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UNDERSTANDING THE DEVELOPMENT OF DIGITAL LEARNING RESOURCES:
THE CASE OF DIGITAL EDUCATIONAL LITERATURE IN ESTONIA
MA thesis

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ABSTRACT

This master's thesis aim is to reach a better understanding of how digital learning resources are designed and developed in Estonia. The research draws on document analysis to understand how national policy, regulatory frameworks, and contextual expectations influence the development of digital learning resource and on expert interviews to investigate anticipatory decisions guiding this process. The analysis revealed that interviewees did not perceive a strong, well-coordinated national commitment to the strategic advancement of digital learning. And that the development of digital educational literature is fundamentally teacher-centered, strongly tied to everyday teaching practices. Future research should involve a larger and more diverse sample, and consider repeating the study after a few years, given the rapid and semiotically transformative developments in educational technology.

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INTRODUCTION

Digital learning resources are becoming increasingly integral to Estonia's educational landscape. This master's thesis investigates digital learning resources that are created for educational purposes and defined as digitally accessible resources featuring text, graphics, or other interactive multimedia content elements (see Laanpere, 2015). Tartu University project *DigiEfekt* (2020–2023) studied teachers' strategies for using digital technologies, digital learning environments and digital content in classrooms. It revealed that out of the 171 lessons observed, digital technologies were already being used in about 80% of the lessons (Raave et al., 2022).

Currently we can see a growing number of digital learning resources in the market – both free and paid solutions. While this trend has the potential to foster an environment where teachers and students can exercise greater autonomy in decision-making and choices, the feedback from teachers indicates that the quality of available resources varies considerably, thus finding and implementing suitable resources need more support (see Tammets et al., 2021). It is important to note that teachers have different levels of experience with using technology. As Adov and Mäeots (2021) demonstrate, the higher the teachers' perceived willingness to use digital technology, the easier it was for them to overcome potential external or internal obstacles and to cope with distanced learning during the Covid pandemic.

Globally, the implementation of digital learning in general education (K–12) faces similar challenges: infrastructure constraints, digital divide and inequality, lack of long-term commitment by the government, etc.; however, the main concern seems to be using technology in pedagogically meaningful ways (*Trends and Issues...* 2023). Pedaste and Bardone (2023) point out that Estonian teachers still tend to use digital tools to replicate traditional learning methods rather than for enhancing their practices, in this way limiting the opportunity to transform learning processes and educational goals. This is a twofold challenge from the digital learning resources perspective: if these resources continue to be used merely to replicate existing teaching practices, there is little stimulus or impulse for developers to create digital learning resources capable of supporting teachers in substantially transforming their approaches.

The Estonian Education Strategy 2021–2035 (2021) understands the problems regarding digital learning resources stemming from an inadequately systematic approach in developing and implementing the resources necessary for learner-based teaching and learning. Thus, in this master's thesis, I will turn my attention to the design and development

process of digital learning resources – more precisely, I will focus on the production of digital educational literature. Educational literature, both printed and digital, offers comprehensive solutions that align closely with the national curriculum and it is the only type of learning resource the state has a legally mandated role in its provision and quality control (Haridus- ja Teadusministeerium [HTM], 2025). Transforming print text- and workbooks into digital interactive learning resources, developers have to anticipate technical as well as pedagogical aspects. Their work is also significantly influenced by the context in which they operate, because the issues outlined in the education strategy are not isolated phenomena but are part of complex system of educational policies, funding, visions of future, dominant trends etc.

To understand the complexities in the design and development of digital learning resources, I will focus on the developers' "design anticipations" and sociotechnical context surrounding their work. For this purpose, I conduct expert interviews. To the best of my knowledge, no research in Estonia has studied digital learning resources developers' decision-making and procedural considerations, and how their contemporary environment impacts their work.

THEORETICAL OVERVIEW

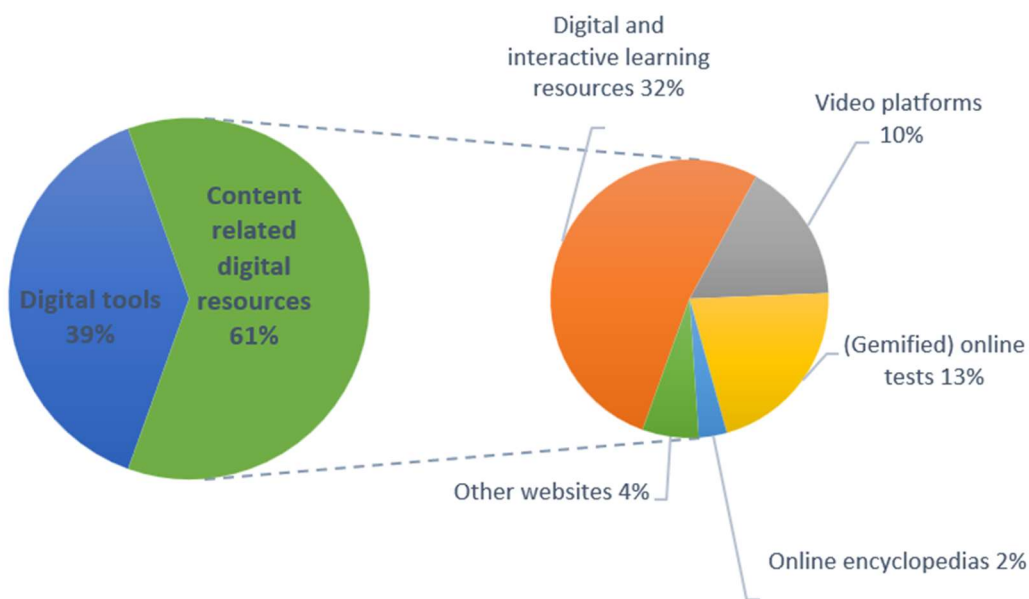
Defining digital learning resources

This master's thesis uses a variety of concepts related to learning resources. It is important to define and clarify the concepts to ensure a shared understanding. I will begin with the framework provided by the Estonian Ministry of Education and Research, as official narratives play a central role shaping the research object. The Ministry's website (HTM, 2025) outlines two distinct categories: "learning aids" and "learning materials." Learning aids include a wide range of resources, including educational tools, hardware, software, and items like balls, skates, and drawing supplies. Learning materials, on the other hand, are defined as resources specifically designed for educational purposes, which consist of text, assignments, supporting visuals and, in the case of digital materials, additional multimedia elements. The understanding of digital learning materials outlined on the Ministry's website aligns with the concept provided by Mart Laanpere (2015). But to better emphasize their flexibility, multimodality, and diverse applications, henceforth the term "resources" is preferred over "materials".

Digital learning resources are an important tool for teachers, who, thinking of their students, are in need of a variety of resources. In Estonia, information about different digital learning resources for general and vocational education, is gathered to a national learning resources repository E-koolikott, available since 2016 (Õpetajate Leht, 2016). As a repository and in some ways library, it is a digital environment where one shelf contains *Open Educational Resources* (OER) created by teachers, another holds supplementary resources developed by various organizations and companies and one shelf is for educational literature. Naturally, the quality, creators' expertise, and intended purpose vary across these different shelves and the issues of quality and usability are important to address in both concerning OER and professionally-created learning resources. In this thesis the focus is on the latter: educational literature, which in Estonia refers to resources – both printed and digital – that meet the substantive and technical requirements outlined in the Educational Literature Regulation (2016) and have been formally reviewed as required by the regulation. When textbooks, workbooks or digital learning resources are ready for use, publishers are required to make an entry in the register of educational literature, a.k.a. E-koolikott.

From the observation data of the *DigiEfekt* study (2020-2023), digital learning resources as understood in this thesis represent the most frequently used subcategory in the use of digital technologies in schools (Figure 1) (Raave et al., 2022).

Figure 1. Digital technology use in K-12 schools: *DigiEfekt* study findings



It is important to recognize that there is a wide range of stakeholders like teachers, education technology companies, government agencies, and other organizations, all contributing to the development and implementation of different kind of digital learning resources. And while publishing houses specializing in educational literature hold a significant position within this network, they are part of a much broader and more dynamic system.

Digital educational literature

While in its traditional form, developing educational literature is a long-standing practice, this master's thesis focuses on the past decade that has seen digital technologies increasingly intersecting with and transforming this process. Educational literature, in any format, refers to learning resources that meet the substantive and technical requirements outlined in the Educational Literature Regulation (2016, henceforth, the Regulation). The development of educational literature is also closely aligned with the national curriculums and guided by principles outlined in the Basic Schools and Upper Secondary Schools Act (2010, § 3). These include the concept of learning, core educational values, general and subject-specific teaching and educational objectives, as well as the intended learning outcomes and content. To better illustrate that, I will first outline the key policy documents that serve as its foundation.

Requirements for textbooks, workbooks, exercise books, as well as for the review process and reviewers of educational literature in the form of the Regulation are retrospectively observable in *Riigi Teataja* since 2010. In its current form and wording, without any changes, the Regulation has existed since 2016. The Regulation in turn refers to the Basic Schools and Upper Secondary Schools Act (PGS, 2010) and to national curriculums: for basic schools (PRÕK, 2011); for upper secondary schools (GRÕK, 2011) and the simplified national curriculum for basic schools (PRLÕK, 2010). These documents provide both value-based and substantive normative requirements for the regulation (overview of all the requirements in Appendix 1).

The regulation has been established based on the § 20 of the Basic Schools and Upper Secondary Schools Act (2010) and the paragraph's most important statement in it concerns the state's role and responsibility ensuring the availability of educational literature to schools:

The Ministry of Education and Research, per grade and subject, ensures the availability of the minimum educational literature required for completion of national curricula. Schools are free to choose the educational literature required in each grade for completing the school curriculum. (§ 20 (2)).

With this statement, it is emphasized that the state has a responsibility regarding learning resources. In Estonia, this responsibility manifests itself in the cooperation with publishing

houses operating in the private sector. The state has entrusted the task of ensuring the availability of educational literature to the private sector, on the assumption that competition in the market ensures the best quality (see Musting & Puumeister, 2020). The state's task is to identify market failures, i.e. gaps that the private market has not filled and if necessary, to intervene in the compilation of educational literature to ensure that the necessary materials are available in all subject areas and age levels (Musting & Puumeister, 2020). I will not deal with this aspect in more detail; however, in future research, it is important to consider how the role of the state, defined in this way, affects the learning resources ecosystem and could change in light of existing and constantly evolving educational technology.

Requirements in the Regulation express the state's vision of high-quality learning resources. Substantive requirements in the Regulation are multi-layered and vary from extremely abstract value-based ones up to more or less specific requirements. An example of higher abstraction in requirements:

The socialization of the new generation is based on the traditions of Estonian culture, common European values, and the recognition of the main achievements of world culture and research. People who have acquired general education are able to integrate into society and contribute to the sustainable social, cultural, economic and ecologic development of Estonian society (PGS § 3. (3), 2010).

And an example of more specific requirement embodies necessary font size for different school levels (see Regulation § 3. (4)).

The requirements for peer review provide an interesting perspective on the state's expectations regarding teachers' awareness about existing learning resources. Publishers are required to obtain a review from the respective subject association, with the expectation that this will foster discussion among teachers, Regulation (2016):

The purpose of the subject-specific association's review, in addition to what is stated in paragraph 2 of this section, is to enable a broad and multifaceted discussion on educational literature among practicing teachers as its users. This aims to ensure the most effective usability of educational literature in accordance with the goals and principles outlined in the national curricula and to promote the growth of informed demand when ordering educational literature. The subject association's review provides practical information on the use of educational literature in teaching. (§ 4 (3)).

However, a key question is – does this expectation is realized and how effective the subject-specific associations are in raising broader awareness. In general (from the perspective of the ecosystem as a whole) it would be again an interesting point of departure in the context of future research addressing concerns that teachers need more support finding and implementing suitable good quality resources.

In the context of this study, it is particularly important to note that the Regulation includes only one requirement specific to digital format and it is a broadly flexible technical requirement, Regulation (2016):

Digital educational literature is, where possible, usable on digital devices with different operating systems and, to a reasonable extent, adaptable for the visually and hearing impaired. (§ 3 (6)).

In the template for peer review (Appendix 2), made available in early 2024, and accessible in the educational literature register subsection of a national learning resources repository E-koolikott, an additional category regarding digital format has been introduced. Questions with the Likert scale and open-answers boxes address aspects such as user-friendliness and logical navigability (e.g., whether the instructions are age-appropriate and easy to understand), as well as whether, in the reviewer's opinion, the interactive task types are methodologically sound and suitable for the target age group. Although some aspects regarding the specificities of digital educational literature have been added to the template, it is still clear that the Regulation itself needs updating or rethinking on a larger scale. Also, since all three referred curricula and PGS have been repeatedly updated or supplemented during the last decade, there are several inconsistencies and outdated wording in the Regulation.

Some of the requirements concerning digital learning resources also come from other regulations and laws made at both national and European Union level. For example, the European Union *Accessibility Directive* will enter into force in 2025 and it concerns digital learning platforms among other e-environments. Also, regulations related to cybersecurity and data protection significantly affect the education sector, for example the European Union *General Data Protection Regulation* (GDPR), which has been in force since 2018.

To summarize this subsection, for example, another highly digitalized country and our neighbor Finland, does not have such state level requirements for the learning resources. Teachers follow the guidelines of the national curriculum; therefore, the use of digital technologies varies greatly (see Näykki & Häkkinen, 2023). Finnish National Agency for Education (*Opetushallitus*) has issued different guidelines on digital learning resources based on the accessibility act, data protection etc; e.g. a guide on what constitutes a pedagogically high-quality digital environment and a guide on the quality criteria for digital learning resources (see the website of the Finnish National Agency for Education, 2025). The guidelines are for both – for the developers of digital learning resources and for the schools and teachers, who can rely on them when choosing learning resources.

Instructional Design

As outlined above, the quality criteria that are addressed in the Educational Literature Regulation concerns: substantive requirements, technical requirements and peer review requirements. To better understand the digitalization of educational literature and bring out

the structured framework that considers both normativity outlined in the Regulation and the iterative nature of digital learning resources development, I describe the process from a point of view where distinct stages or phases can be identified. For that, I will use the instructional design framework, that has two applications: 1) it will guide in understanding and describing the development process; 2) it serves as a frame for conducting and coding the expert interviews.

The model most commonly used for systematically breaking down the key phases involved in the development of a learning resource, a course or a program, is the ADDIE model, which is an acronym for *Analysis, Design, Development, Implementation, and Evaluation*. This model from the 1970s, which is based on Robert Gagne's concepts, is simultaneously widely accepted and contested (see e.g. Amatya, 2022; Branch, 2009; Peterson, 2003). Different stages may occur in a non-linear sequence, and moving back and forth is rather typical for the development of learning resources. So it is important to understand that design and development are not necessarily a strictly linear process.

Interestingly ADDIE is almost monopolistically recommended and implemented model by relevant Estonian government agencies. Since 2007, when the e-learning quality task force – initiated by the then Estonian Information Technology Foundation for Education (HITSA) – began its activities, several guidelines were issued to support the creation of high-quality digital learning resources (Varendi et al., 2018). These include the guide for developing learning objects *Juhend kvaliteetse õpiobjekti loomiseks* (2012) and for creating a e-course *Juhend kvaliteetse e-kursuse loomiseks* (2013), both of which are primarily for vocational and higher education. Additionally, the guide for developing digital learning materials, *Digitaalse õppematerjali loomise soovitused* (2015) aimed to consolidate different types of learning resources used across all levels of education. In 2025, the most recent version of this guide was updated to accompany the national learning resources repository E-koolikott. For all these guidelines, the ADDIE model is used for ensuring the quality of digital learning resources. This demonstrates how the ADDIE model can become deeply integrated in one's nation educational discourse on addressing the quality of digital learning resources.

From the same period when the e-learning quality task force started its work, comes Kairit Tammets' master's thesis (2008), in which she argues that caution must be exercised when using these kinds of process-based models, as they assume homogeneous conditions and target groups (for example a military academy), and may thus not be the most suitable for developing resources that support self-directed learning. However, as Tammets (2008), citing

Reigeluth (1999), points out, we should not entirely reject or discard the old paradigm of existing instructional design theories; instead, they should serve as foundation to build upon and integrate the valuable knowledge developed in previous instructional design frameworks. Therefore, contemporary approaches to the development and design of digital learning resources should be more dynamic than prior and consider learners' needs from multiple perspectives. This is also proven by the fact that the ADDIE model has been repeatedly studied and improved over the years (see Spatioti et al., 2023).

This master's thesis focuses exactly on the processual aspect – how a particular development process unfolds, how it can be planned, and structured. I will now describe each phase of the ADDIE (*Analysis, Design, Development, Implementation, and Evaluation*) model in the context of digital educational literature.

The Analysis phase is first and foremost an analysis of needs to distinguish between what learners already know and what they need to learn (Peterson, 2003). According to Branch (2009) this phase involves identifying the target audience, validating the performance gap, defining instructional goals, determining potential delivery systems, assessing necessary resources – come up with a project management plan. Educational Literature Regulation can work in this phase as a guiding framework, as it helps to define substantive requirements and pedagogical alignment, ensuring that the national education standards are followed. So, this phase ensures that instructional design decisions are grounded in a clear understanding of different key principles; however, as conceptions of teaching and learning evolve over time, this phase must adapt accordingly. On a more practical level in developing digital educational literature, the analysis phase incorporates a review of required competencies and helps to determine the needed workload for completing the project.

The Design phase is based on alignment with data from the analysis phase to deal with finding solutions to the problems identified earlier (Branch, 2009). Peterson (2003), citing Seels & Glasgow (1998), emphasizes the importance of thorough planning, which includes selecting instructional strategies, determining the most effective media and methods, and ensuring alignment between learning objectives and assessments. In this sense, it is similar to the first phase, where effective planning reduces the need for major adjustments later in the development process. Similarly, the Regulations helps here to ensure that fundamental requirements are met. In the case of digital educational literature, it can be assumed that from the content point of view the first two phases have largely been completed during the creation of print text- and workbooks, when a team of authors, editors, illustrators, layout designers are engaged in making substantive and pedagogical decisions. In

digitalizing, the editors and platform management team create a new layer in decision making with a different kind of dynamic and purpose. Rozo and Real (2019) argue that the design of digital learning resources presents several challenges from the pedagogical perspective due to their inherent complexity. Designers have to deal with interactive elements and multimedia components, which involve making simultaneously technical-pedagogical decisions, which have effect on the teaching practice. And at the same time, they have to ensure the integrity of the content from a copyright perspective.

The Development phase focuses on transforming instructional plans into learning resources. Branch (2009) outlines steps such as generating content, selecting or creating supporting media, developing guidance for both teachers and students, conducting formative revisions, and running a pilot test. Peterson (2003) emphasizes in addition to content creation also the importance of iterative evaluation. Digital educational literature especially requires ongoing adjustments because of the medium, making the iterative evaluation critical for maintaining compliance with usability and pedagogical effectiveness. When transforming educational literature into digital format, previously established learning objectives and pedagogical decisions are typically preserved. For instance, when transferring existing assessment methods, it is essential to retain or thoughtfully adapt research-based strategies while using digital advantages, such as interactivity and adaptive feedback.

The Implementation phase is about delivering the product. It also involves the associated data collection, which in turn leads to analysis, conclusions and further development proposals (Branch, 2009). Branch (2009) emphasizes here the importance of preparing both teachers and students to ensure effective engagement in the learning process. Relying on Peterson (2003), it can be said that, much like in the previous phase (iterative evaluation during development phase), editors must take here as well an active role, continuously analyzing, refining, and enhancing the product. Teacher and student involvement can occur at multiple levels; for example, most interesting endeavor from the Educational Literature Regulation is foreseeing subject-specific association's review to enable a broader discussion among practicing teachers and encouraging school tests as means of review. When the educational literature is ready for use, marketing is usually accompanied with teacher training.

The Evaluation phase is multidimensional (Peterson 2003), and it can occur in different forms and phases: during development, during implementation (involving both students and/or teachers), or summative evaluation at the end of implementation. Branch (2009) highlights here key procedures such as defining evaluation criteria, selecting or

creating evaluation tools, and conducting assessments throughout the process. Educational Literature Regulation provides for evaluation some clear guidelines, like required qualifications and needed experience of reviewers. It also provides a supportive template for conducting peer review (see again Appendix 2). Peer review is a form of evaluation that usually takes place in the manuscript stage and/or during development and it is quite common that during peer review, it may be necessary to revisit earlier stages to make revisions. One of my interests in this master's thesis is also to find out what kind of relationship is with peer review in the context of digital educational literature, but more about it in the results chapter.

This subsection focused on the processual aspect – how a particular development process logically should unfold, how it can be planned, and structured. In practice, it is never a matter of strictly following ADDIE-like process-based model and it is important to be aware of both the dynamic nature and adaptability of different phases in the development of learning resources. Nor do such processes occur in isolation – it is always influenced by the surrounding environment and conditions.

Sociotechnical context and design anticipation

As previously outlined, digital educational literature, is deeply intertwined with how K–12 education is conceived. It not only encapsulates curricular objectives but also core educational values and concepts – a broader societal understanding of what education should achieve. And as personalized and adaptive learning by means of technology – as described in the Estonian Education Strategy 2021–2035 (2021) – gains increasing relevance, innovation in educational technology aligns more closely with national educational priorities and educational futures e.g. as envisioned in policy documents.

To discuss contextual impact, I operationalize a sociotechnical approach which stems from science and technology studies. The underlying premise of sociotechnical thinking is that both social and technical factors together should be taken into account as parts of a complex system (Baxter & Sommerville, 2011). Sheila Jasanoff and Sang-Hyun Kim, who are among the most influential scholars in the field, introduced the concept of "sociotechnical imaginaries" in 2009, which refers to collectively envisioned forms of social life and social order reflected in the design and realization of various projects and artifacts. Sociotechnical imaginaries capture the interplay between societal expectations and technological developments. As Jasanoff and Kim (2009) say, imaginaries, in this sense, simultaneously describe achievable futures and prescribe the futures that actors like states believe is

necessary to pursue. In subsequent years, they have refined the concept, emphasizing the interdependent relationship between imaginaries and technological innovation. It is important to mark that these collectively held visions of desirable futures are institutionally stabilized and publicly performed, grounded in the idea that such imaginaries are attainable through advances in science and technology, while simultaneously shaping and reinforcing the progress driving those advancements (Jasanoff, 2015).

Imagining and imagination precedes imaginaries; in that sense imaginations can be considered visions that have not yet become crystallized and widely shared imaginaries. For Jasanoff (2015: pp. 322–323), imagination is a social practice, in which individuals and groups “see and think things differently from what was previously seen or thought”. This process is especially relevant in education, where, as Amsler and Facer (2017) argue, the question of how to understand and engage with the future is particularly pressing. Education – future relation is too often understood instrumentally and imagined futures are used to rationalize present educational policies and agendas (e.g. as imageries of economic hardship are deployed to justify the withdrawal of funding for education) (Amsler & Facer, 2017). Rather than taking the future for granted as an empirical orientation or an object of analysis, Amsler and Facer (2017) stress the importance to conceptualize the relationship between education and future as a construction site for active ‘co-constitution’.

Mike Michael (2017) arise interesting perspective of variety and assortment of futures, where “Big Futures” imply to substantial futures with far-reaching qualitative changes and “Little Futures” applies to much smaller scope with narrower spatio-temporal influence. Even mundane interaction with and through everyday technologies can yield novel Little and Big Futures (Michael, 2017). For example, the way digital learning resources are designed can shape the pedagogical practices and values of tomorrow and vice versa, existing teaching practices determine what kind of digital learning resources are created because of a demand to these kinds of resources.

In research, this kind of practice-oriented perspective “explores the concrete manifestations” and their formation or materialization (see Konrad & Böhle, 2019). In different disciplines (e.g. social science, Forsman et al., 2023; Urry, 2016) and studies (e.g. media production, Mayer et al., 2009; information and data science, Geiger, 2014) exploring or looking at the “behind the scenes” of various social and cultural products or practices means to investigate how people involved operate, organize their work, deploy knowledge, collaborate, handle power relations, develop their professional identities and mindsets and form understandings of what they are involved in. In this master’s thesis this perspective is

deployed to investigate the “behind the scenes” of the design and development of digital educational literature.

I use case study approach and rely on expert interviews conducted with the developers of Opiq platform and editors of selected digital educational literature study kits (a term they use themselves on their English website), because currently these study kits are most widely used digital learning resources in Estonia. The aim is to understand developers’ and editors’ insights and considerations and how different (mainly legislative and technological) conditions impact their work. The concept of "design anticipation" offers here an important lens. Anticipation is integral to design, as design inherently involves envisioning and shaping desired future realities (Zamenopoulos & Alexiou, 2020). Anticipation occurs when the future is used in action in that sense that it expects an active and critically reflective interaction with unknowable (see Amsler & Facer, 2017, Poli 2019). Viewed in this way, it can be said that design anticipations lead to materializations of imaginations – sociotechnical process outlined above. In the case of digital educational literature, this anticipatory process has two inseparable sides. Platform developers operate on anticipating what their platform should enable or how it should perform technically; and publishing house editors, who transform their text- and workbooks to digital study kits, are doing the same, but on a different, more substantive level. The work of both parties is interrelated and they also operate in shared context and in relation to the same existing imaginaries (e.g. of education, digital technology etc.).

This master’s thesis gives an overview of the policy initiatives and legislation to better understand the sociotechnical framing (constructed ways of organizing, interpreting, problematizing matter) that shape the design and development of digital learning resources in Estonia. This overview serves as the context for understanding the development of digital and interactive educational literature through expert interviews. Expert interviews are there to look into anticipatory decision-making that guide interviewees work. The research questions (RQs) are as follows:

RQ1: How does national sociotechnical framing influence the development of digital learning resources in the case of digital educational literature?

RQ2: What kind of decision-making and procedural considerations guide the development of digital educational literature?

METHODS

Case study approach and data collection

To achieve my master's thesis goal, I have chosen a case study approach, as it helps to study and present the research object in its entirety and uniqueness (see Strömpl, 2014). As Judith Strömpl (2014) puts it, case studies allow researchers to examine specific activities within a particular context, including institutional behavior, rituals, and interactions. The qualitative research methods applied here provide the necessary flexibility for in-depth analysis while ensuring necessary coherence with the theoretical foundation.

In a case study, the choice of data collection methods is driven by the goal of gathering as much diverse and comprehensive information as possible about the research object (Strömpl, 2014). Therefore, this study is divided into two parts. An overview of the context surrounding the digitalization of educational literature is compiled based on various documents. The subsequent interview process with developers and editors follows a semi-structured expert interview approach (see Lepik et al., 2014).

Documents

To gain a comprehensive understanding of the context and to begin addressing the first research question, I compiled and analyzed key policy documents related to the digital educational literature. These include the Educational Literature Regulation (2016), the Basic Schools and Upper Secondary Schools Act (2010), Republic of Estonia Education Act (1992) and the national curriculums: for basic schools (2011), for upper secondary schools (2011) and the simplified national curriculum for basic schools (2010). I compared different versions of these legal acts, as most of them are amended over time, to identify changes in regulations and policies affecting the development of digital educational literature.

Another important publicly available source is the Tiger Leap narrative (Roonemaa, 2022) published on the Technology Compass website. This historical overview of the Tiger Leap initiative, authored by technology journalist Henrik Roonemaa was commissioned by the Ministry of Education and Research in collaboration with the Education and Youth Board to mark the 25th anniversary of the initiative. As Forsman et al (2024) put it, the Tiger Leap program had so to say three pillars: to provide schools with computers and Internet; to offer teachers digital training; and to develop digital educational content in the Estonian-language

– this way, this initiative contributed to the prevailing sense of national identity and a narrative about Estonia as ‘the education nation’ at the digital frontier.

I also considered the webpages of the Ministry of Education and Research and the Education and Youth Board that describe the current digital learning resources ecosystem. This ecosystem is also shaped by interministerial cooperation and one of the key policy documents in this regard is the *Memorandum of Understanding and Cooperation* (2022), signed between the Ministry of Education and Research, the Ministry of Economic Affairs and Communications, and EdTech Estonia NGO. The last layer of documents analyzed consists of strategic plans, including Estonian Education Strategy 2021–2035 (2021) and EdTech Estonia Strategy 2023–2027 (2022).

Selection of Study Participants

The participants in this study were selected based on purposeful sampling principles, while also incorporating elements of snowball sampling (see Rämmer, 2014). The sampling criteria were determined by the research object – currently, the most widely used digital learning resources in Estonia are digital educational literature study kits available on the Opiq platform. The network of people involved in the development of these resources can be divided into two groups: platform providers and publishers who distribute their study kits via the platform. Therefore, it was essential to gather input from both sides. This sampling strategy was chosen to provide comprehensive and detailed understanding of the development process and the decision-making behind it.

The study includes four interview participants: two associated with the Opiq platform and two representing Estonia’s largest publishers of educational literature, Avita and Koolibri. Given the limits of this master’s thesis, an additional selection criterion was applied to publishing representatives. This delineation was based on the *DigiEfekt* study, which analyzed the use of digital learning resources on the Opiq platform in science, mathematics, and Estonian language lessons for grades 3, 6, and 9. I chose the subject area of mathematics, as the *DigiEfekt* study identified better usage patterns and a later drop-off in engagement there (see Opanasenko et al., 2022).

First, I contacted the CEO of the Opiq platform, with whom I conducted the first interview, where in addition to exploring the development process, I also inquired about the historical background of the platform’s creation. This participant is the only one in the study for whom anonymity cannot be ensured. He agreed to it. After explaining the research needs

and current focus on mathematics study kits, I received recommendations who to contact next. The interview participants have between min 6 and max 30 years of experience in the field of learning resources. Two of them have a long-standing background in teaching, and one is currently still working as a teacher in addition to the editor's work.

Interviews

Semi-structured expert interviews make it possible to follow a pre-prepared interview plan while also providing the flexibility to ask additional questions at appropriate moments and seek clarifications when necessary (Lepik et al., 2014). While the study does not adopt a predefined interview protocol, it is guided by theoretical frameworks established above – specifically, the ADDIE model and the Educational Literature Regulation – which serves as an analytical lens, ensuring that key aspects of instructional design, development, and evaluation are systematically addressed.

To ensure reliability, I conducted a pilot interview, after which I refined the wording and specificity of the questions and adjusted the thematic structure. The pilot interview was with someone who has also worked in an educational literature publishing house; it took place in January 2025 and lasted 47 minutes. The final semi-structured interview guide included an introduction, general background questions, a thematic block on design and development, a block on activities related to the final product, and a block of future-oriented questions (Appendix 3). Overall, the interview framework proved to be effective in generating the necessary data to answer the research questions.

According to Bogner and Menz (2009), expert interviews should not merely be seen as ways for gathering existing knowledge and that interaction effects should not be seen as distortions of the study but as an integral part of data production. Experts are not neutral sources of knowledge; rather, their responses are shaped by their perceived roles and expectations (Bogner & Menz, 2009). Similarly, the interviewer's position influences the conversation dynamics – experts may perceive the interviewer as a fellow expert, an external evaluator, a critic, or a layman which significantly shapes the type of information shared (Bogner & Menz, 2009). Following their recommendations, I approached the expert interviews reflexively, keeping a research diary to acknowledge how my role and interaction dynamics influenced the collected data and the construction of knowledge.

The expert interviews were conducted in January and February 2025, both in-person and online. The invitation to participate was sent via email, and through further

correspondence, we agreed on the time and place for the interview. I informed the interviewees in advance about the purpose of the study and requested their permission to conduct the interviews and use the collected data in a pseudonymized form in this research and any related articles. The participants took part voluntarily and provided written consent by agreeing to my consent request letter (Appendix 4). In-person interviews were recorded using computer recording tools, while online interviews were recorded via web software. The duration of the three interviews were relatively equivalent and ranged from 57 minutes to 1 hour and 14 minutes, one interview was longer and lasted 1 hour and 57 minutes.

Data analysis

To provide an overview of the context in which the development of digital educational literature takes place, I reviewed policy documents, mapping various decisions and factors related to digital learning resources and digital technology. Key aspects in this sociotechnical framing (see Wikipedia page *Framing (social sciences)*, 2025) included timelines in policy decisions and initiatives, funding schemes, stakeholder involvement, transparency and expectations. The contextual overview also incorporated the Tiger Leap narrative, supported by a few relevant academic articles.

For interview transcription, I used the *tekstiks.ee* platform (Olev & Alumäe, 2022). To ensure anonymity, participants were identified using abbreviations: P1 and P2 for platform representatives and K1 and K2 for publishing representatives. I was solely responsible for handling the audio files and transcriptions in my computer. The average length of three transcriptions were approximately 50,000 characters (including spaces), while one was longer, totaling 89,122 characters. The audio files are deleted after the defense of this master's thesis and the transcriptions will be erased once the planned articles are published.

I used abductive content analysis, because as Dubois et al. (2002) discuss, case studies require an integrated approach, as the greatest challenge lies in managing the interrelatedness of the various elements within the research process. Research activities in case study are deeply intertwined and the researcher continuously moves back and forth between different stages of the inquiry, as well as between empirical observations and theoretical reflection (Dubois et al., 2002). This iterative and reflective process is what Dubois et al. (2002) refer to as systematic combining. For example, with each subsequent interview, I felt the need to review certain documents and policy decisions, because with each interview new layers of knowledge were added.

For coding the transcriptions, I used the QCMap web platform, treating each meaningful unit of thought as an analytical unit. I began the content analysis by addressing the second research question. Based on the Educational Literature Regulation and the ADDIE model, I developed a framework of three main categories, under which the subcodes identified during the coding process were organized. The wording of the main categories does not directly align with the regulation framework of *substantive requirements*, *technical requirements*, and *peer review requirements*. Similarly, the subcategories are not derived from the five phases of the ADDIE model but are more interpretative and intertwining and also more detailed (Table 1).

Table 1. The categorization of the second research question

Content Development	Technical and Digital Considerations	Feedback and Quality Assurance
Content quality and structure	Digital affordances	Peer review
Content analysis and development	Media type selection and interactivity	Ongoing evaluation and review
Design and digital pedagogy	Technical requirements and metadata management	Student and teacher feedback
Consideration of differences in formats (printed vs digital)	User experience and accessibility	Co-creation in training sessions
Language use in digital environments		

To answer the first research question, I reanalyzed the interviews using again an abductive approach, especially I felt the need in parallel to read more about educational technology and societal developmental trends. I based the interview coding on the document analysis and was able to formulate three main categories: legislation, funding and the future. The last one is an intrinsically important dimension in sociotechnical framing, because the stakeholders not only actively shape how digital learning resources are imagined and designed, but this process is simultaneously guided by visions and assumptions about what is possible, necessary or desirable. Coding examples are provided in Appendix 5.

In addition to my own coding, I also employed co-coding. The co-coder had only limited prior experience with the development of learning resources and did not have a comprehensive understanding of the field. After I provided a brief overview of relevant processes, the co-coder analyzed data from one interview within the scope of the second

research question. I assessed the inter-coder agreement as moderate – the co-coder formulated similar codes, just to a lesser extent and with fewer coding units.

Researcher Reflexivity

My professional background and career so far have been related to learning resources. For six years, I worked as an editor and later editor-in-chief at an educational publishing house (not among the publishers examined in this research). Also, I have worked in the public sector as a specialist in learning resources. Through both roles, I have developed connections with different stakeholders: with teachers – as users and creators of learning resources, and with companies and organizations involved in the ecosystem.

I perceived open communication with all interview participants and consider the diverse insights and perspectives gathered through the interviews to be highly valuable. I did my best to maintain neutrality and objectivity in my interactions with interviewees and in document analysis. As both a field expert and a qualitative researcher, it is crucial to reflect on personal perceptions and experiences, as they may influence the research process. The researcher's diary was a good place for internal dialogue, where to record, for example, observations that influenced specific interviews or coincidences with theory. Also, I discussed with my supervisor to critically reflect on how my prior professional experience may influence the interpretation of data. Throughout the research process, I adhered to the principles of good scientific practice *Hea teadustava* (2023), providing participants with information about the study, ensuring impartiality, and guaranteeing privacy and confidentiality where possible.

RESULTS

Research findings are presented by research question and illustrated with examples from documents and interviews (in italics for better reading). The first research question asks about national sociotechnical framing that shape the development of digital learning resources in Estonia. The second asks about digitalization of educational literature – what decision-making and procedural considerations guide it.

RQ1: How does national sociotechnical framing influence the development of digital learning resources in the case of digital educational literature?

Addressing the first research question, results are presented under three main categories: legislation, funding and the future.

Legislation. The first fundamental change occurred in 2010 when textbooks, workbooks etc. no longer needed to receive prior approval from the Ministry of Education and Research. Under free market conditions, learning resources digitalization intensified in 2013 when obligation to provide digital versions of printed educational literature was introduced, with implementation applying to materials published from May 2015 onwards. The requirement was stated as follows, PGS (2010, § 20 (4)): *The publisher of educational literature shall make the educational materials corresponding to the national curriculum available in digital form on the portal (...) under the terms and conditions and procedure agreed upon between the Ministry of Education and Research and the publisher of educational literature.*

Interviews provided me with a good perception of the searches and evolution of thought how to support learning and teaching digitally. Using the example of Star Cloud LLC and Opiq platform, which grew out of the Avita publishing house, one can point out how a traditional textbook has gradually been developed into an interactive learning solution. Initially, in the 2000s, a teacher's guide (*õpetajaraamat*) functioning on a USB stick called "e-lesson" was created. It provided the teacher with the full methodology and materials for the lesson in a situation where internet connection was poor or non-existent. After that teacher-centered development, the focus shifted towards a platform that would be more than a mere collection of PDFs. In 2014, a separate company was established and a web-based and device-independent solution, Opiq, began to be developed. For this solution, flexibility, accessibility in various conditions, and data-driven personalization are considered important. Development is guided by the understanding that it does not replace traditional high-quality educational literature but complements it, using modern technological possibilities to make teaching and learning more meaningful.

P1: *In the case of Estonia we operate in a market hardly able to afford this kind of service, or rather, cannot afford it at all – we are subsidizing it in a way at the expense of the learning resources creators, so that if there were no print market, it would not be possible to do this.* The requirement of providing a digital version of print textbooks and workbooks is open to the interpretation that the digital version could just be a PDF, because the requirement prescribed no specific format – which, presumably, was not what such a

requirement aimed for. Considering how resource-intensive and time-consuming it is to develop interactive digital learning resources, it actually does not seem a very realistic expectation that diverse digital versions would be published in parallel with comprehensive textbooks and workbooks that cover entirely one subject area class-course. The reality of evolutionary and gradual development and enhancement of digital learning resources will be discussed in more detail later on.

Funding is a crucial factor that affects the digital learning resources ecosystem from multiple aspects. The state and local governments provide funding for learning resources in the case of municipal schools. However, municipalities contribute in addition to the state funding very unevenly – and in many cases not at all. Until the end of 2015, schools were allowed to use state-provided funding exclusively for purchasing educational literature. And only after this need was met could they spend the remaining funds on other teaching aids. Since 2016, this “funding pocket” was broadened to cover all kinds of learning related resources (including sports equipment like balls and skis) and, if necessary, also to cover personnel-related costs (see PGS § 82 (3)). Funding strategies will most likely change in the near future, for example the national project *Digitaalse õppevara ja teiste õppeotstarbeliste digitaalsete lahenduste soetamise platvormi prototüübi analüüs* (Riigikantselei, 2025) aims to address issues of accessibility. They plan to develop a dissemination model and technical prototype to distribute digital learning resources and management systems. This intervention is technical and focuses on business analysis and technical architecture; it also provides legal analysis.

The amount of state support in funding learning related resources has been the same since 2011. P2: *Financial means, right, I see that this is still the main issue – if a school simply has to choose between paying a teacher’s salary or buying a digital study kits license, then that is a very harsh choice (...) I think that considering Estonia’s small size, our success can only lie in a smart and educated nation, so we must find a sufficiently dignified financial solution for that as well – the school must have a choice.* In light of rising costs, some publishers have recently proposed reinstating the option for parents to contribute to the purchase of learning resources. This option existed before, but since 2013 municipal schools are prohibited from asking students and parents to co-finance learning based on school curriculum, including the acquisition of learning resources (see PGS § 82 (11)). Systemic underfunding is problematic both for schools in terms of supporting the teacher’s freedom of decision and choice over which learning resources to use, and also affects the development of learning resources. Thus, it has become vitally important for everyone to find alternative

sources of funding. P1: *our goal is still to expand the business side so much that it becomes larger and through that we could also offer better solutions more quickly to our current main market, Estonia. (...) This is not charity, and we still have to cover our salaries and all other costs every day. That's why developing the ecosystem and the market is not something to be taken lightly.*

The future. Discussing the future of educational technology, all interviewees mentioned that young people are now fully surrounded by digital technologies and temptations of the digital world. Therefore, restricting or banning digital technology use in schools is no longer seen as feasible. K2: *I think we can't manage without it anymore, because, well, let's face it – most things are digital. We have phones that serve the function of dozens of tools, all the maps, flashlights, communication, you name it. Everything is now in one phone (...) It doesn't produce actual fire, so a lighter or matches might still be good to have (...) You can't sweep the floor with it either, but it pretty much replaces everything else.* One interviewee highlighted an important distinction: while the purposeful use of technology in learning is predominantly accepted, there is growing public concern about how digital technology may hinder young people's social interaction and act as a kind of substitute for real-life experience.

It is important to stress that one of the themes that emerged from the interviews was the impact of distance learning in times of the pandemic. On the one hand, it marked a leap in the development of digital learning resources because of the pressing need for digital tools, and on the other hand, it significantly influenced implementation. P2: *In my view, corona did the job for us. Before the pandemic, we had to go to schools and explain why we're necessary, why we're not just some donkey, and why what we do matters. After corona, no one questioned it anymore. In a way, we are a strategic and nationally important domain – because if you can't go to school physically, then you realize that school textbooks are still there and teaching doesn't have to stop.* Here appear one of the sociotechnical paradigms that currently shape the ecosystem of digital learning resources – importance of accessibility.

Most of the national initiatives for developing digital learning resources for general education have been implemented through the European Social Fund (ESF) measure *Developing and Implementing Modern and Innovative Learning Resources*. One of these state-level initiatives, important in the context of this study, was to provide free access to digital study kits on the Opiq platform for all basic school students and teachers during the 2018/19 school year (it was extended for two more school years with continued ESF funding). During the same period, the COVID-19 pandemic struck, and in 2020/21 school

year, the state provided also all upper secondary school students and teachers with free access to Opiq's digital study kits as well. However, this time the one-time funding came from the state budget, as ESF funds cannot be used to finance recurring activities. This initiative initially sparked controversy over market intervention and lot of stakeholders were upset (see Ehala, 2018). Ecosystem stakeholders and schools highlighted problematics with unsustainability of project-based initiatives and uncertainty about their continuity.

The fragility of the digital learning resources market and ecosystem is addressed both in the strategy document of EdTech Estonia NGO (2022) and in the *Memorandum of Understanding and Cooperation* (2022). To establish a thriving and sustainable digital learning ecosystem, the latter outlines several commitments, for example concerning market self-regulation. To ensure the functioning of the digital learning resources market, transparency and avoiding unnecessary market intervention are considered essential.

In summary, interviewees did not perceive a strong, well-coordinated national-level commitment to thoughtfully advancing digital learning. Since funding in this domain largely comes from the ESF measure, it is project-based and subject to limitations – this is not regarded as sustainable in the long term. Nevertheless, initiatives in a small market like this have a large impact and require thorough evidence-based consideration with a long-term view. K1: *They have their own limitations and traps they have fallen into and can't get out of – they're stuck. They can't turn the big ship around mid-course, because too many decisions have already been made. In some ways, I understand them. But I don't approve of their actions. I think they are not on the side of learning and becoming smart as a phenomenon.*

RQ2: What kind of decision-making and procedural considerations guide the development of digital learning resources?

In addressing the second research question, the results are presented under three main categories: content development, technical and digital considerations, feedback and quality assurance.

Content development. When developing digital educational literature study kits, previously established learning objectives and pedagogical decisions are preserved as much as possible to maintain continuity in instruction and to ensure planned pedagogical effectiveness. And as mentioned earlier, it is also relevant regarding copyright. K1: *In a sense, a print textbook and a digital textbook are completely different. They teach the same*

subject, but in different ways. The subject to be taught – the one the student must master – has to be the same. (...) The student must know how to solve a system of linear equations. Therefore, both teach how to solve a system of linear equations, but they do it differently.

The difference begins at the level of perception. For example, a textbook makes more information visible at once – you have a double-page spread in front of you. On a screen, there is less information visible at a given moment, and this information is structured by a “screen-to-screen movement”. For digital learning resources, editors consider a different kind of structural logic. K1: *We know how learning works with print materials and dialogue. But digital is linear (...) so how to create the same quality of thought. (...) how to structure that inner logic in a way that knowledge itself does not become simplified. (...) So, in digital, things need to be made more fragmented, but we have to be careful not to lose the whole.* This editorial view is supported by the experience of platform developers who interact with publishers from different countries – structure is the key. Identifying recurring content units and designing them consistently helps to ensure clarity and supports the digitalization process.

The design and development process of digital learning resources can be characterized as evolutionary and gradual development and enhancement. For example, for one editor, it has taken about 6 years to digitalize one publisher’s mathematics’ text- and workbooks from 1st to 12th grade. And when the first digitalization round (mainly creating interactive tasks) will be completed, the next round of interactive value is planned. K2: *Well, sitting behind the computer and keeping track on paper is the main work for me, so in that sense it’s still very easy at the moment – I hope the creative work is still ahead. (...) If I start making some videos or other added-value content next year, then I’ll have to think that idea through more thoroughly.*

Some interviewees emphasized how language use in digital environments differs from that in traditional formats, and the issue of language in digital learning resources is highly multi-layered. In addition to the requirement for correct language use – which typically involves professional language editing – guidelines in the Regulation also stipulate that the content must be age-appropriate. One interviewee insightfully pointed out that the person creating the learning resources is usually at least 20 years older than the learner, and therefore can only aim for language that is *as* age-appropriate as possible. Thus, in the case of content and carefully considering the instructions, attention must also be paid to how wording can direct the student’s thinking and curiosity. K1: *It’s basically a game with words. (...) How to pose the question – that is the foundation, the biggest of all challenges.*

Technical and digital considerations. In connection to the evolutionary aspect of development mentioned above, it is important to point out that publishers have different approaches and expectations. From the perspective of platform-level quality assurance, much depends on the background of the person who is digitalizing. P2: *How much support a publisher needs from us really depends on them (...) In some publishers, people with a digital background are involved; in others, it's people with a content background. Naturally, their questions and concerns differ. Some have employed separately digitalizers, while others have the editors handle it. And you can immediately tell the difference in style – you see where technical flaws come, and where the content-related uncertainties arise.* As platform developers mention, publishers often do not grasp the workload – at the beginning expectations are higher. In fact, it is extremely resource-intensive and platform developers advise to move in phases, first digitalizing the elementary layering, then moving on.

It can be said that the content and technical aspects are deeply intertwined. An interesting kind of “play” occurs at the level of media and interactive task type selection. K2: *The most I can do is ensure that the task type is as convenient as possible for the teacher to check and for the student to complete.* When choosing between interactive task types, editors consider how the task displays on various devices – especially how students will experience it on mobile phones – as well as the different possible ways to input an answer. In mathematics, the issue of acceptable answer variations is crucial in some topics. K2: *In the topic of set members (hulkliikmed), I think I've even had tasks with 100 correct answers. If you have a set with four members, then order matters. Then there's the question of how you input the exponent (...) And so on.*

The student is, in some ways, more alone with digital learning resource – even when learning in class – because as one interviewee interestingly pointed out, the teacher stands, so to speak, behind the student and cannot get between the device and the student. In contrast, with print text- and workbooks, interpretive interaction is more common – for instance, the teacher can point out where to focus attention on a double-page in front of you. In solving interactive tasks, students also get different kinds of information that they have to process step-by-step on their own. For example, when Opiq previously did not have a specific “math gap” with a math keyboard, but only a regular input field, the instructions concluded all necessary steps to compile an answer, but now digital keyboard is so self-evident and intuitive for the students that instructions have become significantly shorter. Asking open-ended questions is still problematic because the available response mechanisms do not yet support this well.

Feedback and quality assurance. Teacher centeredness and how to support their teaching practices is strongly evident when talking about feedback. Teachers' experience with Opiq formulates into activities both at the content level and at the platform development level. There are two main ways to provide feedback – teacher training and bug report button – where feedback goes to the platform development team or publishers, and changes are often made very quickly, sometimes even on the same day. P1: *I believe that teachers notice things like this. When study kits are updated – not just that there will be a new edition after, I don't know, year X or N – if there has been some feedback or there has been some change in the curriculum or some other thing, then they see that these resources live with the everyday life where they themselves are, and this connects them much more with these digital learning resources.*

In addition to enabling ongoing review, the bug report button also has pedagogical value in some cases. K1: *Every part of our study kits has a “report an error” or “give feedback” option. And that's absolutely brilliant, because input comes from students, teachers, even some parents. Sometimes they notice a real mistake, sometimes they imagine there's one – maybe because they're missing some background knowledge – but that doesn't matter. (...) One important follow-up is to respond politely. For example, if I have to reply, especially when a student sends something in, I need to respond very thoughtfully. If it's a teacher, then I can usually answer more simply and briefly. (...) Because the student is learning through that interaction. The fact that they took the time to write – even if the system was technically correct – the thought process is incredibly valuable.*

As discussed above, peer review plays an important role in developing educational literature. The interviewees were well acquainted with this process, as they have previously also been largely involved in the preparation of print text- and workbooks. The important thing is that in this regard print and digital version are seen as one-to-one products and the same reviews as for the print text- and workbooks apply here. If to look deeper, several obstacles to reviewing the digital version becomes apparent. It is perceived that there is a real shortage of reviewers from a digital perspective, especially among practitioners who can evaluate digital learning resources based on both technical performance and pedagogical effectiveness. And in particular, there is a lack of specialists with experience teaching large numbers of students through digital learning resources. P2: *In Kenya we have the experience that our platform was approved and found suitable because they previously didn't have any kind of digital study kits platforms, so they kind of looked at what our options are (...) but*

there is no experience of digital reviewing at such a level, and this is, well, let's say maybe this tradition and practice still needs to be created – like, how it could look like.

In summary, for a learner who starts to acquire something new and enters an unknown world, a well and logically structured whole is important. Good structure is helpful in developing cognitive frameworks, which they can later use or creatively adapt to generate new ideas. At the moment Opiq's study kits are the most used digital learning resources in Estonia. As several interviewees said, that the best feedback is use and people vote with their feet. For all interviewees, an important starting point was that Opiq would support the teacher in their everyday work. Teachers are largely seen as regular co-creators and inspiration is gained from their practices. K2: *I really enjoyed giving those trainings. Even though I have terrible stage fright, the feedback and insights I got from them (...) I think that the study kits got better – it became more useful and usable for both students and teachers.*

DISCUSSION

The aim of this master's thesis was to understand how national sociotechnical framing influences the development of digital learning resources and what guides digital learning resources developers' anticipatory decision-making. In the following, I will discuss the results by key messages.

Digital learning resources development requires a healthy and sustainable growth environment. Within the framework of the first research question, the development of digital learning resources was described as time-consuming (happening in phases or evolutionary) and investment-intensive process, that is not well supported by its surrounding political and financial framing. The perceived sociotechnical environment that came through in expert interviews is also supported by the analysis of policy documents. *Memorandum of Understanding and Cooperation (2022)* stresses the need for greater transparency and the avoidance of unnecessary market intervention. The analysis of the Educational Literature Regulation (2016) shows the need to update requirements, or, rethink the role of the state in the light of constantly evolving educational technology ecosystem.

The development of digital educational literature is motivated by curricular objectives and national educational values and its influenced by existing future visions, trends, hypes and as Sheila Jasanoff would say, by imaginaries. Based on the interviews, two dominant crystalized achievable future-visions were outlined: importance of (digital) flexible accessibility of learning resources and teacher centeredness. As Forsman et al (2024) describe, over time, the focus in Estonian educational technology development (and also

research) has shifted from being tech centered to becoming focused on innovative pedagogical methods and the design of the future classroom.

Teacher-centeredness and her/his daily teaching practices are central to the development process of digital educational literature. Teacher feedback is central to both designing and developing interactive content and platform functionalities. Based on the interviews, it can be said that perceived co-creation with teachers occurs at micro levels; and as small-scale, these immediate changes are subject so to say Little Futures (see Michael, 2017). “Little” does not mean unimportant, but refers to their specific happening motivated by teachers’ everyday practice. Although it is a good example of collaboration, it also exhibits signs of standstill. As *DigiEfekt* project brought out, teachers seldom modified or redefined their teaching practices but used the same methods and activities as in traditional learning process not involving technology (Raave et al 2022).

When digitalizing educational literature, previously established learning objectives and pedagogical decisions are typically preserved to maintain continuity in instruction and to ensure planned pedagogical effectiveness. As said, it is also relevant regarding copyright. In addressing the problems regarding digital learning resources as understood in the Estonian Education Strategy 2021–2035 (2021), it can be said, that the systematic approach is not missing, but in its core, it is based on traditional learning process. However, the second research question provided a lot of material for thought in terms of different nuances in the digital educational literature developing process and how technological development is currently in an accelerated state. New platform functionalities and tools like OpiqGPT (launched in 2024), which helps students to discuss and solve various problems with chatbot, and newly piloted OpiqBot, an adaptive tool that provides tasks based on the learner’s level and performance, are important trials in this rapid rise of artificial intelligence use everywhere. But more importantly, it highlights the need for research and evidence-based collaborations even more.

The practical value of this master’s thesis is evident from several aspects and could be of interest to several stakeholders: to publishers who wish to develop quality learning resources; other educational technology developers; policy implementers and makers; and to those interested in developments in the Estonian general education. Here are some key recommendations made based on this case study:

- It is necessary to update the requirements of the Educational Literature Regulation (2016) and open a discussion about the expectations for digital learning resources and constantly evolving educational technology.

- The need to explore and map different funding options and schemes to support both educational equity and teachers' autonomy in choosing learning resources.
- Develop a framework how to better review digital learning resources, specifically, so that it would support their pedagogical and technological development.
- Publishers have a good opportunity in the form of training to map teachers' needs, but trainings could also be designed and elevated by introducing more learner-centered focal points and related topics for co-creative discussion.

The case study conducted here focused on the Opiq platform and the subject area of mathematics. An interesting further development would here be interviewing editors from other subject areas, for example natural sciences and Estonian language. An editor of mathematics experiences development and design process differently than someone working on language study kits. Also, it would be necessary to involve other existing platforms and publishers (in Estonia, there is another platform and publisher with a similar approach). As part of further research, I also consider it important to repeat the same expert interviews in about three years to see where current developments and trends (especially in relation to generative artificial intelligence) have led.

The expert interviews conducted provided a lot of input on various nuances and details concerning digital educational literature study kits development and design. However, due to space constraints, I was unable to fully analyze all these aspects within the framework of this thesis. Including such analytical segments would have reduced the theoretical diversity and depth of document analysis, which I prioritized at this stage to provide a strong foundation for future research and analysis.

Authorship Statement

I hereby confirm that I have independently written this thesis and have properly acknowledged the contributions of other authors and supporters. The thesis has been prepared in accordance with the requirements of the Institute of Education at the University of Tartu and adheres to good academic practices.

Mirjam Puumeister

/digitally signed/

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APPENDIX

Appendix 1. Educational Literature Regulation requirements divided into three categories

Educational Literature Regulation	
Substantive requirements	Fundamental values of general education schools.*
	Fundamental educational values.*
	Concept of learning.
	General objectives of teaching and education.
	Subject-specific objectives.
	Intended learning outcomes and content.
	Requirements for the learning environment.
	Content – presented in an age-appropriate, diverse, and methodologically purposeful manner.
	Exercises and tasks – methodologically structured and diverse, providing differentiation.
	Language – accurate and age-appropriate.
	Structure and content – relevant, systematic, and logical.
	Paper quality requirements...
	Text size requirements...
Requirements for illustrations, graphic material.	
Digital format should be compatibility with different operating systems.	
Reasonable adaptability for visually and hearing-impaired users	
Peer review requirements	Reviews from at least two experts: <ul style="list-style-type: none">- a teacher from the corresponding subject-specific association, who has at least five years of work experience, of which at least three years at the school level for which the educational literature being reviewed is intended;- a lecturer, researcher or specialist with a scientific degree in an appropriate specialty or field.
	Review from subject-specific association may also be based on a school test.

Notes. A requirement in green refers to the Basic Schools and Upper Secondary Schools Act (PGS), while requirements in blue refers to the general parts of the respective national curriculum that the learning resource aims to comply with (GRÖK, PRÖK or PRLÖK).

Appendix 2. Templet for peer review, as it is accessible in the educational literature register

Näide pedagoogilise retsensiooni vormist.

RETSENSIOON ÕPPEMATERJALILE

Õppematerjali pealkiri	
Õppematerjali autor(id)	
Retsensiooni koostaja (nimi, ametinimetus)	
Retsensiooni esitamise kuupäev	

Hinnang õppematerjalile

Andke palun hinnang õppematerjalile alltoodud kriteeriumitest lähtuvalt, tehke valik 3-astmelisel Likerti skaalal:

3 Sobib, nõustun täielikult	2 Sobib koos parandustega	1 Ei nõustu üldse
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Põhjendage oma vastuseid ja vajadusel tooge näiteid.

1. Õppekavale vastavus

1.1. Õppematerjali aluseks on riiklik õppekava .				
nõustun täielikult	3	2	1	ei nõustu üldse
Põhjendage:				
1.2. Õppematerjal lähtub õppekava üldosas nimetatud alusväärtustest .				
Alusväärtustena tähtsustatakse üldinimlikke väärtusi (ausus, hoolivus, aukartus elu vastu, õiglus, inimväärikus, lugupidamine enda ja teiste vastu) ja ühiskondlikke väärtusi (vabadus, demokraatia, austus emakeele ja kultuuri vastu, patriotism, kultuuriline mitmekesisus, sallivus, keskkonna jätkusuutlikkus, õiguspõhisus, solidaarsus, vastutustundlikkus ja sooline võrdõiguslikkus).				
Vajadusel tooge näiteid alusväärtustest, mille käsitlemine tuleks õppematerjali veel lisada või mis vajab muutmist/täiendamist.				
nõustun täielikult	3	2	1	ei nõustu üldse

Põhjendage:

1.3. Õppematerjal toetab õppekavas kirjeldatud **üldpädevuste** kujundamist.

Õpilastes kujundatavad üldpädevused on: 1) kultuuri- ja väärtuspädevus; 2) sotsiaalne ja kodanikupädevus; 3) enesemääratluspädevus; 4) õpipädevus; 5) suhtluspädevus; 6) matemaatika-, loodusteaduste- ja tehnoloogiaalane pädevus; 7) ettevõtlikkuspädevus; 8) digipädevus.

Vajadusel tooge näiteid üldpädevustest, mille käsitlemine tuleks õppematerjali veel lisada või mis vajab muutmist/täiendamist.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

1.4. Õppematerjal arvestatakse **läbivate teemadega**, milleks on:

1) elukestev õpe ja karjääri kujundamine; 2) keskkond ja jätkusuutlik areng; 3) kodanikualgatus ja ettevõtlikkus; 4) kultuuriline identiteet; 5) teabekeskond ja meediakasutus; 6) tehnoloogia ja innovatsioon; 7) tervis ja ohutus; 8) väärtused ja kõlblus. Vajadusel tooge näiteid läbivatest teemadest, mille käsitlemine tuleks õppematerjali veel sisse lõimida või mis vajab muutmist/täiendamist.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

1.5. Õppematerjal pakub mitmekesiseid **tagasisidestamise** võimalusi, sh võimaldab kujundavat hindamist ja kogu õppe vältel õpilase arengu toetamist.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

2. Õppematerjali metoodiline esitus ja õppetegevuses kasutatavus

2.1. **Ainealane teave** on korrektne (sh ajakohane) ning on esitatud eakohaselt ja õppimist toetavalt (vajadusel toetatud selgituste või definitsioonide/sõnastikuga).

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

2.2. Õppematerjal arvestatakse õppija **lähtetasemega**.

Nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

2.3. Õppematerjal on loodud seoseid **õpilase igapäevaeluga** ning läbivalt on toodud õpilase eelteadmisi ja kogemusi aktiveerivaid ja toetavaid näiteid.

Nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

2.4. Õppematerjal toetab vastava **kooliastme õpitulemuste** saavutamist, sh on arvestatud kontsentriilist lähenemist.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

2.5. Õppematerjal toetab **ainevaldkonna pädevuste** omandamist vastava kooliastme taotletavate teadmiste, oskuste ja hoiakute raames.

Nõustun täielikult	3	2	1	ei nõustu üldse
Põhjendage:				
2.6. Õppematerjal võimaldab õpilasel olla aktiivne osaleja sh ülesanded toetavad enesekontrollioskuse kujunemist ja reflekteerimist. (Näiteks suunab leidma teavet, korrastama ja kasutama erinevaid allikmaterjale, õpikeskondi jm; suunab probleeme sõnastama, probleemide hüpoteese püstitama, probleemide lahendamisel omandatud teadmisi rakendama.)				
Nõustun täielikult	3	2	1	ei nõustu üldse
Põhjendage:				
2.7. Õppetekstid on sihtrühmale keeleliselt ea- ja jõukohased.				
nõustun täielikult	3	2	1	ei nõustu üldse
Põhjendage:				
2.8. Tööjuhendid on selged ja arusaadavad. Töövõtete järjestus on loogiline (liikumine kergemalt keerulisemale).				
nõustun täielikult	3	2	1	ei nõustu üldse
Põhjendage:				
2.9. Õppematerjal võimaldab läbivalt õppeprotsessi diferentseerimist .				
nõustun täielikult	3	2	1	ei nõustu üldse

Põhjendage:

3. Vormistus ja kujundus

3.1. Õppematerjal on koostatud **korrektses keeles**, järgitud on kirjakeele reegleid.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

3.2. Õppematerjali esitamise viis toetab õppimist, **liigendus ja esiletõstmised aitavad sisu mõista**, olulist teavet välja tuua.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

3.3. Õppematerjali teksti (ka lisateksti) suurus, kirjastiil, paigutus ja värv (sh taustavärv), võimaldavad ladusalt teksti lugemist, võttes arvesse õppematerjali kasutava õpilase vanust.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

3.4. Õppimist toetava **illustreeriv materjal** (pilt, skeem, joonis, foto, video jne) on teemakohane ja moodustab tekstinarratiivi või ülesandega terviku.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

3.5. Õppematerjal sisaldab viiteid kasutatud allikatele ja täiendavatele materjalidele.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

Digitaalse õppevara sisulähendused

**Järgnevatele küsimustele vastata juhul kui õppevara on digitaalne.*

3.6. Digitaalne õppematerjal on **kasutajamugav** ja loogiliselt navigeeritav (sh töökäskude järgi liikumine ja tegutsemine on eakohane ja arusaadav).

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

3.7. Kasutatud on **interaktiivseid ülesandetüüpe**.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

3.8. Interaktiivsed ülesandetüübid on **metoodiliselt põhjendatud ja eakohased**.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

3.9. **Videolahendusi**, animatsioone, simulatsioone, on kasutatud metoodiliselt põhjendatult ja mitmekesiselt.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

4. Õpetaja juhendmaterjal

**Hinnang anda vaid juhul, kui õppevaral on õpetajale mõeldud metoodiline juhend.*

4.1. Juhendmaterjal on süsteemne ja loogilise ülesehitusega ning **toetab õpetajat õppematerjali kasutamisel** (nt kas on selgitatud ülesehituse, sümbolite jne tähendus).

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage, tooge näiteid:

4.2. Juhendmaterjal kirjeldab õppematerjali **rakendamise pedagoogilisi võimalusi**.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage, tooge näiteid:

4.3. Juhendmaterjal kirjeldab, kuidas toetada aine **mõtestatud õppimist** ja luua tingimusi õppija õpioskuste arengu toetamiseks.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage, tooge näiteid:

4.4. Juhend **sisaldab viiteid** kasutatud allikatele ja täiendavatele materjalidele.

nõustun täielikult	3	2	1	ei nõustu üldse
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Põhjendage:

Vorm konkreetsete täiendus- ja parandusettepanekute jaoks

**Konkreetsed tähelepanekud võib anda endale sobival viisil vabas vormis või kasutades seda tabelit.*

	Viide õppematerjali osale (nt link, peatükk, lk nr jne), mille kohta ettepanek on tehtud	Küsimus, täiendus- ja/või parandusettepanek	Retsensendi põhjendus	Autori vastus
1				
2				
3				
...				

RETSENSIOONIL PÕHINEV KOKKUVÕTE

Õppematerjali pealkiri	
Õppematerjali autor(id)	
Retsensiooni koostaja (nimi, ametinimetus)	
Retsensiooni kokkuvõtte esitamise kuupäev	

Retsensendi otsus pärast autori(te) tagasisidet ja õppematerjali täiendamist

--

1. Õppematerjali õppetegevuses kasutamine ja eakohasus.

--

2. Õppematerjali metoodiline mitmekesisus.

--

3. Õppekavas kirjeldatud üldpädevuste arengu toetamine ning õppekava läbivate teemadega arvestamine.
4. Õppekavas kirjeldatud kooliastme teadmiste, oskuste ja hoiakute kujundamise ning õpitulemuste saavutamise toetamine.
5. Õppematerjali vormistus ja kujundus.
6. Õpetajale mõeldud metoodiline juhend. (Hinnang anda vaid juhul, kui õppevaral on õpetajale suunatud osa või koostaja on teinud eraldi metoodilise juhendi.)
7. Koolikatsetuse tulemuste kokkuvõte. (Juhul, kui õppematerjali katsetati koolis õppetöö kontekstis.)
8. Digitaalse õppevara tehnilised lahendused. (Hinnang anda vaid juhul, kui õppevara on digitaalne.)
9. Kokkuvõtlik hinnang. (Retsensendi hinnang õppematerjali kui terviku tugevuste ja nõrkuste kohta.)

* Väljaandja teeb retsensioonid kättesaadavaks digitaalse õppevara portaali kaudu.

Appendix 3. Interview plan

This interview plan includes all the questions – both for platform administrators and for publishing house editors. The questions were adjusted based on the interviewee's background.

Interview Questions
Introduction <i>Understanding the development of digital learning resources: the case of digital educational literature in Estonia</i>
Background <ol style="list-style-type: none">1. How did you come to work in the field of educational technology/learning resources?2. What led to the creation and development of the Opiq platform? (Motivations, interests.) When did this happen?3. What was the original vision for the Opiq platform, and how has it evolved over time?4. Please describe your role in the company. (Responsibilities, tasks, routines.)
Design, Development, evaluation <ol style="list-style-type: none">1. What is your relationship with publishers, and how does the collaboration work?2. What are the main stages in transforming educational literature into digital study kits on the Opiq platform?3. Are there any specific guidelines or models provided for those doing it?4. Please describe the roles behind the following job titles: <i>technical editor, digitalizer, content manager, quality assurance specialist</i>. Are there any other roles involved with the development of digital educational literature?5. Describe the design and development process from a product perspective:<ul style="list-style-type: none">○ ...in terms of content;○ ...in terms of structure;○ ...key considerations when choosing media types and digital solutions;○ ...user-friendliness for a) teachers and b) students;○ ... in terms of metadata.○ What is important for quality assurance?○ What is the role of peer review?

Product and Market

1. How would you describe your product/service (unique features, capabilities)?
2. What are the main follow-up activities once the product is in use?
3. How is feedback collected and used?
 - What kind of feedback have you received from teachers?
 - What kind of feedback have you received from students?
4. What are the biggest current challenges?
5. How would you describe your company in the context of the Estonian educational technology market?
6. In your opinion, what are the biggest challenges in the Estonian educational technology sector in general?

Future


1. How does your product align with the current development directions of general education in Estonia?
2. What are the future plans for Opiq?
3. What newer technologies could be applied to the creation of learning resources, and how?

Closing

Is there anything you would like to add?

Thank you!

Appendix 4. Example of consent request letter

 Mirjam Puumeister
Adressaat: @koolibri.ee

Vasta Vasta kõigile Saada edasi

N, 13.02.2025 08:00


Tere!

Soovin oma Tartu Ülikoolis haridusteadustes tehtava magistritöö "Understanding the development of digital learning resources: the case of digital educational literature in Estonia" raames teid õppekirjanduse digitaliseerimise osas intervjueerida.

Intervjuu toimub 14. veebruaril kell 17.00 veebi vahendusel ning kohtumise lingi saadan sama päeva hommikul. Intervjuu salvestan ja tulemusi kasutan mitte-anonüümsel kujul (pseudonümiseeritult) oma magistritöös ja sellel uurimistööl põhinevates artiklites.

Jään ootama Teie tagasisidet nõustumise või mittenõustumise kohta.

Tänuga
Mirjam Puumeister
TÜ Haridusteaduste instituudi haridusinnovatsiooni magistriõppe üliõpilane

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Tere!

Nõustun intervjuuga ja andmete kasutamisega Teie poolt kirjeldatud kujul.

Appendix 5. Coding examples

Coding examples for RQ2: What kind of decision-making and procedural considerations guide the development of digital learning resources?

Category	Subcategory	Example from interview
Content development	Content quality and structure	<i>The division into lessons must be in place, and then within that lesson there must be a division into what are my so-called tuning activities, what are my learning activities, and how I will summarize the lesson, so to speak.</i>
	Content analysis and development	<i>Sometimes you tinker with something to make it display sensibly. You tinker between different windows, you copy-paste again, you put it in, you look. Okay, now it looks more or less as it should. And well, sometimes you get stuck, then you close it, you can't, well somehow you can't get the same answer as in the textbook. You check it several times and you don't get the answer, then okay, I'll check it tomorrow morning. You continue with something else that your brain is already working on, then you look at it the next morning.</i>
	Design and digital pedagogy	<i>Digital platform or let's say, the whole conceptual approach that Opiq has... if the teacher has the slightest strength and desire, she/he can give a student an assignment from any class, from any textbook, according to students' readiness to master it. This means that uniformity as such disappears and teachers are afraid of this and rightly so. At one point, the learning process becomes unmanageable and we no longer know what the child can do, what the child cannot do. There is a danger there, that, that is not only good. But still, I can make them do the same thing using, for example, three, four, five different methods. When I am in class with paper and a textbook, I don't have enough of myself to explain to one group and another group. I have to allow some students to be free, and Opiq allows that.</i>

Consideration of differences in formats (printed vs digital)

Paper sets certain limitations on how much, what, and where you can put, but digitally in principle there are no limitations. At the same time, it is not completely valuable, because much more is not always better. Here, you have to be able to find balance, where more is better and where it is not better, and that is a substantive decision. In this sense, this digitalization is a creative process. If you want to make good digital learning resources, then it is, so to speak, creative process and pedagogical process must be written into it. But this can be done by the publisher, not us as the platform. We can say that we interpret these possibilities and limitations in this way. We can tell them what potential is here and there, but this realization still has to be done by textbook publisher.

Language use in digital environments

Their self-expression and colloquial language is formed partly by talking, partly by chatting, yes. What kind of normativity can we talk about?

Technical and Digital Considerations

Digital affordances

Integration can also be done better and a student who is interested in a particular issue can move on to a different learning path. That gives the interested student a huge treasure trove (varamu). Our school system tends to work in such a way that you only have your current textbooks to use, right? But you know that you had something in fourth grade that talked about the same topic and that you liked it, and you can quickly find it here with a search, right? You actually gain autonomy, you get the opportunity to find other learning paths, that you are not just on the track that is given to you by the teacher, but you can discover it yourself and it is great that this environment has guaranteed you quality content, and you do not have to be afraid that you will stumble upon some nonsense.

Media type selection and interactivity

At first I did a lot of dragging and dropping on the picture, especially in the primary school materials. But when we started experimenting with it more and when I also looked at the trainings, these things, for

example, move, they are different sizes. So, you have to think all the time, whether one text you drag there, if you drag another one here next to there, can they cover each other and make it incomprehensible. Or if two gaps are very close to each other, then well, it happened to me too, that you drag to the lower gap, but it jumps to the upper one for you and replaces the upper one, then that's it. But well, right now in the high school materials, the main thing for me is the math gap and the regular gap, there are very few other types of tasks, maybe you can sort it a little or use some concept maps.

Technical requirements and metadata management

Without a certain level of metadata, the platform doesn't work or, well, doesn't exist. In that sense, it's like a kind of DNA for these things. Well, and it can be used in different ways. I think that the last word is maybe that when we talk about some kind of learning analytics and machine learning algorithms that can use this dataset very actively. But on a daily basis, we don't think about it that much, but it's there all the time and we think about these different uses over time.

User experience and accessibility

It would be great if our children could get a school education, an Estonian school education, no matter where they are. Some others have a problem, for example, they have some kind of anxiety disorder that they can't really leave the house. Or such deep depression. Maybe that's the only thing - that they have digital tools for their studies, which is the last thing that keeps them up. Well, this digital helps so many of us, if it is good.

Feedback and Quality Assurance

Peer review

Well, I think multiple views are always valuable and necessary. Now the question is, at what stage to do it, if it has been done properly on paper, then digitalization usually does not shake it to its foundations, so to speak, certainly not, to maybe just check that this added interactivity part is competent. But, that is again decided by the publisher themselves and they decide

	<i>whether they will take separate reviews for this digital form or not.</i>
Ongoing evaluation and review	<i>We give each publisher access to a data table where the usage data of their works is collated and they can view it with chapter-by-chapter accuracy. They can see which devices specifically it has been viewed on, how many times, which sessions, which schools, of course it is not personalized, this data, so you will never know that Mari or Jüri did it, but you will know that in Kükametsa school it was used 30 times, for example, this chapter.</i>
Student and teacher feedback	<i>There are so many students and, in that sense, with very different interests, right? There are those who would expect Opiq not to tease them, so that they wouldn't have to do homework. There are those who would like this chat or our OpiqGPT to answer homework questions beautifully, so that it wouldn't start to be smart (ei hakkakas targutama) and want to lead the student herself generate knowledge.</i>
Co-creation in training sessions	<i>I think teachers are mostly grateful for what already exists and often expectant of what is added and improved. It's not that a new work is added, but that the same work is developed and improved, right? Additional material is added, additional tasks are added, it becomes more exciting and so on and so on, so that the same work develops and changes. And most of the time it is received positively. There are some specific, so to speak, technological developments that they expect from us, so that they can manage their diaries more conveniently and so that they can, for example, set a specific time for homework, when it opens and when it closes. Well, in short, little things like that that we know, that have been expected for a long time and that we will bring to them as much as we can, technologically.</i>

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Mirjam Puumeister, 14.05.2025