and intuitive in order to point out the essence [30]. However, student activities should continue to focus on the knowledge to be acquired, the purpose of the entertainment should be limited, primarily to maintain attention and interest, and this should in no way be burdensome for the student. In a poorly designed multimedia material, parts or activities that are primarily for fun can overload the working memory before the learner reaches the part of the material they want to learn, which can impair efficiency [17].

2.3. Dual Coding Theory (DCT)

According to the DCT theory, cognition involves two distinct subsystems. On the one hand, it is a verbal subsystem that deals directly with language, while on the other, it is a nonverbal subsystem designed to handle nonlinguistic objects and events. It is assumed that these systems consist of internal units of representation that are interconnected, thus realizing the transmission of nonverbal and verbal behavior independently or in collaboration with each other.

In some tasks, the verbal system is active (simple examples are crossword puzzles), while in others, the nonverbal picture system is in the foreground (e.g., puzzles). Cognition is the result of the interaction of these two systems, which also influences the way and manner in which the information is processed and exchanged [31]. In the case of multimedia content, both subsystems are relevant for improving development of content-specific parts of online curse materials.

2.4. Individual Learning Styles

James and Blank [32] defined learning style as the "complex manner in which, and conditions under which, learners most efficiently and most effectively perceive, process, store, and recall what they are attempting to learn". The learning style has three dimensions: the perceptual (physiological or sensory) mode, the cognitive (mental or information processing) mode, and the affective (emotional or personality traits) mode [33]. Considering learning styles in the design of teaching and learning materials will undoubtedly improve the effectiveness of learning different educational materials [34]. However, some basic aspects of adult education should not be forgotten either, as learning styles in adulthood follow different characteristics to those at a young age. Knowledge of the specificities of new technologies and individual learning styles will undoubtedly improve the effectiveness of learning, and these should be considered when compiling online e-learning materials [35]. The results of the study [36] suggest that simulation environments can be a good complement to teaching tools and an effective way to acquire state-of-the-art and sophisticated practical knowledge, which is a key requirement for engineers in the future [37].

Santo categorized "learning style" into three layers, thus providing some coherence to the wide range of models. The inner layer is about personality: "An underlying relatively stable dimension that controls learning behavior" [38]. The middle layer is about cognitive style and focuses on how learners process information, while the outer layer is about the environment in which students prefer to learn, including the nature of interaction with the instructor or other students [39].

3. Materials and Methods

This study examines the process of creating successful, engaging, interactive and activity-based online educational materials, while taking the cognitive aspects of learners into account. The study provides a multidimensional guide for the main concepts of the theoretical framework defined by the following key factors:

- Key principles of creating successful online educational materials.
- Team work.
- Aspects of e-learning, design, and creation.
- Platform.
- Multimedia.
- Methodological aspects.

The presented framework is primarily derived from the authors' own experiences with curriculum development, which have evolved through the participation in, and management of, a large number of projects implemented within the framework of the e-Region (www.e-regija.rs, accessed on 29 December 2021) online curriculum development organization. The guidelines and suggestions presented in this paper are based

on the projects' implementation and feedback, as well as the whole process of online curriculum development.

4. Theoretical Framework for Creating Effective Online Educational Materials

The authors try, with tips, tricks, and practical concrete advice, to help colleagues working in public and higher education to create the most effective online curriculum possible. The next sections follow the steps defined in the methods section.

4.1. Key Principles of Creating Successful Online Educational Materials

One of the most important key aspects is the planning of students' online activities: continuous interactivity and sending feedback. One of the most effective ways to process the curriculum is to display it using multimedia, which is when we act on multiple senses in the form of images, video, text, and sound at the same time. The assessment can take the form of an online test (using different types of questions), but situated learning can also be used, where students need to make decisions in a given life situation, using the knowledge they have acquired [40].

4.2. Instructional Design Principles Depend on Cognitive Theories and Models

The cognitive theories listed above were developed by following the instructional design principles below:

- Clean and intuitive online learning environment, eye-catching, but without any unnecessary graphic or content elements (based on the principles of working memory and cognitive load theory).
- Presentation of the curriculum with subtitled multimedia, most often with a lecturer and in a virtual studio (based on the principles of supporting individual learning styles).
- Supporting individual learning styles (a variety of content is available to students: multimedia, e-book, summary videos).
- Continuous technical and content assistance.
- Monitoring and control of the learning processes (time spent in the system, login history).
- Interactivity and feedback (varied tasks, evaluation and situated learning).
- Responsive and device independence.
- Application of summary videos using infographics (based on the principles of dual coding theory).
- Multichannel communication (based on the principles of supporting individual learning styles).

The cognitive theories and models listed above all influence the production of effective online learning materials, so ignoring them would be to the detriment of efficiency. The cognitive aspects of learners have an influence on the process of creating successful, engaging, interactive, and activity-based online educational materials, which serves as the starting point for the design.

Support for individual learning styles can be implemented in several ways. For our developments, we support forms of learning that are independent of place and time and can be accessed from any smart device. In addition, during development, we pay special attention to the fact that the knowledge required to complete the training is available in at least three forms. These are usually subtitled educational videos, e-books, and summary videos.

If we take the three layers of Santo's learning style as a basis, instructional design should take the middle and outer layers into account. For the middle layer (information processing), different content should be provided, and individual learning pathways should be supported. In the case of the external layer (educational environment), however, the focus should be on the clarity of the platform, the user-friendliness, and the content and methodological elements of the educational materials appearing here.

In the case of synchronous or asynchronous education and adult education, it should be said that asynchronous education is more appropriate for adults, as synchronous educa-

tion reduces access for working adults [39]. This research fully supports our developments, as a significant target group of our online educational material, which is implemented almost exclusively asynchronously, is the adult population.

4.3. Working in Teams

The creation of educational materials, which is effectively realized by an instructional development team, achieves high result rates and creates excellent teaching materials/courses with scientifically validated, unique methodological solutions. It is recommended that the online learning materials be created in a complex team, while proper planning and a precise definition of roles is also important.

If the online education material is created in a complex team, as mentioned above, either in-house or outsourced [41], then proper planning and a precise definition of roles will also be important. The development starts based on the customer's needs and ideas, and the development costs are usually paid by the customer. Project management coordinates both the implementation of the project, as well as the work and communication between teams. The instructional designer team develops and prepares the curriculum, uploads it to the platform, tests and evaluates it, and tracks user activity, as well as leads the process of writing the scenarios. Of course, they conduct their activities in coordination with all the other teams.

This team is successful because we look at a problem as individuals of different ages, perspectives, and statuses (teachers, college students, and PhD students). Within the team, everyone can specialize in a narrower area, such as scenario writing, multimedia editing, task creation, testing, and more. Each member of the team has a significant pedagogical background.

The cameraman and video post-production team are responsible for making the educational videos technically flawless.

This team of experts plays a major role mainly in the preparation phase. The experts are excellently acquainted with the given topic, and with their help, the scenario is prepared. The actor or lecturer uses the script to execute the curriculum, and from these pieces of content, instructional videos are made which serve as the main source of information and knowledge for the courses. The proposed structure of the team is shown in Figure 1.

Figure 1. The proposed structure of the team.

4.4. Aspects of E-Learning

The most common form of education in distance learning is e-learning. E-learning is an open form of exercise available on a computer network, independent of space and time constraints, which, by organizing the teaching–learning process, has effective, optimal knowledge transfer, learning methods, curriculum and student resources, tutor–student communication, and integrates computer-based, interactive, instructional software into a unified framework, making it accessible to the learner.

"E-learning can be viewed as an innovative approach for delivering well-designed, learner-centered, interactive, and facilitated learning environments to anyone, anyplace, anytime by utilizing the attributes and resources of various digital technologies along with other forms of learning materials suited for open, flexible, and distributed learning environments" [42].

According to DeGreeff, Burnett, and Cooley [43] who approach the need for e-learning from a societal perspective, it can be dated back to the overall phenomenon we now describe as a "rushing world". Central to this is the cumulative distribution of attention, the shortening and fragmentation of time spent on one thing, and the sequences of constant conversions into our next activity. Examined from another point of view, from a technical standpoint, all possibilities for the development of e-learning have gradually become more feasible: the continuous spread of computers and other mobile communication devices and their availability, together with the increasing mobility, and the rapid improvement in bandwidth and internet speed. This has greatly facilitated the spread of proprietary tools and collaborative approaches [44]. At the same time, software solutions coupled with these technologies have also made it possible for educators to create educational materials in a user-friendly way, which became accessible to learners through the Internet, without the need for advanced IT (e.g., programming) skills, and with the need for the involvement of special IT professionals not being required at all or only to a very limited extent. We are now in an age of big data and endless information. No matter where we are, we are inevitably faced with the situation of receiving news, either actively or passively [45].

The importance of online educational content has increased significantly in the context of the COVID-19 pandemic that began in 2020, as education could only be provided online in most cases.

"As a result of the COVID-19 pandemic, social conditions around the world have changed radically in a short time. In addition to social conditions, education has also been significantly affected by this global pandemic. A large number of educational institutions have been closed, and the only option for continuing education became (online) distance learning" [46]. Due to the circumstances, the transition to distance learning in this situation happened due to compulsion and not because of pedagogical development or innovation. However, in most cases, these emergency solutions were based on ill-considered strategies [46].

4.5. Design and Creation of Online Educational Materials

In order for e-learning to be used as a learning model, an appropriate training plan must be defined to enable the effective use of e-learning. In this process, it is very important to define the learning goals and to know under which criteria conditions they should be achieved. The criteria serve as a guideline for defining the expected outcomes of education, in which the educational design criteria for e-learning are inseparable from the commonly used development model of education [47].

The process of creating the educational material depends on appropriate instructional design and can be built on different models. The models define the steps of development and the relationship between them. One of the most common and most widely used instructional design models is the ADDIE model, which serves as an acronym for the following: analyze, design, develop, implement, and evaluate. In addition, often used is the Dick and Carey model, while the Nexius model is also noteworthy. The instructional design team of e-Region uses their own model, called the e-Region model, for planning,

design preparation, scheduling, and tracking the course, and they built said model on the milestones shown in Figure 2.

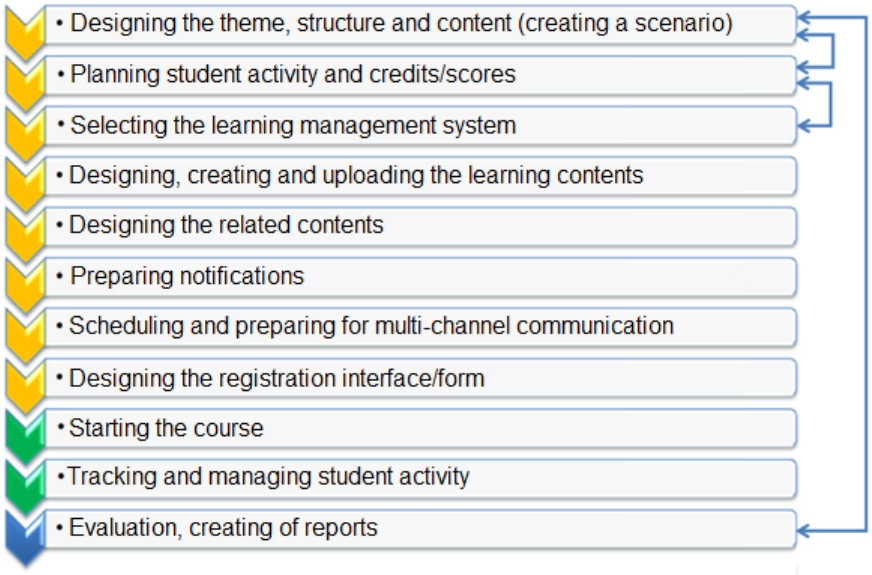

Figure 2. Theoretical model for design and creation of educational materials.

In the case of the presented model, the yellow phases indicate the development phase, the green ones the education phase, and the blue one the evaluation phase. The practical application of cognitive theories takes place in the milestones of the development phase.

In the phase of *designing the theme, structure, and content (creating a scenario)* the most important task is to write a scenario that includes the text of the tutorial videos with various comments (displayed content, tools used, etc.). The scenario also includes tasks and refers to various additional content, such as a summary video or contents related to online situational learning. It requires complex teamwork and is preceded by brainstorming.

Planning student activity and credits/scores is also one of the first steps in the planning process, as the possibilities are very limited only after the start of education. In our courses, the most points a student can earn are 100 points and they can complete the training with at least 50 percent.

Selecting the learning management system is also an important step, influenced by the project's financial plan, and the knowledge and experience of the development team. The learning management system determines the subsequent developments, the framework, but often also defines the limits of further planning.

The *designing, creating, and uploading the learning contents* phase is one of the most significant and time-consuming processes. This is where the tutorial videos are recorded, edited, and subtitled, and the tests and quizzes are created and uploaded to the platform.

Designing the related contents includes tasks such as making summary videos, developing e-books, and creating content for online situational learning.

The *preparing notifications phase* consists primarily of writing reminders and informational messages to be sent within the system, as well as preparing the text of the e-mails.

Scheduling and preparing for multichannel communication is a milestone in the creation of communication interfaces across different platforms. In many cases, in addition to platform-specific messages and emails, we use instant messaging applications and social networking sites to create groups around a course. In addition, we are constantly trying to help students solve problems and difficulties related to the technical and learning process.

In the step of *designing the registration interface/form*, the interface that will be the first one the students encounter is created. Here, they provide their contact details and practically register for the course.

Starting the course, as well as the opening and closing of the various modules and contents, using the results of our preliminary research, are scheduled for Sundays. In some cases, we used synchronous solutions such as video conferencing for these sections, but their popularity has steadily declined as the course has progressed.

Tracking and managing student activity is primarily concerned with the evaluation and administration of various tasks, as well as the ability to manage the communication in the forums. Scores are always administered in accordance with the current privacy regulations.

In the last phase, called *evaluation, creating of reports*, the collected and logged results are evaluated. In addition, we provide the customer with a detailed technical description that includes a list of all content produced (videos, tests, e-books), as well as their duration. The evaluation also includes an assessment of the student score, activity, and satisfaction questionnaire. These results will be examined later using statistical methods and will serve as empirical data for various scientific works.

With the examined models being too general, and not applicable to a decentralized development team, we found that there was a need to develop our own milestone model based on our own development experience. Our team members work on different schedules, from significant geographical distances, so it is important that their work be traceable to all members of the team, which is one of the basic conditions for effective cooperation. There was a need to develop our own model because our curriculum development team consists essentially of peer-to-peer developers, despite the fact that teachers and students are working on the same project.

The developed model is suitable for creating effective online learning materials and courses in any field of science in different learning management systems. This educational content focuses on multimedia learning tools and on interaction with dynamic contents. They support individual learning styles, provide effective/active learning, and build problem-solving and critical thinking skills. In the Supplementary Materials Section, we listed the online courses we created in 2021 based on the model and principles described above. The content of the courses ranges from language learning to self-knowledge and career choice, to the basic knowledge needed to start a business. It can also be used effectively in engineering education in an online educational environment.

4.6. Platform Used

Just as the location of traditional classroom education is not incidental, the online learning environment and the learning management system are also key. These platforms can be accessed via the Internet, and the digital content and teaching materials created by the instructors are placed here. As users access educational content through the framework, it is very important that it is clear and reliable. In addition, the cost of the learning management system, the available languages for the interface, and the need for installation and maintenance (an administrator must be employed, or the system is centrally maintained), as well as the availability and intensity of support, are all important. Just as in the case of traditional education, where location does not decisively determine the effectiveness of education, the same applies to online education. The framework can be in English or in another language, free or paid, with more or less possibilities, it can either be clear or difficult to review, while the effectiveness of online education is also determined by the personality, training, and professional knowledge of the lecturer themselves, as well as the applied professional methodology. This list should be supplemented (especially in the case of online education) with the implemented educational technology.

4.7. Educational Videos

In the current learning environments, multimedia materials are preferred by many teachers, which serves as both a major challenge and motivation [48]. Multimedia animation can contain words, pictures, sounds, images, and moving pictures [49]. Previous studies indicated that animation improves a learner's ability to remember facts and process information [50,51]. With sound, action, and images, animation can elucidate complex

abstract concepts for learners' pictures [49]. Studies have also shown that multimedia animation as a teaching tool can help learners understand complex concepts, identify misconceptions, and positively impacts learners' motivation, satisfaction, learning achievement, digital tools, and information processing [52,53]. In addition, the effects of different multimedia materials on brain waves can be investigated [54], as the analysis of brain waves can also determine the level of attention and ultimately affect the effectiveness of learning [55,56], which anticipates one of the important applications of the future.

According to the results listed above, and our experience, online education is most effective when we teach with the help of educational videos, because multimedia (simultaneous display of text, sound, image and/or video, and interactive content) affects several of our senses at the same time. The educational videos are created by a dedicated cameraman and a post-production team. It is important that the finished content (audio and video) is perfect, as even a seemingly minor technical error can have a significant distracting effect. The videos begin with an eye-catching intro (5 s) that includes information about the course (course name and logo, possibly the name of the ordering company or sponsor). In the case of intros, care must be taken not to contain unnecessary information or overload the short-term memory of the viewers. The name of the lecturer and their affiliation should be displayed in a field at the beginning of the video. The videos should be subtitled, which can be optionally turned on/off so that hearing-impaired students can easily follow along as well. In addition, the captioning can be used to display any translations as well. When recording educational videos, it is recommended that instructors appear on the screen (give authenticity to the video) and that the keywords for that section appear next to them. The video can be recorded in a classroom or even outdoors, but care must be taken not to contain distractions or any distracting elements (focus on the presenter and blur the background).

Another good solution is the green box-recorded educational video, where you have the option to delete the entire background and display the presenter in a new virtual environment/studio [7].

On the other hand, in addition to the technical aspects of the videos, the preparation and presentation of the performers are also significant. The presentation should be enthusiastic, vibrant, friendly, and engaging, and the speakers need to be properly prepared for this. They can write notes, but it is also recommended that they practice their presentations before recording (even in front of a mirror). Care should be taken to seem as if having a personal conversation, and, if possible, it is recommended to establish a more informal relationship through the presentation. It is important for the beginning of the performance to be particularly good because the audience will make a decision about the quality of the performance after only a few seconds.

Thus, it is recommended to start the lecture with the following things:

1. A question.
2. With a personal story related to the topic of the lecture.
3. With interesting or surprising facts (which are also related to the topic of the lecture).

The appropriate choice of these can have an attention-grabbing effect, which helps the learner to show more interest in the curriculum. It is also important to plan the length of the videos. We often find that lecturers consider school hours, 45 min, to be authoritative. A study conducted on the scope of videos [57], covering 6.9 million views (Figure 3), has proved the following:

- Videos less than 6 min long provided a result of nearly 100%, meaning almost everyone watched the entire recording.
- Videos of 9 and 12 min were only nearly 50% watched.
- 12 and 40 min videos provided a watch time of only 20%.

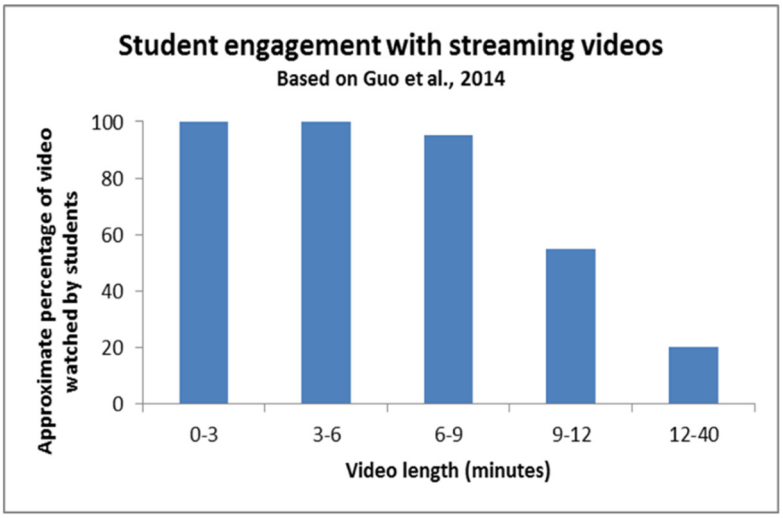

Figure 3. Educational video view rate (edited based on [57]).

Based on these findings, it can be said that the optimal length of tutorial videos is between 3 and 9 min. Of course, this does not mean that a 60 min video should be divided into ten 6 min sections, rather that instructional designer teams and experts need to define content units that can be properly presented in that amount of time.

On the other hand, students' attention can be increased or even be maintained with questions embedded in an educational video. The essence of this method is that while watching the tutorial video, questions pop up from time to time and the learner has to answer them. The questions are asked about the curriculum and the answers received are summarized by the system, so various statements can be created with their help.

4.8. Methodological Aspects

To publish educational content in the form of an online course, it is worth keeping in mind the following things, which also apply to online educational processes in general. Based on our experience and research results, it can be concluded that in addition to the regularities described above, many other factors influence the effectiveness of learning, the motivation of the participants, and their satisfaction.

4.8.1. Content Divided into Modules and Weeks

When planning the content, it is recommended to combine study materials on similar topics into one module at a time. When designing, it is worth following the one-module/one-week principle. Thus, the time allotted to learning will be divided into weeks, so the problem that users' activity increases radically before a deadline will not be as pronounced. Depending on the potential workload of our target group, it is recommended to set the weekly activity for an online course between 2 and 5 h. Based on our experience so far, deadlines and module changes should be planned for Sundays.

4.8.2. Diverse and Interactive Activities

When planning students' activities, all online tools and technical possibilities, which allow students to collaborate with others or to supplement static elements with interactive content, should be considered. We have achieved significant results with embedded questions in videos to help sustain audience attention. A mandatory element of the courses is the final online test, which can be used to assess the effectiveness of learning. The forums are the best embodiment of the community knowledge and experience that can be created on the surface of a course with hundreds or possibly thousands of students. In our experience, the intensity and direction of forum activity is largely determined by the topic of each sub-forum. It is recommended to use questions that are a bit provocative and affect

emotions as well. If the content allows it, we can also perform exciting tasks by evaluating the inputs made on different interfaces as well as the students.

4.8.3. Awareness of Requirements and Expectations during the Online Learning Process

Before starting the course, it is recommended that participants or potential participants are informed of what exactly will be expected from them, exactly how much time they have to spend learning the management system, and what activities this process can be divided into (watching videos, forum activity, making submissions, completing tests, etc.) [12]. This time (according to our measurements so far) is three times the length of the tutorial videos, so there is time for taking notes as well as other activities. Of course, it is important for them to know what parts and modules the course is made up of and what dynamics are used to plan the teaching. It is also recommended to create a set of rules for the courses. If prior knowledge is required to complete the course, this should also be communicated to those interested.

4.8.4. Ongoing Assistance

An online course is usually entered by people with heterogeneous knowledge. This applies to the professional content of the training, but also to the IT competencies. That is why it is important to keep helping online learners. It is important to tell them which interfaces/systems the learning takes place on, and to create a registration and user guide for them. In addition, questions that arise during the course should be answered on an ongoing basis. The continuous tracking of students' scores also serves as a very strong motivating force, as they can receive feedback on the effectiveness of their activities after the activity is complete.

4.8.5. Multichannel Communication

According to our research, multichannel communication significantly motivates students. These can be the following channels: e-mail, the LMS's internal messaging system, forums on the course interface, a Facebook group, Instagram, etc. Of course, each environment has its own function and specificity. Deadlines and the tasks of the given week or module are sent out with the help of e-mails; on forums, there can be interactive professional discussions, and since the users spend a lot of time on social pages, these are suitable for both information transfer and communication. It is recommended to create groups on social media for this purpose. Of course, the various forms (application, satisfaction questionnaire) are an effective tool for communication and the further development of online content. We cannot prevent certain information from appearing duplicated, but the instructor may draw attention to this. In the case of online communication, however, it is important that if we already have a well-functioning communication interface with our target group, it should only be used in exceptional situations.

5. Discussion and Conclusions

Online education, as is clear from its definition, is a form of education in which no direct personal relationship is established between the teacher and the learner. This simple fact results in several methodological specialties, and the triangle of student, teacher, and educational material must be supplemented with the educational technology solutions that are necessary for the realization of online education. Educational technology solutions are various applications or software that allow the presentation to be recorded or transmitted, as well as complemented by various interactive and communication tools. Also included are technical devices, such as a computer, tablet, or smartphone, and the Internet itself, which are also needed for the implementation of online education. With all this in mind, it should be noted that the identity and role of the teacher remains key in the educational processes, and this fact is even more pronounced in the case of younger students [58]. The online form of education has also created a new educational situation by the fact that as opposed to the traditional form of education, enclosed between the four walls of

the classroom, online education forms a multiple open system. Parents, the head of the institution and colleagues also gain insight into the educational content and the entire educational process itself. Therefore, it can be concluded that this situation definitely requires teachers to move away from their comfort zones and adapt the role of online educators. In addition, it is also a new situation to enter the private space, be that the living room, kitchen, or the child's room, even if only virtually, and it gains insight from strangers.

In online education, the curriculum should be divided into smaller sections, which are much shorter than a traditional 45 min school lesson. This can be a few minutes of a tutorial video or a video call, but in the case of microlearning, it is, in many cases, SMS message-length information (160 characters). These curricula and the whole educational process should be supplemented with constant feedback, evaluation, and motivation, and should be maintained and even increased where possible. Of course, the forms of work that were used in traditional education, such as frontal, individual, and pair work, are also excellent for online education when using the appropriate software tools.

In addition to the principles and benefits listed above, a further advantage of digital education, due to the new situation caused by the coronavirus, is the lack of need for meeting face-to-face, which, in the declared emergency, has resulted in distance learning remaining the only possible form of education. What is new, in the current situation, is that in the case of e-learning in the traditional sense, most of the online students are unknown to the lecturer, while in the current situation, the teacher continues to work online with an already well-known class or grade. The situation raises further questions, namely how well or differently the learners behave in an online space, what results does the lack of personal presence have, and how much does all this affect the activity and results of each student [59].

In our opinion, in the current situation, instead of the different platforms and strategies, the most important thing is for educators to master the basic methodological principles of online education and to apply them effectively in different educational situations. Of course, compared to the learning materials used in traditional teaching methods, the preparation of teaching materials compiled according to the methodology presented requires much more work and knowledge, but we believe that this will pay off later. It also arises as to what information from several sources may have an impact on the effectiveness of knowledge transfer, but we believe that the curricula prepared according to the described methodology are sufficiently attention-grabbing and highlighting, so that efficiency improvements are expected.

In this study, after defining the basic concepts, some of the key points in creating an effective online educational material are reviewed. We covered the general guidelines, the criteria for choosing the platform, the specifics of the educational videos, and the use of other tools. Based on our own experience, we have elaborated on the elements of online instructional design that can help us create more effective content. These are content divided into modules/weeks, diverse and interactive activities, multichannel communication, etc.

Supplementary Materials: Website S1: Tanulj velünk magyarul! (Learn Hungarian with us!) (https://tinyurl.com/tanuljvelunkmagyarul); Website S2: Tanulj velünk magyarul2! (Learn Hungarian with us2!) (https://tinyurl.com/tanuljvelunkmagyarul2); Website S3: Ki vagyok én? (Who am I?) (https://tinyurl.com/kivagyoken); Website S4: Vállalkozz, Vajdaság! (Do business, Vojvodina!) (https://vallalkozzvajdasag.prosperitati.rs/); Website S5: Út a siker felé (The road to success) (https://elearning.easygenerator.com/5589ab2a-ef7b-4f61-92eb-298cdd12ecbf/); Website S6: Web 2.0 Online eszközök használata a tanórán és azon kívül (Web 2.0 Use online tools in and out of class) (https://classroom.google.com/u/0/c/MjQ4NjU1MjQyMjU1) (accessed on 30 December 2021).

Author Contributions: Conceptualization, Ž.N. and A.K.; investigation, Ž.N.; methodology, Ž.N. and A.K.; writing—original draft, Ž.N. and A.K.; writing—review and editing, Ž.N. and A.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Tomlinson, C.A.; McTighe, J. *Integrating Differentiated Instruction and Understanding by Design: Connecting Content and Kids*; Association for Supervision and Curriculum Development: Alexandria, VA, USA, 2006.
2. Bransford, J.D.; Brown, A.L.; Cocking, R.R. *How People Learn: Brain, Mind, Experience, and School*; National Academy Press: Washington, DC, USA, 1999.
3. Lengyelné Molnár, T. Changing reading habits and methodological options resulting from digital transformation. *J. Appl. Tech. Educ. Sci.* **2019**, *9*, 27–42.
4. Maull, K.E.; Saldivar, M.G.; Sumner, T. Observing online curriculum planning behavior of teachers. In Proceedings of the Educational Data Mining 2010, Pittsburgh, PA, USA, 11–13 June 2010; pp. 121–130.
5. Horváth, I. Evolution of teaching roles and tasks in VR/AR-based education. In Proceedings of the 9th IEEE International Conference on Cognitive Infocommunications, Budapest, Hungary, 22–24 August 2018; pp. 355–360.
6. Ibrahim, W.; Morsi, R. Online engineering education: A comprehensive review. In Proceedings of the American Society for Engineering Education Annual Conference & Exposition Annual Conference, Portland, OR, USA, 12–15 June 2005; pp. 10.973.1–10.973.10.
7. Bourne, J.; Harris, D.; Mayadas, F. Online engineering education: Learning anywhere, anytime. *J. Eng. Educ.* **2005**, *94*, 131–146. [CrossRef]
8. Lima, R.M.; Andersson, P.H.; Saalman, E. Active Learning in Engineering Education: A (re) introduction. *Eur. J. Eng. Educ.* **2017**, *42*, 1–4. [CrossRef]
9. Mills, J.E.; Treagust, D.F. Engineering education—Is problem-based or project-based learning the answer. *Australas. J. Eng. Educ.* **2003**, *3*, 2–16.
10. Bishop, J.; Verleger, M.A. The flipped classroom: A survey of the research. In Proceedings of the ASEE Annual Conference & Exposition, Atlanta, GA, USA, 23–26 June 2013; pp. 23.1200.1–23.1200.18.
11. Grodotzki, J.; Upadhya, S.; Tekkaya, A.E. Engineering education amid a global pandemic. *Adv. Ind. Manuf. Eng.* **2021**, *3*, 100058. [CrossRef]
12. Chen, L.L. A model for effective online instructional design. *Lit. Inf. Comput. Educ. J.* **2016**, *6*, 2302–2308. [CrossRef]
13. Roblyer, M.D. *Introduction to Systematic Instructional Design for Traditional, Online, and Blended Environments*; Pearson Higher Education: Hoboken, NJ, USA, 2014.
14. Quinn, C. The Great ADDIE Debate. Available online: http://blog.learnlets.com/?p=1489 (accessed on 30 December 2021).
15. Huang, C. Designing high-quality interactive multimedia learning modules. *Comput. Med. Imaging Graph.* **2005**, *29*, 223–233. [CrossRef]
16. Gőgh, E.; Racsko, R.; Kovari, A. Experience of Self-Efficacy Learning among Vocational Secondary School Students. *Acta Polytech. Hung.* **2021**, *18*, 101–119. [CrossRef]
17. Sorden, S.D. A cognitive approach to instructional design for multimedia learning. *Inf. Sci.* **2005**, *8*, 263–279. [CrossRef]
18. Atkinson, R.C.; Shiffrin, R.M. Human memory: A proposed system and its control processes. In *Psychology of Learning and Motivation*; Elsevier: Amsterdam, The Netherlands, 1968; Volume 2, pp. 89–195.
19. Baddeley, A.D.; Hitch, G. Working memory. In *Psychology of Learning and Motivation*; Elsevier: Amsterdam, The Netherlands, 1974; Volume 8, pp. 47–89.
20. Baddeley, A.D. *Essentials of Human Memory*; Psychology Press: Hove, UK, 1999.
21. Cowan, N. Working memory underpins cognitive development, learning, and education. *Educ. Psychol. Rev.* **2014**, *26*, 197–223. [CrossRef]
22. Baddeley, A.D. Is working memory still working? *Eur. Psychol.* **2002**, *7*, 85–97. [CrossRef]
23. De Jong, T. Cognitive load theory, educational research, and instructional design: Some food for thought. *Instr. Sci.* **2010**, *38*, 105–134. [CrossRef]
24. Sweller, J. Cognitive load theory. In *Psychology of Learning and Motivation*; Elsevier: Amsterdam, The Netherlands, 2011; Volume 55, pp. 37–76.
25. Pinter, R.; Cisar, S.M.; Balogh, Z.; Manojlovic, H. Enhancing Higher Education Student Class Attendance through Gamification. *Acta Polytech. Hung.* **2020**, *17*, 13–33. [CrossRef]
26. Kovács, G. Gamification vs Game Addiction. *Comput. Learn.* **2020**, *3*, 12–20.
27. Schrauf, G. Importance of project-based learning in software development. *Comput. Learn.* **2019**, *2*, 27–39.
28. Sweller, J.; van Merriënboer, J.J.; Paas, F. Cognitive architecture and instructional design: 20 years later. *Educ. Psychol. Rev.* **2019**, *31*, 261–292. [CrossRef]
29. Szűts, Z. An Iconic turn in art history—The quest for realistic and 3D visual representation on the World Wide Web. In *The Iconic Turn in Education*; Benedek, A., Nyíri, K., Eds.; Peter Lang: Frankfurt, Germany, 2012; pp. 59–66.

30. Molnár, G.; Nagy, K.; Balogh, Z. The role and impact of visualization during the processing of educational materials, presentation options in education and in the virtual space. In Proceedings of the 10th IEEE International Conference on Cognitive Infocommunications, Naples, Italy, 23–25 October 2019; pp. 533–538.
31. Paivio, A.; Clark, J.M. Dual coding theory and education. In *Pathways to Literacy Achievement for High Poverty Children*; The University of Michigan School of Education: Ann Arbor, MI, USA, 2006.
32. James, W.B.; Blank, W.E. Review and critique of available learning-style instruments for adults. In *New Directions for Adult and Continuing Education*; Wiley: Hoboken, NJ, USA, 1993; Volume 59, pp. 47–57.
33. Tyng, C.M.; Amin, H.U.; Saad, M.N.; Malik, A.S. The influences of emotion on learning and memory. *Front. Psychol.* **2017**, *8*, 1454. [CrossRef]
34. Rajcsányi-Molnár, M.; Bacsa-Bán, A. From the Initial Steps to the Concept of Online Education: Teacher Experiences and Development Directions Based on Feedback from Online Education Introduced During the Pandemic. *Cent. Eur. J. Educ. Res.* **2021**, *3*, 33–48. [CrossRef]
35. McIver, D.; Fitzsimmons, S.; Flanagan, D. Instructional design as knowledge management: A knowledge-in-practice approach to choosing instructional methods. *J. Manag. Educ.* **2016**, *40*, 47–75. [CrossRef]
36. Demeter, R.; Kovari, A. Importance of digital simulation in the competence development of engineers defining the society of the future. *Civ. Szle.* **2020**, *17*, 89–101.
37. Horváth, I. An Analysis of Personalized Learning Opportunities in 3D VR. *Front. Comput. Sci.* **2021**, *3*, 673826. [CrossRef]
38. Santo, S.A. Relationships between learning styles and online learning: Myth or reality? *Perform. Improv. Q.* **2006**, *19*, 73–88. [CrossRef]
39. Speece, M. Learning Style, Culture and Delivery Mode in Online Distance Education. *US-China Educ. Rev. A Educ. Pract.* **2012**, *2*, 1–12.
40. Benedek, A.; Molnár, G.; Szűts, Z. Practices of Crowdsourcing in relation to Big Data Analysis and Education Methods. In Proceedings of the IEEE 13th International Symposium on Intelligent Systems and Informatics, Subotica, Serbia, 17–19 September 2015; pp. 167–172.
41. Rajcsányi-Molnár, M.; András, I. Online strategies and international market development in higher education. In *Metamorphosis: Glocal Dilemmas in Three Acts*; Új Mandátum Kiadó: Budapest, Hungary, 2013; pp. 172–193.
42. Khan, B. Learning features in an open, flexible and distributed environment. *AACE J.* **2005**, *13*, 137–153.
43. DeGreeff, B.L.; Burnett, A.; Cooley, D. Communicating and philosophizing about authenticity or inauthenticity in a fast-paced world. *J. Happiness Stud.* **2010**, *11*, 395–408. [CrossRef]
44. Molnár, G. Collaborative technological applications with special focus on ICT based, networked and mobile solutions. *Trans. Inf. Sci. Appl.* **2012**, *9*, 271–281.
45. Krájnik, I.; Demeter, R. The specific characteristics, economic aspects and importance of banking risk management in accounting training. *J. Appl. Tech. Educ. Sci.* **2021**, *11*, 265.
46. Molnár, G.; Námesztovszki, Z.; Szűts, Z. Switching to online education, experiences from Hungary and Serbia. In Proceedings of the XI International IT and Education Development Conference, Zrenjanin, Serbia, 30 October 2020; pp. 55–59.
47. Triyono, M.B. The Indicators of instructional design for e-learning in Indonesian vocational high schools. *Procedia-Soc. Behav. Sci.* **2015**, *204*, 54–61. [CrossRef]
48. Molnár, G. Challenges and Opportunities in Virtual and Electronic Learning Environments. In Proceedings of the IEEE 11th International Symposium on Intelligent Systems and Informatics, Subotica, Serbia, 26–28 September 2013; pp. 397–401.
49. Chiou, C.C.; Tien, L.C.; Lee, L.T. Effects on learning of multimedia animation combined with multidimensional concept maps. *Comput. Educ.* **2015**, *80*, 211–223. [CrossRef]
50. Holzinger, A.; Kickmeier-Rust, M.; Albert, D. Dynamic media in computer science education; content complexity and learning performance: Is less more? *J. Educ. Technol. Soc.* **2008**, *11*, 279–290.
51. Kocsó, E.; Cserné Pekkel, M. Using of Dynamic Animations to Illustrate Mathematical Theorems. *Trans. IT Eng. Educ.* **2020**, *3*, 1–15.
52. Dalacosta, K.; Kamariotaki-Paparrigopoulou, M.; Palyvos, J.A.; Spyrellis, N. Multimedia application with animated cartoons for teaching science in elementary education. *Comput. Educ.* **2009**, *52*, 741–748. [CrossRef]
53. Orosz, B.; Kovács, C.; Karuovic, D.; Molnár, G.; Major, L.; Vass, V.; Szűts, Z.; Námesztovszki, Z. Digital education in digital cooperative environments. *J. Appl. Tech. Educ. Sci.* **2019**, *9*, 55–69.
54. Katona, J.; Ujbanyi, T.; Sziladi, G.; Kovari, A. Examine the effect of different web-based media on human brain waves. In Proceedings of the 8th IEEE International Conference on Cognitive Infocommunications, Debrecen, Hungary, 11–14 September 2017; pp. 407–412.
55. Katona, J. Examination and comparison of the EEG based Attention Test with CPT and TOVA. In Proceedings of the IEEE 15th International Symposium on Computational Intelligence and Informatics, Budapest, Hungary, 19–21 November 2014; pp. 117–120.
56. Katona, J.; Kovari, A. Examining the learning efficiency by a brain-computer interface system. *Acta Polytech. Hung.* **2018**, *15*, 251–280.
57. Guo, P.J.; Kim, J.; Rubin, R. How video production affects student engagement: An empirical study of MOOC videos. In Proceedings of the First ACM Conference on Learning Scale, Atlanta, GA, USA, 4–5 March 2014; pp. 41–50.

58. Bartal, O.; Rajcsányi-Molnár, M. Teachers of the 21st Century and the Mobile-tools. *J. Appl. Tech. Educ. Sci.* **2020**, *10*, 53–66.
59. Balogh, Z.; Kuchárik, M. Predicting Student Grades Based on Their Usage of LMS Moodle Using Petri Nets. *Appl. Sci.* **2019**, *9*, 4211. [CrossRef]