

Criteria for Evaluating the Quality of Interactive Didactic Materials

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Abstract

Interactive teaching materials and didactic applications are widely used in educational activities from primary schools to universities and higher educational institutions. Unfortunately, the quality of these materials does not always match the requirements they should meet. But the question is, what are those requirements? What are the criteria that will ensure the quality of the materials? The article contains proposals of possible criteria for examining and evaluating the quality of interactive educational materials. The overall assessment of the quality of a didactic application or learning material is created based on the evaluation of three key criteria: content structuring, design efficiency and evaluation system.

Keywords: Didactic, Interactive materials, Quality, Criteria

1 Introduction

In our modern era, the couch and television reign as the household favourites, while our mobile phones have seamlessly integrated into our handbags and pockets. Hours pass as we immerse ourselves in watching TV shows, scrolling through social media, and mobile gaming daily. In such a "digital" environment, it is challenging to engage our children in learning with the help of books and notebooks.

It becomes increasingly apparent that the field of education is embracing and implementing modern methodologies, facilitating its continuous evolution. A significant shift has occurred within the current educational landscape where computers, interactive whiteboards, and various information and communication technologies have assumed pivotal roles in the learning process. The gradual normalisation of students incorporating their smart devices as essential tools into education is underway (BYOD – Bring Your Own Device).

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Numerous studies (Bakonyi, Illés, 2018) show that utilising these tools enhances learning efficacy compared to sole reliance on teacher-led instruction. Enhancing communication and collaboration between students and educators is attainable through utilisation of interactive teaching materials. These resources serve to boost learning motivation, amplify instructional clarity, foster subject comprehension, and infuse engaging elements into different lesson phases. In distance education, incorporating digital teaching materials has become indispensable, forming an integral part of the educational experience.

However, the preparation and utilization of digital teaching materials and their interactive application pose a formidable challenge. Often, it falls upon the teachers themselves to create suitable educational content, select elements of the “non-interactive” materials which are suitable for transformation into an interactive format, and select the data quantity incorporated within them. Crafting a design that not only supports comprehension and clarity but also distinguishes the interactive material from a mere electronic rendition of the textbook is no small feat.

In the early era of creating didactic materials, they were essentially digitalized workbooks. Subsequently, dedicated applications emerged, designed explicitly for pedagogical use. These applications have been instrumental in aiding classroom instruction and facilitating independent study for students. Furthermore, comprehensive software ecosystems have surfaced, empowering educators and enthusiasts to fashion their own didactic interactive materials and applications to their specific requirements. Yet, a crucial aspect in their creation lies in the thorough understanding and adherence to the principles governing the proper development of interactive didactic materials.

The amount of currently accessible didactic applications is notably varied, often lacking uniformity in their functionalities, which complicates the assessment of their educational value. To construct a well-rounded assessment, establishing principles, guidelines, or criteria becomes essential. These benchmarks would serve as a foundational basis to evaluate didactic materials systematically, enabling educators to discern and select the most fitting ones to meet their teaching requirements.

2 Interactive Didactic Material

Whether termed interactive learning material, educational material, or interactive applications, the nomenclature doesn't alter the core objective of the curriculum—presenting content for interactive student engagement, be it through interactive whiteboards or directly on computers. The fundamental essence remains consistent: it must encompass a comprehensive dataset tailored for interactive teaching methods, comprising two integral components:

- *static*, which is basically the same as the content of printed textbooks intended for teaching, possibly supplementing it with new knowledge, bringing additional images, and enabling effective work with text, images, and other components.

- *dynamic*, which is made up of interactive, multimedia elements incorporated into the curriculum. These can be animations, video clips, or audio recordings that cannot be presented in printed form. In addition, it may also include links to web pages that can be launched from the whiteboard through computer interaction. The teacher can also use his own materials, which are suitable for clarifying and diversifying the subject matter. (Pšenáková, 2019)

There are numerous options for introducing interactive elements into teaching materials. While some methods demand proficiency in programming languages, there are user-friendly software packages enabling the creation of interactive learning materials without coding expertise. These program environments empower educators—regardless of their computer science proficiency—to craft suitable interactive content. Competence in utilizing computer technology and specialized programs tailored for material creation suffices for their development (Pšenáková, 1998, 2001). Examples of program environments conducive to creating interactive teaching materials encompass, for example, HotPotatoes, Learning Apps, and Alf.

Regardless of the chosen form for creating didactic interactive materials, it's imperative for the teacher to grasp the fundamental principles of their proper creation and strive to adhere to these principles as closely as possible.

3 Principles of Correct Creation of Interactive Didactic Materials

Crafting teaching materials in the right way, whether interactive or not, involves a multifaceted process. Teachers possess the capacity to create interactive learning resources themselves, adhering to specific rules, language, and principles inherent to this creation. These guidelines and insights aim to render the material understandable, purposeful, intriguing, and frequently utilized. The advantage of crafting personalized materials lies in tailoring them to meet teachers' specific requirements, while aligning with methodological content. However, developing interactive educational materials demands advanced digital prowess alongside patience, creativity, and, notably, a substantial time commitment.

Individual preferences heavily influence the creative process. What one person finds aesthetically pleasing might not resonate similarly with another. Colours, for instance, evoke diverse reactions among individuals, and the arrangement of shapes and their abundance on the screen is inherently tied to the creator's taste. Even the size and style of the font can either enhance or hinder the readability and, subsequently, the comprehensibility of the text content. Ultimately, the completed didactic material is consumed by diverse students, each with their own unique tastes, diverging from those of the creators. Consequently, the overall impact of the curriculum hinges on numerous factors, whose interplay may yield positive or negative outcomes in different scenarios (Pšenáková, 2019).

The creator faces the dual task of aligning with the curriculum's content while also prioritizing the design aspect, given that teaching materials are predominantly presented via interactive whiteboards or computer screens. Prior to commencing the production of the learning material's visual elements, meticulous consideration is necessary regarding how to effectively integrate the required curriculum and information into a coherent and apt structure.

While crafting educational material, meticulous attention must be paid to its correct design, ensuring alignment with professional, didactic, and design standards while fostering comprehensive student development. True interactivity in the educational material necessitates activities capable of engaging all students in the learning process, ideally incorporating not just verbal and cognitive aspects but also prompting physical involvement to enhance the overall learning experience.

In the development of interactive educational content, the intended purpose of the material stands as the foremost guiding factor. However, it must also align harmoniously with didactic, technical, aesthetic, and economic considerations. Material devoid of clear objectives tends to lack organization and coherence, often straying from its intended focus. Conversely, planning tasks and objectives gradually brings clarity, especially when multiple authors collaborate simultaneously on its creation (Pšenáková, 2010a).

The author must be concerned with the content aspect only after defining the goals of the materials, when the creator starts looking for suitable sources of information - methodological instructions, literature, suitable websites, or other media. Only the necessary parts are selected from the sources, which together create a certain thematic whole. The selected information must not appear sketchy, because after the transfer of the teaching material, the issue will become even more visible. Language and its use also fall into the sphere of content, as it is inappropriate to use slang words, profanity, or diminutives (Pšenáková, 2019).

Once the objectives and content are established, the phase of preparing and structuring the teaching material commences. An essential consideration during this planning phase involves determining how to segment the content across individual screens (or interactive whiteboard pages), directly influencing how the material's content is perceived. Planning the structure is an ongoing process; the creator must envision future expansions and adaptations, considering the frequent renewal of information, common in education due to ongoing research and the inclusion of new topics.

The teaching material should not remain static; instead, it ought to evolve in tandem with the changing educational landscape. Should the curriculum become outdated or fail to meet students' needs, the teacher should modify and update the material accordingly. Priority should be placed on the visual appeal, quality of presentation, clarity, and the depth of knowledge encapsulated in the didactic materials. Creators must acknowledge that when teaching material is displayed via an interactive whiteboard, it becomes the focal point of the lesson. However, it should not unduly constrain the flow of the lesson or disrupt its natural progression.

The principles of the correct creation of interactive learning materials are elaborated in more detail in several publications (Pšenáková, 1998; 2001; 2007, 2010, 2010a; 2019; 2021), and we have given only a brief overview of this much more complex issue.

Drawing from the cited data, existing literature, and substantial personal experience, it becomes evident that the quality of interactive learning materials hinges on numerous factors that warrant careful consideration. While many authors endeavour to adhere to these quality standards, some remain unaware or unconcerned with them. Consequently, in practice, a significant number of educational materials surfaces, some of which prove unsuitable or only partially adequate for effective integration into the pedagogical process.

4 Theory of Transaction Distance

As electronic learning material and interactive applications are suitable for the implementation of distance education, when analysing didactic applications, we consider it appropriate to analyse and evaluate them in terms of transactional distance theory. Transactional distance theory is an educational framework that delineates pivotal concepts within distance education. It encapsulates a definition of distance education that emphasises the physical and/or psychological separation between teachers and students as a fundamental characteristic.

Michael G. Moore, a distinguished educator at Pennsylvania State University, crafted the transactional distance theory during the 1970s. In 1972, he published the initial articulation of this theory, positing that distance education is not solely about the geographic distance between students and teachers; rather, it fundamentally revolves around pedagogical principles (Moore, 1972). The theory contends that the physical and temporal separation between learners and instructors creates pedagogical challenges. To mitigate potential misunderstandings, effective course structures and active learner-teacher interactions are crucial in minimising these gaps and fostering effective education.

The theory of transactional distances asserts that decisions made by the creator of a distance course, typically a teacher, result in a specific structure, dialogue, and student autonomy. This balance is created either unintentionally during the instructional design process or as a deliberate choice in instructional design. Despite this, these elements interact, forming a transactional distance—a psychological and communicative space representing a potential misunderstanding between the teacher's input and the learner's input that needs to be bridged.

This theory's utility lies in guiding creators, instructors, and designers in course design by determining the optimal level of structure, dialogue, and autonomy. This balance aims to minimize transactional distances and, consequently, enhance learning outcomes. Transactional distance is defined as the dynamic interaction between teachers and students in environments characterized by spatial separation (Moore, 2007).

Transactional distance serves as a metric reflecting a student's challenge in actively participating within their online learning setting. This distance manifests across several dimensions: the separation between students themselves, between students and teachers, between students and the course content, and between students and the instructional technology employed (Zhang, 2003). Each of these facets contributes to the varying degrees of psychological and communicative space that can potentially hinder effective engagement within the learning environment.

Three interrelated factors need to be considered in the nature of the transaction between distance learning teachers and students (Moore, 2007):

1. Structure of the Program: encompasses elements defining the intended learning structure within the curriculum plans of the distance education program.
2. Dialogue Exchanged Between Teacher and Student (Teacher Interaction): Reflects the quality and nature of communication between teachers and students.
3. Autonomy of Students: pertains to the students' roles in decision-making regarding what, how, and to what extent they engage in the learning process, aligning with their roles in the proposed structure.

These three factors were derived from the analysis:

- curriculum plans of the distance education program (1)
- communication between teachers and students (2)
- students' roles in deciding what, how and how much to learn (3).

The nature of the course structure is characterized by its degree of rigidity or flexibility. This aspect encompasses various elements, including the extent to which the course's goals and objectives are pre-established, the chosen pedagogical model (like teacher-centred or student-centred approaches), the evaluation methods employed within the course, and the course's adaptability to cater to individual student needs. These components collectively delineate the structural framework of the course, dictating its adaptability, responsiveness, and alignment with diverse learning styles and requirements.

Dialogue extends beyond mere two-way communication; it encompasses all forms of interaction aligned with clearly outlined educational objectives. It embodies cooperation and mutual comprehension between the teacher and students, culminating in the resolution of learners' issues. Within this context, the emphasis lies not on the frequency of dialogue, but rather on its quality, depth, and efficacy in addressing the learning challenges encountered by distance learners. The focus remains on fostering an effective exchange that actively resolves and supports learners in navigating their educational obstacles.

Student autonomy is conditioned by the previous two factors, as it refers to the sense of independence and interdependence that students perceive when participating in classes. The nature of the dialogue shapes the extent to which students feel empowered to self-direct their

learning journey exchanged and the adaptability of the course structure, ultimately impacting their autonomy and agency in the learning process.

Moore's theory of transactional distances highlights the dynamic interplay between structure and dialogue. An increase in structure corresponds to an increase in transactional distance, while heightened dialogue correlates with a decrease in transactional distance. The complexity heightens with the inclusion of learner autonomy, where the distinction between personal autonomy and autonomy linked to learning materials remains ambiguous. However, the theory posits that as transactional distance expands, student autonomy also increases. This underscores the intricate relationship between these elements, showcasing their influence on the learning experience within distance education frameworks.

4.1 Types of Didactic Applications

The Park's categorisation was adopted (Park, 2011) concerning m-learning, which offers a foundational framework for our specific objectives. Considering the inclusion of teaching via mobile phones and online/offline education utilising personal computers under the umbrella of distance education, we infer that the requisites for interactive educational material should align for both scenarios. The outlined learning approaches exhibit diverse transactional and social dynamics within didactic applications; the didactic application can be characterised as:

1. *Highly Transactional and Socialized (TS)*- Emphasizes increased interaction between students and the teacher and encourages collaborative group work among students, with the primary interaction occurring among peers. Learning materials are disseminated via a didactic application, facilitating communication and engagement.
2. *Highly Transactional and Individualized (TI)*- Offers ample space for student-teacher communication. The application provides learning materials, focusing on individualised approaches to content processing. Students work autonomously with the provided curriculum. This approach showcases the advantages and flexibility of e-learning, enabling students from geographically disadvantaged areas to participate.
3. *Low Transactional and Socialized (LS)* - Promotes student interaction with both peers and the teacher, offering limited information to encourage group engagement, brainstorming, and greater social and technological flexibility in task development. The curriculum's endpoint remains open-ended, fostering asynchronous learning and prioritising peer-to-peer interaction.
4. *Low Transactional and Individualized (LI)*- is based on independent student work with minimal teacher influence. Teacher or application developer-led activities guide the learning process within this approach.

These approaches showcase a spectrum of transactional levels and socialisation, offering varied opportunities for communication, collaboration, and individualised learning within e-learning.

4.2 Classification of Didactic Applications Based on the Theory of Transaction Distance

When evaluating a didactic application, it is beneficial to classify it based on the transactional distance theory. This classification does not inherently influence the overall evaluation; instead, it serves as an informative criterion aiding in selecting the most suitable didactic application for a specific educational environment.

Didactic applications are attributed to:

- TS, if they require the cooperation of pupils and the materials are obtained through a didactic application,
- LS if it focuses on the cooperation of students, using the application primarily to guide the work,
- TI, if the application gives the material to the student but supports independent work,
- LI, if the didactic application is only intended to provide the student with guidance for independent work.

5 System of Criteria for Evaluating the Quality of Interactive Didactic Material

The development of digital educational resources occurs across diverse program environments, often lacking standardized procedures or guidelines for quality control. Authors frequently overlook design principles or opt for content unfit for electronic adaptation. Furthermore, these materials commonly undergo inadequate testing by students or a quality assessment process before implementation.

But the question arises, how to evaluate the quality of these materials? Are there evaluation criteria that would help determine whether the given material is suitable or unsuitable for use in the educational process?

Marciniak and Rivera (2021) created a system of indicators for the quality assessment of didactic materials in online education, consisting of 43 evaluation indicators. Based on these indicators, it is possible to evaluate didactic materials in detail, but the evaluation process is very long. For the needs of our project, we wanted to create a system of criteria based on which the evaluation of materials would be more straightforward.

Considering the points, we have established the following criteria for assessing didactic materials and applications:

- content structuring,
- design efficiency,
- method (system) of assessment.

5.1 Structuring the Content of the Didactic Application

Several educational applications make the mistake of overcrowding screens with excessive information, disregarding the reader's experience. This approach renders the digital application akin to an e-book, which might feature basic comprehension questions but fails to leverage the full potential of its digital medium.

Establishing precise educational objectives aligning with the curriculum and standards is crucial when developing a didactic application. Failing to do so constitutes a significant mistake. Without clear goals, content organisation on individual pages or screens becomes complicated, often leading to deviations from the main topic—especially evident in collaborative projects involving multiple creators. Besides defining primary goals, setting incremental sub-goals aids creators in gradually reaching a successful outcome. A practical didactic application should dynamically adjust its objectives based on user knowledge. Monitoring subject choice, content coherence, appropriateness for specific age groups, and language within the content page is advisable.

When assessing content structuring, it is essential to consider the data the application demands from its users. Every didactic application necessitates a user account to allocate this data while crafting a customised curriculum for students. Evaluating this criterion involves scrutinising how user information is handled, the extent of information required for account setup, the level of student involvement, and the data storage protocols. This scrutiny is crucial for detecting potential data misuse, like identity theft, and ensuring the application maintains the requisite user data security standards.

5.2 Effectiveness of the Design of the Didactic Application

Effectiveness in design encompasses all graphical elements within a didactic application. Such a tool demands simplicity, clarity, comprehensibility, and a user-friendly interface. A well-designed didactic application should instantly convey its intended goal. A common pitfall for novice designers is crafting an overly intricate system that impedes effective learning despite offering numerous user options due to its complexity and lack of clarity.

When developing interactive applications, adhering to critical principles significantly impacts their quality. Designing didactic applications warrants attention to three crucial subcategories of design effectiveness: colour, font, and graphics. Adherence to critical design principles heavily influences the quality of interactive applications.

Colours influence individuals, evoking diverse emotions. Colour accessibility is crucial to ensure the application is user-friendly for individuals with visual impairments. A well-thought-out colour scheme enhances readability and inclusivity. An illegible font within a didactic application can markedly diminish its effectiveness and create an unpleasant user experience. Additionally, graphic design is pivotal in influencing material visibility, whether enhancing or detracting

5.3 Evaluation System of Didactic Application

The evaluation system within didactic applications holds significant importance. Unfortunately, numerous learning management systems (LMS) and didactic applications lack provisions for learners to rectify errors or address deficiencies. Upon completing a learning unit, it is beneficial to grant students the chance to revisit past exercises or assignments to identify their mistakes. Simply offering a percentage score and a choice to proceed or repeat the task is inadequate. A practical didactic application should actively assist users in error correction. Moreover, enabling adjustments to task difficulty, such as providing additional information after an incorrect answer, proves advantageous for users' learning experiences.

6 Evaluation of the Quality of Interactive Didactic Material

In crafting evaluation criteria for didactic applications, using transactional distance theory aids in classifying these applications into four distinct types. However, this classification does not directly impact the comprehensive evaluation; it is an informative tool for selecting the most suitable didactic application for a specific educational setting. Following this classification, educators need not assess applications unsuitable for their current environment, streamlining the selection process for the appropriate educational tools.

In our assessment of didactic materials, we identified key elements aligned with the primary criteria outlined earlier (content structuring, design efficiency, and evaluation system). We have formulated a table enumerating our proposed criteria to streamline this assessment process. Evaluators can allocate points to these criteria (Table 1). This table is available for manual printing and completion. Additionally, we have developed a version compatible with MS Excel, facilitating the automatic calculation of scores based on the assigned points for each criterion.

Filling in the table is very simple. The name of the material to be evaluated is entered in the first line. The application type can be indicated within the print version by marking a cross within the respective square. Conversely, the electronic version features a dropdown list (combo box) for selection. Upon opening, this list presents four possible types based on transaction distance theory (TS et al., LI). It is important to note that classifying an application into a specific type serves an informative purpose. This classification doesn't categorise a didactic application as inherently good or bad; each type serves a distinct didactic scenario based on its characteristics and suitability.

The next part of the table is divided into three sections according to key criteria, which collectively create an overall assessment of the didactic material. In the individual sections, we have singled out several characteristics according to which the quality of the didactic application is evaluated:

1. structuring of content: purpose of the application, selection of subject matter, suitability of the topic, active participation, data security,

2. design efficiency: colour scheme, typography, graphics, images, animations, videos, user environment,
3. evaluation system: accessibility of topics, active error correction, difficulty adjustment.

Table 1: Evaluation table of the didactic application

Application name:	
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Mark with a cross!

Application type:		Highly Transactional and Socialized (TS)
		Highly Transactional and Individualized (TI)
		Low Transactional and Individualized (LS)
		Low Transactional and Individualized (LI)

Enter points from 0 to 5!

Content structuring	Rating	Notes
Purpose of the application		
Selection of subject matter		
Suitability of the topic		
Active participation		
Data security		
Category rating	<i>Mean =</i>	

Design efficiency	Rating	Notes
Colour scheme		
Typography		
Graphics, images		
Animations, videos		
User environment		
Category rating	<i>Mean =</i>	

Rating system	Rating	Notes
Accessibility of topics		
Active error correction		
Adjustment of difficulty		
Category rating	<i>Mean =</i>	

Insert calculated averages!

Overall rating	Category rating	Notes
Content structuring		
Design efficiency		
Rating system		
Evaluation result	<i>Mean =</i>	

Each characteristic is assessed on a scale of 0 to 5, with 5 indicating the highest rating. The evaluation of the main category is derived from the average rating of its attributes. When filling out a paper form, the evaluator manually computes this average, whereas in the

electronic version, this calculation is automated. In the "Remarks" section, the evaluator can provide a concise rationale for the assessment.

Subsequently, after evaluating each key category, the computed partial averages are entered (manually or automatically) in the lower section titled "Overall Evaluation." The cumulative average of these partial averages determines the final evaluation outcome.

7 Conclusion

Back in 2001, Marc Prensky categorised individuals into two distinct groups: the "Digital Natives," who were born into the realm of advanced information and communication technologies like computers, video games, and the Internet, and the "Digital Immigrants," representing the generation for whom these technologies became integrated into their lives. This latter group had to familiarise themselves with them, learn, and adapt to the digital landscape (Prensky, 2001).

Digital natives are surrounded by modern technology from an early age, practically from birth, and an environment full of technology is a natural, self-evident part of their lives. These children and young people do not even realise that a few years before birth, there was no Internet or mobile phones. They have already grown up among different media practically from the cradle, so their way of thinking and working with information differs from the way of thinking and working of digital immigrants. Prensky claims that digital natives absorb new information quickly, can multitask, prefer graphics to text, like random information (e.g., hypertext), prefer play to "serious work", and so on. The theory calls those who were not born into the digital world, but at a particular stage of their lives had to adopt the culture of new media, digital immigrants.

Nonetheless, the evolution of technology and the natural progression of generations signify that the immigrant generation will gradually phase out, leaving behind only natives who seamlessly integrate electronic media into their lives. While this shift poses certain risks, electronic media will remain a vital source of information, education, entertainment, and relaxation for future generations. Educators must recognise the transition from traditional curriculum-focused schooling to a modern learner-centric approach to drive educational advancement. Traditional schooling prioritises teachers' dissemination of information, whereas modern education centres on student activity and skill acquisition. A modern educator does not just fulfil responsibilities but pioneer's new ideas and imparts them. Interactive teaching epitomises a contemporary, potent instructional technique grounded in pedagogical interaction. Integrating interactive elements into electronic teaching materials enriches the educational experience, rendering the curriculum more engaging and comprehensible for students, accelerating learning, and augmenting academic performance. Furthermore, leveraging information and communication tools, including interactive whiteboards, positively influences the development of digital competencies among students due to heightened engagement, thereby enhancing their academic outcomes.

Crafting didactic, interactive materials and applications requires a multifaceted skill set. It goes beyond mere design proficiency; it necessitates a command of web design and typography, comprehension of how program code influences system functionality, and a deep understanding of pedagogical principles applicable to traditional and distance learning settings. Didactic applications augment students' learning within school premises and extend learning opportunities beyond, enabling access for individuals facing medical or other limitations. Consequently, these applications must adhere to specific criteria serving as benchmarks for evaluating their quality.

The suggested system for evaluating didactic applications is among many approaches to assess their quality. It is a subjective methodology that allows for agreement or disagreement. Given our lack of prior experience with such a system, it is a valuable tool aiding in selecting suitable applications for practical use.

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