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EXPLORING E-BOOKS EVALUATION: ISSUES, EVALUATION CRITERIA AND TECHNIQUES

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Abstract:

E-book evaluation involves balancing technical and user-centered criteria to ensure usability and functionality across various contexts and platforms. This study reviews existing literature to examine the issues, challenges, evaluation criteria, and techniques used in e-book evaluation. Identified challenges include the lack of standardization in interfaces and functionalities, licensing restrictions such as Digital Rights Management (DRM), variability in accessibility features across formats, and the complexity of criteria influenced by context and user needs. Commonly used evaluation criteria include readability, accessibility, interactivity, efficiency, and navigation. The evaluation approaches vary across domains, with educational settings focusing on engagement and knowledge retention, academic contexts prioritizing accuracy and depth, and professional environments emphasizing practicality and efficiency. Methodologies such as mixed methods, usability testing, and surveys are used to measure user satisfaction and technical performance. This review offers valuable insights for developers, educators, and researchers. Additionally, guiding better user experiences in future e-book design and innovation.

Keywords:

E-Book Evaluation, E-Book, Usability, Review

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Introduction

E-books' popularity has been boosting and swiftly moving towards delivering information across educational, academic, and professional settings. E-books offer numerous benefits that none can be found in conventional books. These benefits make e-books vary from the traditional library resources in terms of their acquisition, use, and information retention (Clark, 2016). Portability, searchability, and instant delivery are key reasons that put e-books on top of printed books. E-books are usually cheaper than traditional textbooks as well. What's more, e-books provide convenience when it comes to storage, other than being environmentally friendly (Bozkurt & Bozkaya, 2015) and lightweight alternatives compared to the heavy physical books (Parveen and Ramzan, 2024). The additional features that do not exist in printed books like multimedia content, the ability to change font size and style offer conveniences that may increase user satisfaction too (Ghaebi & Fahimifar, 2011).

The benefits of e-books are undoubted and have been researched extensively. The evaluation of the usability and functionality of e-books is crucial for ensuring that they meet the needs of diverse users which consist of different backgrounds. Existing e-book evaluation models often focus on factors relevant to libraries, like cost analysis, budget allocation, and content coverage (Goertzen, 2017). These models strongly depend on quantitative data for usage trend tracking, cost-effectiveness of subscriptions assessments, and collection development decision guides. While crucial for library management, this approach lacks the ability to comprehend the complexities of user interaction and satisfaction. However, most evaluation methods still tend to focus either on the IT fundamentals, such as system performance, security, and accessibility, or on subjective user-centered measures, such as engagement and satisfaction (Haslinda & Shiratuddin, 2015; Tovstiadi et al., 2018). This gap often leads to incomprehensive feedback that lacks synergy between the two.

Several studies (Bozkurt & Bozkaya, 2015; Zhang et al., 2016) have highlighted the lack of a cohesive framework for assessing e-books across technical and user-centered dimensions. While IT metrics provide valuable insights into usage patterns, cost analysis, system performance, and content availability, user feedback through surveys, interviews, and usability testing reveal the understanding of usability, accessibility, and overall satisfaction, which are important aspects for developers, educators, and other stakeholders aiming to improve the user experience (UX) of e-books. Therefore, it is important to plan a holistic evaluation criterion which can measure both technical and user-centric aspects effectively. This review paper aims to examine the issues and challenges in e-books evaluation, identify the evaluation criteria and techniques in e-books from diverse contexts.

Issues and Challenges in E-book Evaluation

Despite the growing adoption of e-books, their evaluation can cause several challenges that need to be addressed to improve both technical aspects and user satisfaction. The concerns associated with the e-book's evaluation include lack of standardization, accessibility, licensing, and complexity in evaluation criteria.

Lack of Standardization

Evaluating e-books presents a unique set of challenges due to their rapidly evolving nature and the wide range of formats and platforms available. The lack of standardization in e-book interfaces and functionalities is a significant problem in establishing consistent evaluation criteria. There are standards in web and mobile design, but the evaluation can be a challenge

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(Matraf, Hashim and Hussain, 2023). This is because the e-book varies in terms of content, audience, functionality and platforms. For instance, as highlighted in Tovstiadi, Tingle and Wiersma (2018), navigation and the ability to locate specific information within an e-book can vary greatly between platforms. For example, e-books on mobile platforms usually lack this crucial feature. This leads to difficulties in navigation evaluation. What constitutes "good" navigation, or an "effective" search function can change depending on the platform being evaluated. This inconsistency complicates efforts to compare e-books and platforms objectively and make a comprehensive evaluation.

On top of that, the term “interactive e-book” lacks a universally accepted definition. This ambiguity affects users and stakeholders from every background as it results in varied interpretations of the degree of interactivity features that constitute an interactive e-book. This causes a floating problem in evaluating interactivity of e-books. However, (Allison, 2003) divides e-books into three major categories, with simple e-books being the digitalized and downloadable versions of conventional books. Complex e-books are those that include hyperlinks to external resources or internal media and content elements. Lastly, advanced e-books, according to Mariusz (2013), combine a multitude of audio-video components which accompany the content with an element of interactivity, whereby the reader is given the opportunity to search through and use the features available, depending on their individual needs. Alternatively, Bozkurt and Bozkaya (2015) specified that there are four major interaction levels within interactive e-books that are based on the users’ involvement in the learning activity. At Level 1, termed "Passive", the user acts solely as a receiver of information. At Level 2, known as "Limited Participation", the user makes simple responses to instructional cues. Level 3, referred to as "Complex Participation", involves the user making a variety of responses using varied techniques in response to instructional cues. Finally, Level 4, labeled "Real-Time Participation", is characterized by the user being directly involved in a life-like set of complex cues and responses.

While the frameworks by Allison (2003) and Bozkurt and Bozkaya (2015) offer useful perspectives on categorizing e-books and their interactivity, they don't fully address the confusion around defining what makes an e-book "interactive." There's no consensus on which features or levels of interactivity are necessary, leading to different interpretations. Some stakeholders might prioritize multimedia, while others emphasize user engagement or adaptability. This lack of consistency creates problems for users, developers, educators, and researchers, as there’s no standard way to evaluate or compare interactivity. A clear, widely accepted framework is needed to resolve these issues and provide a better understanding of interactive e-books.

Licensing and Access Challenges

Licensing issues significantly influence e-book usability, especially in academic and educational settings, presenting various challenges for evaluation. Non-uniform licensing models across platforms restrict users' ability to access e-books seamlessly (Landoni, 2010). This problem is especially significant in academic environments where students and faculty encounter limitations due to licensing restrictions (Clark, 2016; Landoni, 2010). For example, some licenses may only allow a limited number of simultaneous users or impose restrictions on the duration of access, hindering the effective use of e-books, especially for high-demand titles (Goertzen, 2017; Tovstiadi et al., 2018). Evaluation models need to address how these

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limitations affect the user experience and academic workflows (Tovstiadi et al., 2018; Zhang et al., 2016).

The presence of Digital Rights Management (DRM) further complicates the evaluation process. DRM, while intended to protect intellectual property, often disrupts legitimate academic activities such as collaborative research and classroom use (Goertzen, 2017; Tovstiadi et al., 2018). Evaluation criteria should explicitly assess the impact of DRM on user experience, including the limitations on printing, copying, and sharing that reduce the effective use of e-books (Bozkurt & Bozkaya, 2015; Sun et al., 2018; Tovstiadi et al., 2018). For instance, restrictions on printing may force students to rely on screen reading, potentially leading to eye fatigue (Halim & Widyanti, 2018; Sun et al., 2018). Goertzen (2017) argues that DRM restrictions can contribute to user frustration and ultimately reduce e-book adoption. The lack of standardization in e-book licensing and DRM across publishers makes it difficult to develop comprehensive evaluation frameworks (Goertzen, 2017).

The challenge of accurately measuring e-book usage is another significant issue, particularly when users can download chapters or entire books offline (Uziel et al., 2016). Traditional IT metrics like page views and downloads become less reliable when offline access is unlimited (Goertzen, 2017; Uziel et al., 2016). Relevant stakeholders need to develop alternative assessment methods to capture offline usage patterns and gain a more accurate understanding of the value and impact of their e-book collections (Uziel et al., 2016). This might involve exploring user surveys, focus groups, or data from e-reader applications that track reading time and engagement even when offline.

Accessibility Concerns

Accessibility is another major issue in e-book evaluation. Sun et al. (2018) conducted a study on the accessibility of e-textbooks, identifying significant variability between different formats such as EPUB, HTML, and PDF. EPUB and HTML formats are generally more accessible compared to PDFs, but challenges remain in ensuring that all e-books are compatible with assistive technologies (AT). Ensuring that e-books meet the needs of users with disabilities is essential, as inaccessible designs can exclude a significant portion of potential users. Assistive features like text-to-speech, adjustable font sizes, individualized impaired-readers' feedback, and alternative text for images are crucial for making e-books accessible to all learners. (Bozkurt & Bozkaya, 2015; Matraf & Hussain, 2017; Sun et al., 2018).

Despite some progress, inconsistencies in accessibility features across platforms are still the same, creating a fragmented experience for users. Mune and Agee (2015) point out this lack of standardization as a major challenge. For instance, their study found that while some platforms provide adequate text-to-speech functionality, many others lack this essential feature, forcing users to rely on external applications or entirely tolerate the inconvenience.

E-book evaluations must push for greater standardization in accessibility features and advocate for a user-centered design approach that prioritizes inclusivity and a seamless reading experience for all. This involves identifying inconsistencies in accessibility features across platforms and advocating for consistent implementation and moving beyond checklists and compliance metrics to assess the actual user experience of individuals with disabilities. Finally, promoting the development of e-books that are not merely accessible but also enjoyable, engaging, and beneficial for everyone.

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Complexity in Evaluation Criteria

Developing comprehensive and useful evaluation criteria for e-books presents a significant challenge due to the wide range of factors that influence their quality. As Çırakoğlu et al. (2022) note, elements like content presentation, usability, interactivity, and technology make evaluations complex and potentially inconsistent.

This complexity is further amplified by the lack of standardized evaluation models. The absence of a widely accepted framework means that different institutions and researchers may prioritize various criteria differently, making it difficult to compare findings and draw meaningful conclusions (Bozkurt & Bozkaya, 2015; Fahimifar et al., 2016; Goertzen, 2017). The large number of variables to consider can be overwhelming for evaluators, leading to incomplete or inconsistent assessments (Fahimifar et al., 2016).

Several factors contribute to this challenge are as follows:

- Diverse formats and functionalities: E-books come in various formats (e.g., EPUB, HTML, PDF) with varying levels of functionality. This necessitates evaluation criteria that are adaptable to different technical specifications and affordances (Biancarosa & Griffiths, 2012; Divayana et al., 2019; Wang, 2018).
- Content heterogeneity: E-books encompass a wide range of content, from academic textbooks to corporate handbooks and interactive books. Evaluating diverse content requires different criteria and expertise, further complicating the process (Çırakoğlu et al., 2022; Divayana et al., 2019; Wang, 2018).
- Varied user needs and contexts: E-books cater to diverse user groups with different needs and objectives. For example, users from educational, academic, and professional backgrounds all have very different requirements and needs. Evaluation criteria also must consider accessibility and user experience across these groups (Mariusz Marczak, 2013; Takacs et al., 2015; Wang, 2018).

To address this complexity, future research should focus on developing standardized evaluation frameworks that provide a common ground for assessing e-books, creating adaptable evaluation criteria that can be suited for different e-book user contexts (Biancarosa & Griffiths, 2012; Bozkurt & Bozkaya, 2015; Mariusz Marczak, 2013; Sun et al., 2018; Wang, 2018). By tackling the complexity of evaluation criteria, the field can move towards more robust and meaningful assessments of e-book quality and effectiveness.

Evaluation Criteria

It is important to acknowledge that carefully defining the criteria that will be used to evaluate e-books is the top-most priority to produce a holistic evaluation criteria list. These criteria must cover both technical aspects and the more subjective, user-centered aspects of UX. The adaptable evaluation of e-books is critical in understanding their effectiveness and usability across various contexts. Different e-book domains require specific evaluation criteria to evaluate their suitability for users in educational, academic, and professional settings. The evaluation criteria can be grouped into several themes such as content quality, interface usability, interactivity, technology features, accessibility, and IT metrics. These themes consist of personalized items according to the e-book domain. This will help in accurately assessing the strengths and limitations of e-books, guiding their development and use. Table 1 summarized the evaluation criteria and techniques employed in evaluating the e-books

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associated to their domain. In Table 2, the list of evaluation criteria according to the technical and user-centered categories are presented.

Content Quality and Relevance

In most e-book evaluations, content quality is one of the most significant criteria, especially in educational and academic settings. The richness, clarity, and relevance of content are vital to ensuring that the e-book serves its purpose effectively (Çırakoğlu et al., 2022; Divayana et al., 2019). For educational e-books, content is often evaluated on its educational value, clarity, and engagement potential. For instance, in the study by Çırakoğlu et al. (2022) and (Wang et al., 2023), content was evaluated based on learning effectiveness and student engagement, which are critical in keeping learners motivated and helping them achieve learning outcomes. Knowledge retention is also a focus here (Hwang et al., 2018). In this setting, content needs to be accurate, easy to follow, and aligned with the curriculum. These covers the usage of the right terminology for the specific level of education, like the criteria used in the study of (Halim & Widyanti, 2018).

In academic contexts, the depth and academic rigor of the content are truly important. The accuracy, comprehensiveness, and integrity of the content are evaluated to ensure it meets the needs of scholars and researchers. The evaluation criteria may include how well the e-book facilitates research tasks, knowledge acquisition, and understanding of complex concepts. For professional e-books, the practicality and applicability of the content are crucial. Content in professional e-books is often evaluated based on its relevance to industry needs, technical accuracy, and clarity of instructions. For example, Ghaebi & Fahimifar (2011) examined professional e-books based on whether the information is up-to-date and deliver the users' needed content. These are essential for professionals seeking efficient and user-friendly resources for on-the-job tasks while not compromising their reliability.

Usability and Interface Design

The usability of e-books, which refers to how easy and intuitive the interface is for users, is a core criterion across all settings. On top of that, a user-friendly interface design can significantly impact a reader's ability to interact with and enjoy an e-book. These hugely contribute to increasing users' intention to keep using the e-books. In educational settings, the interface is often evaluated for ease of navigation, customizability, and accessibility features. For example, Bozkurt & Bozkaya (2015) identified ease of interface use, layout design, and universal design for accessibility as important elements in ensuring that students of learning and physical disabilities can use e-books without struggling.

In academic contexts, usability criteria include ease of search, highlighting and annotation features, and the ability to cross-reference. Moreover, having the ability to change font, font size, line spacing, and screen blue light intensity greatly reduces the discomfort of using e-books for an extensive period while carrying out research tasks. For professionals, the interface must be efficient and task oriented. Usability evaluations for this setting focus on navigation efficiency, access to relevant tools, and the speed of interaction. As seen in studies like Kang et al. (2009) and Halim and Widyanti (2018), reading speed and eye fatigue are important factors in evaluating e-book usability, especially for professionals who need to engage with content for extended periods, particularly in environments like libraries or corporate settings.

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Interactivity and Engagement

According to Bozkurt & Bozkaya (2015), *the interactive e-books are essentially digital book formats in which the user, the digital book, and the environment can interact reciprocally at a high level; digital book elements can communicate and interact among themselves and the environment as well as users, and many communication channels are put in use at one and the same time*. Interactivity refers to how well an e-book allows users to engage with its content. This is especially important in educational and academic e-books, where engagement directly impacts the learning experience. Research shows that learning outcomes are improved if the interactive elements in e-books are based on certain learning strategies (Connor et al., 2019; Çırakoğlu et al., 2022). Takacs, Swart, and Bus (Takacs et al., 2015) analyzed 29 studies and noted that different features in e-books can impact learning outcomes in distinct ways such as enriching animations that support understanding and overly stimulating interactive features that can distract from the main learning goals.

In educational contexts, interactivity is evaluated based on how well it supports active learning. Interactivity criteria such as interactive exercises, multimedia elements, integration with online dictionaries, automated tutors, individualized levels of support and instant feedback have been suggested to further enhance the educational value of e-books (Biancarosa & Griffiths, 2012). Graphics or animations could potentially cause students to memorize terms or formula better other than improving knowledge comprehension (Hwang et al., 2018). On the other hand, Çırakoğlu et al. (2022) designed an e-book that implements interactive elements like predict-observe-explain (POE) methods. It is a three-phase learning model in which students first predict the results of an experiment, situation, or question related to the topic. After the prediction phase, there comes the observation phase where students observe the right process regarding their predictions. Lastly, they will compare their predictions and observations to point the learning outcomes out at the explanation phase. These interactive elements are essential in educational settings to enhance engagement and facilitate deeper understanding. This directly supports better knowledge retention and understanding.

In academic e-books, interactivity is evaluated based on the ability to support research tasks and collaborative learning. This includes the ability to interact with concept maps, citations, and data visualizations. Fahimifar et al. (2016) emphasized searchability, audiovisual capability, and properly organized hyperlinking as key interactive features for academic users who need to engage with large volumes of research material efficiently. Meanwhile, interactivity in professional e-books is often measured by practical engagement features, such as real-time collaboration, interactive troubleshooting, and multimedia tutorials. Ghaebi & Fahimifar (2011) explored how multimedia features and ease of selection impacted the user experience in professional settings, especially where users needed to access practical information quickly and effectively.

Technology and Accessibility Features

The technological features of an e-book are critical in determining its compatibility with various devices and platforms, as well as its overall accessibility for users with diverse needs. Technological tools and features vary greatly depending on settings and users' needs. They are also open to a wide range of possible innovations to enhance user experience and learning achievement.

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In educational settings, accessibility is often evaluated based on support for assistive technologies (e.g., screen readers, magnification tools), platform compatibility, and device flexibility. Sun et al. (2018) focused on accessibility checkpoints such as text adjustment, navigation, and multimedia compatibility to ensure that e-books are accessible to all students, including those with disabilities. In a study by Hover & Muhlhauser (2014), they presented a lecture e-book having a quiz on the left page and slide, its corresponding audio, and the lecturer's pen annotations on the right page to their survey participants. None of the participants answered that the lecturer's pen annotation is not important, which indicates another important criterion in this setting. For academic users, technology-related criteria include the ability to integrate citation management tools, cloud storage, and cross-platform compatibility. The study by Goertzen (2017) emphasized how quantitative data, like usage statistics and cost analysis can be used to evaluate the efficiency and accessibility of academic e-books in libraries. In professional contexts, technological features are evaluated based on performance efficiency, security features (such as DRM protection), and integration with professional tools.

Professionals require e-books that can integrate seamlessly with enterprise software and provide high-quality multimedia for training and reference. Kang et al. (2009) noted that visual fatigue is an important criterion when assessing the quality of e-books in professional environments, particularly when used for long periods. In general settings, accessibility features like individualized feedback for impaired readers, expressive graphic explanation for deaf users, and text-to-speech are criteria not to be overlooked at (Biancarosa & Griffiths, 2012).

IT Metrics

In addition to content and usability, IT metrics play a vital role in evaluating e-books, particularly when assessing their effectiveness in practical, real-world applications. These criteria are essential for determining the overall efficiency, cost-effectiveness, and sustainability of e-book systems. They can also facilitate better improvement or future project decision making.

Usage Patterns

This refers to how frequently and in what manner users interact with the e-book. In academic settings, usage patterns often highlight how researchers and students engage with e-books for study or research. Research like the ones conducted by Goertzen (2017) and Uziel et al. (2016) emphasized usage trend data to evaluate e-book effectiveness and economic status. A study analyzed system logs to evaluate student interaction with a web-based e-book integrated with a concept mapping system (Li, 2015). The analysis focused on specific behaviors such as text highlighting and concept map creation. The researchers also investigated the correlation between these behaviors and learning outcomes (Li, 2015). Another research investigated the relationship between reading behavior patterns, captured through e-book log data with learning outcomes (Wang et al., 2023; Yin et al., 2019). On the other hand, some studies examined student usage patterns towards e-books in academic environment (Hover & Muhlhauser, 2014; Matraf & Hussain, 2017). They specifically study user preferences by utilizing the usage data like locations where students read and functionalities they use. Zhang et al. (2016) reviewed various studies that are more complex in this matter. The review highlighted studies that utilized transaction log analysis to investigate e-book search behaviors and reading patterns, including time spent on specific pages and navigation patterns.

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Cost Analysis

Evaluating the cost-effectiveness of e-books is essential, particularly in institutional or professional contexts. For instance, the study by Wang et al. (2023) incorporated cost-benefit analysis to evaluate the return on investment of developing e-book systems. In professional settings, the cost of purchasing, maintaining, and updating e-books is a key consideration. This is balanced against the value it provides to the organization in terms of time savings and accessibility.

System Performance

System performance measures how well the e-book functions across various devices and under different conditions. For professional users, the speed, compatibility across platforms, and stability of the e-book system are crucial. In educational and academic settings, performance is evaluated by factors such as loading times, system crashes, and user feedback on platform stability, as these can significantly affect the usability and accessibility of e-books. This involves securely storing users' data, such as bookmarks and annotations, without compromising speed or functionality.

Content Availability

This refers to how easily content can be accessed, downloaded, or integrated into the user's workflow. In educational and academic contexts, availability of up-to-date content is essential for ensuring that users have access to relevant, current information. Content availability also involves the ability to access content in different formats (e.g., EPUB, PDF) and across different devices (e.g., mobile, desktop) at any time of the day (Sun et al., 2018).

Evaluation Methodologies

In evaluating e-books, researchers employ various methodologies to assess usability, effectiveness, and user satisfaction. These methodologies range from quantitative approaches, such as surveys and statistical modeling, to qualitative methods, such as interviews and observational studies. The evaluation methodology used often depends on the type of e-book being assessed, the context of its use, and the specific criteria being measured. In this section, use **Table 1** as the main reference. We will explore the evaluation methodologies used in studies across different settings (educational, academic, and professional), focusing on task distribution, tester groups, and quantitative and qualitative assessments.

Mixed Methods Approaches

One of the most common methodologies in e-book evaluation is the mixed methods approach, which combines both quantitative and qualitative research techniques. This approach allows for a comprehensive understanding of e-book usability by integrating numerical data with rich user feedback. Bozkurt & Bozkaya (2015) used a mixed methods approach to evaluate interactive e-books for Open and Distance Learning (ODL). Their methodology involved a four-round Delphi study with 30 experts (Delphi panel) and 20 interactive e-books. In this study, qualitative insights from the Delphi panel were combined with quantitative evaluations based on heuristics and expert ratings of e-book features. The Delphi study included 30 experts from various fields, including instructional design and e-learning. Additionally, a separate group of 20 e-books was used for hands-on evaluation to validate the experts' findings. The task distribution for the experts included evaluating the e-books based on pre-defined criteria such as ease of navigation, content quality, and technical performance. This mixed approach

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of quantitative and qualitative assessment gave a comprehensive understanding of how the e-books performed in different aspects.

Empirical Evaluation

Empirical evaluation focuses on direct observation and hands-on testing of e-books in real-world conditions. These evaluations often include user testing with specific tasks assigned to groups of testers. Çırakoğlu et al. (2022) used an empirical evaluation methodology to assess an interactive e-book based on the Predict-Observe-Explain (POE) method. In this study, students were given the task of interacting with the e-book while engaging in scientific inquiry. The evaluation focused on assessing interactivity, learning effectiveness, and student engagement. The testers in this study were students who interacted with the e-book as part of their regular classroom activities. The task distribution involved having the students complete a series of activities related to the POE method. The e-books were tested to assess how well they supported these activities. The data gathered helped to assess whether the e-book enhanced learning engagement and the overall educational experience.

Experimental Design

Experimental methodologies are commonly used in studies that aim to compare the effects of different e-book designs or features. These studies often involve control and experimental groups to test specific hypotheses. Hwang et al. (2018) conducted an experimental study comparing two groups of fifth-grade students (experimental vs. control) to measure the impacts of guided peer-feedback on learning achievements and project outcomes. The study employed pre-test and post-test measures to assess the effectiveness of the e-book intervention. The testers were two groups of fifth-grade students. The experimental group used the e-book with guided peer-feedback, while the control group used a traditional learning method. Task distribution involved assigning both groups to complete the same learning activities, but with different methods of feedback. The students' learning achievements were measured based on the outcomes of the tasks. The learning achievement was quantitatively assessed through pre-test and post-test scores. The statistical analysis (ANOVA) helped determine whether the e-book intervention improved learning outcomes compared to the control group. In addition, cognitive load and engagement were measured to assess the e-book's impact on learning.

Task-Based Usability Testing

Task-based usability testing is used to evaluate how well users can complete specific tasks with an e-book. This method is often applied in professional settings, where efficiency and ease of use are key. Study Example: Tovstiadi et al. (2018) employed a task-based usability testing methodology to assess e-books from the students' perspective. The study involved participants completing typical e-book tasks on three platforms (aggregators and publishers), while providing feedback on usability and satisfaction. Testers: The testers included 35 students from various academic levels (undergraduates, masters, and doctoral students). The testers were assigned specific tasks such as navigating e-book content, searching for key topics, and using interactive features like annotations and highlighting. The study combined quantitative measures of task completion time and accuracy with qualitative feedback gathered through think-aloud protocols and user satisfaction surveys. The quantitative data helped assess the efficiency of e-book platforms, while the qualitative data provided insights into user preferences and frustrations. In the study by Fahimifar et al. (2016), data from the survey were analyzed using confirmatory factor analysis (CFA), which allowed the researchers to identify key factors contributing to e-book effectiveness in academic contexts.

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Qualitative Research: Interviews and Observations

Qualitative research methods, including interviews and observations, provide in-depth insight into user experiences, which can be crucial for understanding subjective aspects like satisfaction and engagement. In the work of Goertzen (2017), interviews and focus groups are held to capture subjective feedback about e-books. Plus, open-ended questions are effective as well as we will have richer in-depth user insights (Goertzen, 2017). The qualitative data was analyzed to identify patterns and inform improvements in e-book systems.

The evaluation methodologies employed in e-book research vary significantly depending on the context and purpose of the study. From mixed methods approaches that combine both quantitative and qualitative data, to experimental designs that compare the effectiveness of different e-book features, these methodologies provide comprehensive insights into how e-books are used and how they perform. In addition, understanding how testers are selected, and tasks are distributed across different groups, whether experts, students, or professionals helps inform how e-books are evaluated in real-world settings. The combination of task-based usability testing, survey research, empirical evaluations, and qualitative interviews ensures that the evaluation of e-books is both thorough and diverse, providing useful information for designers, educators, and professionals looking to optimize e-book use.

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Table 1: Review of Existing Studies on E-books Evaluation

E-book Domain	Author (Year) & Title	Evaluation Methodology	Testing Subject	Evaluation Criteria
General context.	Huang et al. (2017), *What Factors Satisfy E-Book Store Customers? Development of a Model to Evaluate E-Book User Behavior and Satisfaction*	Data were collected through an online survey, and the results were analyzed using structural equation modeling (SEM).	The testing subjects were 183 e-book users who participated in the survey.	Key criteria include factors such as functional service, mobility, convenience, and searching tasks. These factors influence user satisfaction and behavior based on the Task-Technology Fit (TTF) theory.
General context.	Sun et al. (2018), *E-Book Accessibility Evaluations*	The study uses a methodology developed by Human Factors researchers to evaluate the accessibility of e-textbooks. This includes evaluating e-textbooks using assistive technologies (AT) and non-assistive technologies (NAT).	The evaluation involved 140 publicly available e-textbooks from the California Open Online Library for Education (COOL4ed).	The evaluation criteria were based on 15 Skills Commons accessibility checkpoints. The study also compares e-textbooks accessibility based on the type of technology used (AT vs. NAT).
Academic context.	Fahimifar et al. (2016), *Evaluation of Academic EBooks, From Conceptual Framework for Structural Equation Model*	Survey research conducted via a 125-item questionnaire with a five-point Likert scale. Data analyzed through confirmatory factor analysis (CFA) using LISREL software.	12 subject professionals with specialty in e-books, digital IT, library, and research methods.	3 major categories - electronic media factors, paper media factors, delivery factors, and library factors which include IT metrics of data relating to loans of e-books in libraries, their classification and management, and

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E-book Domain	Author (Year) & Title	Evaluation Methodology	Testing Subject	Evaluation Criteria
				around the clock availability.
Academic and professional context.	Ghaebi & Fahimifar (2011), *E-book acquisition features: Attitude of Iranian information professionals*	Survey research using a paper-based questionnaire (20 items) and interviews. Data were analyzed using descriptive statistics.	60 information professionals working at universities in metropolitan Tehran.	Academic user top needs are high storage capacity and multimedia features are essential, while those of the professionals are compact size, ease of selection, and simultaneous distribution.
Educational context.	Bozkurt & Bozkaya (2015), *Evaluation Criteria for Interactive E-Books for Open and Distance Learning*	Mixed methods, including a four-round Delphi study and heuristic inquiry.	30 experts (Delphi panel) and 20 interactive e-books.	4 basic themes - content, interface, interaction, and technology.
Educational context.	Çırakoğlu et al. (2022), *Designing, Developing, and Evaluating an Interactive E-Book Based on the Predict-Observe-Explain (POE) Method*	Empirical evaluation of an interactive e-book based on the Predict-Observe-Explain (POE) method.	Students engaging with the interactive e-book using the POE method.	Interactivity, learning effectiveness, and student engagement are crucial criteria to evaluate educational e-books.
Educational context.	Hwang et al. (2018), *Creating Interactive E-Books through Learning by Design: The Impacts of Guided Peer-Feedback on Students' Learning*	Comparing the two groups on learning achievement, cognitive load, and project outcomes after an eight-week e-book design activity.	The testing subjects were two groups of fifth-grade students	The evaluation criteria include learning comprehension, feedback from peers, and the effectiveness of the interactive design, with a focus on engagement and knowledge retention.

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E-book Domain	Author (Year) & Title	Evaluation Methodology	Testing Subject	Evaluation Criteria
	Achievements and Project Outcomes in Science Courses			
Educational context.	Shiratuddin (2015), *Evaluation of e-Book Applications Using ISO 25010*	The survey of 16-item questionnaire was processed using SPSS, and the instrument was tested for reliability and validity using Cronbach's Alpha Coefficient.	200 teachers from 37 primary schools in Terengganu, Malaysia.	The evaluation is based on four ISO 25010 quality characteristics - usability, performance efficiency, reliability, functional suitability.
Educational and academic context.	Goertzen (2017), *Applying Quantitative Methods to E-book Collections*	Mixed-methods approach combining quantitative data analysis and qualitative insights from user feedback and stakeholder consultations.	No test held.	Applies IT metrics including citation data, usage data, vendor use data, cost per use, and e-book development costs.
Educational and academic context.	Tovstiadi et al. (2018), *Academic E-Book Usability from The Student's Perspective*	Task-based usability testing combined with a think-aloud protocol. Subjects were asked to complete typical e-book tasks on three platforms and provide feedback.	Thirty-five students (undergraduates, masters, and doctoral).	The evaluation criteria focused on usability aspects such as platform features, design elements, and user satisfaction.
Educational and academic context.	Wang et al. (2023), *Development and Evaluation of a Visualization*	The study evaluated two learning modes: reception comparison,	146 participants who studied in cache-cache comparison mode and 50	The evaluation criteria include learning perception, learning achievement, and

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E-book Domain	Author (Year) & Title	Evaluation Methodology	Testing Subject	Evaluation Criteria
	System to Support Meaningful E-Book Learning	where expert-generated topic maps were shown, and cache-cache comparison, where learners' pre-made relationships were compared to those of experts. Pre- and post-test scores were analyzed using ANOVA.	participants who studied in reception comparison mode.	user feedback regarding the effectiveness of the learning modes and system design.
Educational and academic context.	Zhang, T., & Niu, X. (2012), *The User Experience of E-Books in Academic Libraries: Perception, Discovery, and Use*	The paper reviews existing studies and integrates findings on three key phases of user experience: perceiving e-books as a useful resource, discovering e-books in library collections, and using e-books for academic purposes.	The subjects include library users such as students, faculty, and staff.	The paper evaluates user awareness of e-books, discovery and navigation in library catalogues, essential e-book features like search functions and annotations, user interface design, and barriers to effective use, such as navigation difficulties and technical issues.
Mobile platform context.	Chiu et al. (2016), *Implementation and evaluation of mobile e-books in a cloud bookcase using the information system success model*	Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 2.0	College students from three universities in southern Taiwan.	System quality, information quality, intention to use, and service quality are the main aspects in evaluating e-book systems, including load speed and storage capacity as parts of the IT metrics.

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E-book Domain	Author (Year) & Title	Evaluation Methodology	Testing Subject	Evaluation Criteria
Mobile platform context.	Matraf & Hussain (2017), *Usability evaluation model for mobile e-book applications*	Questionnaires were used to measure user satisfaction.	The testing subjects were 30 students from Universiti Utara Malaysia.	The evaluation criteria include readability, effectiveness, accessibility, efficiency, and navigation. These characteristics were evaluated to determine their impact on user satisfaction.
Web platform context.	Li (2015), *Development and evaluation of a Web-based e-book with a concept mapping system*	The evaluation involved collecting user feedback and system logs to assess usability and effectiveness. The analysis of the system logs provides numbers of behaviours and annotations in creating the concept maps.	The testing subjects were 139 seventh-grade students.	The evaluation criteria included user feedback, system logs, and the quality of concept maps created by students. System logs are the IT metric utilized to get the data of student annotations and behaviours such as number of highlighted text segments and comments.

Table 2: E-books Evaluation Criteria between Technical and User-Centered

Evaluation Criteria	Technical Criteria	User-Centered Criteria	Source
System Performance (speed, stability, compatibility)	√		Shiratuddin (2015), Fahimifar et al. (2016), Kang et al. (2009)
IT Metrics (usage patterns, system logs, data tracking)	√		Goertzen (2017), Li (2015), Wang et al. (2023)
Cost Analysis (cost-effectiveness, ROI)	√		Goertzen (2017), Wang et al. (2023)
Content Availability (format compatibility, accessibility across devices)	√		Sun et al. (2018), Zhang & Niu (2012)

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Evaluation Criteria	Technical Criteria	User-Centered Criteria	Source
Digital Rights Management (DRM) restrictions	√		Goertzen (2017), Tovstiadi et al. (2018)
Licensing and Access Control	√		Goertzen (2017), Tovstiadi et al. (2018)
Integration with professional tools and citation management systems	√		Goertzen (2017), Ghaebi & Fahimifar (2011)
Accessibility (text-to-speech, font, screen reader compatibility)	√	√	Shiratuddin (2015), Matraf & Hussain (2017), Tovstiadi et al. (2018)
Search and Annotation Features (highlighting, bookmarking, notetaking)	√	√	Zhang & Niu (2012), Shiratuddin (2015), Fahimifar et al. (2016), Tovstiadi et al. (2018)
Usability & Interface Design (navigation, ease of use)		√	Shiratuddin (2015), Matraf & Hussain (2017), Tovstiadi et al. (2018)
Readability (clarity of content, font size, contrast)		√	Bozkurt & Bozkaya (2015), Matraf & Hussain (2017)
Interactivity and Engagement (multimedia, interactive exercises, feedback features)		√	Takacs et al (2015), Bozkurt & Bozkaya (2015), Çırakoğlu et al. (2022)
Learning Effectiveness (knowledge retention, student engagement)		√	Hwang et al (2018), Çırakoğlu et al. (2022)
User Satisfaction and Perception		√	Huang et al (2017), Goertzen (2017), Tovstiadi et al. (2018),

Conclusion

The e-book evaluation landscape is constantly evolving, but there is a great need for a more integrated approach that balances both technical and user-centered criteria. The aim of this article is to examine the evaluation of e-books, from its criteria to the methods of evaluating e-books that serve different user needs and technical platforms. This research highlights the importance of understanding the criteria that can be planned for evaluating e-books according to their purpose, setting, target audience and maintaining high standards of quality and accessibility. Additionally, issues and challenges have also been highlighted that the developer can address while developing the required e-books. It was a big challenge especially for the practitioners to reconcile the topic and the evaluation criteria from the technical aspect to the user experience.

Based on this study, the e-book designer and the developer can use the criteria to design and develop the e-book tailored to the user perspectives. The usability aspects and the interactivity of the e-book can be improved if its criteria are taken into account at the beginning before design and development. This is of crucial importance, since you have to take several factors of the user experience into account, for example, age, background, domain of the e-book and others. The interactivity and accessibility, which includes a different form of multimedia such

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as photos, video and text-to-speech, can influence the use of the e-book. A balance in designing the e-book is important to ensure that the content is understood by the reader without producing any critical distractions. The gaming features can also be included in the e-book when looking at the nature of today's community interest. Besides fun and interactive, the user is easy to follow the flow of the e-book, understand the content better and effective in user retention like a study conducted by Noor, Rahim, & Ekhsan (2024) for the secondary student. Perhaps the idea of integrating gaming elements can be done to the content that is difficult to understand.

Future research work on e-book evaluation should concentrate on the development of a holistic evaluation framework that integrates both the technical and the user-centered aspects in order to provide a standardized assessment approach. The examination of the long-term effects of interactivity on learning retention is important, especially in various educational and professional environments. In addition, the integration of AI-controlled personalization, augmented reality (AR) and voice-supported navigation could significantly improve accessibility and engagement to different users, including those with disabilities. AR is another element that can attract motivation of the readers to actively engage with the content (Kamaruzaman & Rozuki, 2024). Investigations should also examine ethical considerations and data protection in e-book analytics to ensure that the user behavior tracking for personalization corresponds to data protection algorithms. Finally, coping with licensing and DRM challenges through policy-based studies could help improve the accessibility and availability of e-books and make digital learning resources more effective and integrative.

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