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How to study contemporary digital teaching materials? Merging traditional textbook analysis with analysis of digital materials

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Abstract

This article reports on an attempt how to study contemporary digital teaching materials based on using traditional textbook analysis and methods for analysing digital materials. The explored method combines traditional textbook analysis with multimodal perspectives on digital media, with the aim of analysing layout, structure, and content. In the exploration of the method, twelve digital teaching materials from three publishers in Sweden was selected and guided the research process towards both quantitative and qualitative analysis. The findings are twofold. First, the method as such demonstrates one type of finding, which benefits methodological triangulation between layout, structure, and content. Second, other findings demonstrate varying the layout, structure, and content separately and in combination. With the method, different types of frequencies in layout, structure and content emerged, as did qualities in the content within a specific topic of the national curricula.

Keywords: content, digital teaching materials, layout, method, structure, Sweden

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Introduction

For nearly 200 years, textbooks have had a dominant position in teachers' organizations of teaching and learning (Klerides, 2010; Svingby, 1978). During the last forty years, this dominant position has, in small steps, been challenged through the implementation of varying digital materials and content in schools (Bergström, 2019; Jedeskog, 2005). In practice, generally, textbooks are often heavily used as a pedagogical and didactic assistive technology in teaching and learning (SOU, 2021: 70; Spjut, 2019). Regardless of form, the history of textbook research demonstrates textbooks' purposes' being to help teachers transform curricula and syllabi, choose and structure content in planning and implement their teaching practice (Repoussi & Tutiaux-Guillon, 2010). This is similar to the didactic communication chain, where expressions of what someone wants to mediate and how it is mediated are observed (Ammert, 2011). However, textbook researchers have often focused primarily on content, while paying less attention to layout and structure, as printed textbooks have generally shared a relatively stable book format despite historical changes in visual design and presentation. The shift to digital teaching materials has challenged this established tradition. Digital teaching materials demonstrate greater variations in not only layout and structure but also the presentation of content, for example through hyperlinks, animations and other forms of media (SOU, 2021: 70).

In schools, teachers' opportunities to make informed choices expand with the new possibilities offered by increased digitalization (Organisation for Economic Co-operation and Development [OECD], 2018). In policy, two strands have emerged between content from traditional textbooks and content labelled digital learning resources recently referred to as digital teaching materials (SOU, 2021). From the perspectives of these two strands, moving from traditional printed textbooks to digital teaching materials, we notice the different layouts and structures of digital content such as (i) teachers' produced digital content, (ii) PDF versions of textbooks (Al-Qatawneh, Alsalhi, Al Rawashdeh, Ismail & Aljarrah, 2019), and (iii) collaborative digital textbooks (cDTBs) being reported as platforms with communication and interaction possibilities (Kempe & Grönlund, 2018). Hence, when the teaching material becomes digital, there is not one single layout and structure; instead, the layout and structure vary between publishers.

Only a limited number of studies have focused on digital teaching materials. The methodological approaches in current research demonstrate analytical tools focusing on either analogous teaching materials (e.g., Spjut, 2020; Spjut, 2019), or the technical characteristics of digital teaching materials (e.g., Kempe & Grönlund, 2019). At the outset of this study, twelve digital teaching materials from three publishers took a starting point in a common approach of text analysis which textbook researchers often use (Spjut 2019; 2020; Holmén, 2006). The research process was halted because the digital teaching materials in this study were so different from printed textbooks that we had to consider variations in layout, structure and content. Against this background, we developed and tried out a merged approach to analysing these new digital teaching materials. The aim of this study is to develop and critically examine an analytical approach for studying how layout, structure, and content interact in digital teaching materials. Twelve digital teaching materials are used as an empirical case to test and assess the approach's analytical opportunities, limitations and need for further refinement. The following research

questions were asked: 1. How can layout, structure, and content be operationalised and combined in an analytical approach for digital teaching materials? 2. What are the strengths and weaknesses of the analytical approach?

The Swedish context

The increasing number of digital learning resources in relation to textbooks and implicitly, the kind of practice that emerges from these different materials have recently gained increasing interest from policy makers. In the Swedish context, recent policies demonstrate tensions between textbooks and digital teaching materials materials (Government decision I:1, Supplement to Government decision, 2017). A national digitalization strategy was launched in 2017 and was followed in 2019 by a plan of action for the digitalization of K–12 schools, called #skoldigiplan (Government decision I:1, Supplement to Government decision, 2017). One message concerns the national goal to expand digitalization through increased access to and use of laptops and tablets in teaching and learning. In 2021, the *Educational Materials Inquiry* was published (SOU, 2021: 70). This rich document covers several issues, but of particular interest for this article, we choose to highlight (a) the problematization of traditional textbooks in relation to digital teaching materials and (b) suggestions of new acts. Regarding the first issue, one statement concerns "[that] textbooks provide a clearer overview of the content and are easier to navigate than digital teaching materials" (SOU, 2021: 70, p.16). Despite that, when defining teaching material, the *Educational Materials Inquiry* says,

> "[...] The investigation proposes that the concept of teaching aids be defined in the Education Act. According to the inquiry's proposal, a teaching aid must refer to a quality-assured printed or digital material that is intended to be used in teaching and that is consistent with the syllabi and with the curriculum. The teaching materials must also, according to the investigation, be produced by a professional publisher." (*Educational Materials Inquiry*, SOU, 2021: 70, p.16)

The above quotation indicates a connection to the curricula that defines a teaching material, not whether it is printed or digital. Another issue concerns both the teaching aid's function as a teaching tool and its pedagogical function, where the pedagogical function must be prioritized (SOU, 2021: 70) and that technical features in digital teaching materials should support the intended working methods and not draw attention from the content: "A teaching aid does not necessarily become more appropriate through a large number of functions, but the essential thing is how tools and different modalities, such as text, sound, image, animations and film interact with each other and how they help to strengthen students' understanding of the content" (SOU, 2021: 70, pp.320–321). The next section presents literature first from textbook research, and thereafter on the digitalisation of teaching material.

Literature

Historically, a convincing amount of research, all analysing content, shows the dominant position of analogue textbooks in teachers' practices (Englund, 2011; Klerides, 2010; Hartsmar, 2001;

Långström, 1997; Svingby, 1978; Tingsten, 1969). For example, the elementary school's first curricula, in 1962, encouraged teachers to use different teaching materials as a resource to plan teaching (Lgr 62, Svingby, 1978). Research also shows that teachers using the 1980 Swedish national curriculum (Lgr 80) did not plan their teaching based on the curriculum, but instead based it on the textbook structure (Kilborn, 1982). A survey of teachers from 2003 shows that a large majority (ninety-eight percent) of the teachers surveyed stated that they used the textbook, and four fifths stated that they used textbooks regularly (Englund, 2011). Furthermore, a considerable amount of research shows that History and Civics are among the subjects where textbooks are used most frequently (Olsson, 2014; Ammert, 2011; Englund, 2011; Hartsmar, 2001). In contrast, other studies show that motivations given for not using textbooks are, for example, that they are too difficult to understand, too information-laden, boring, or incorrect (Olsson, 2014; Englund, 2011; Reichenberg, 2000; Paxton, 1999).

The digitalization of schools has changed the materiality of the classroom (Sørensen, 2009), as is evident through the ongoing shift from printed textbooks to digital content accessible (Krumsvik, 2006) through a digital device (e.g., tablet or laptop) (Johnson, 2013). Based on this development with student digital devices, publishers have started to distribute textbooks electronically as digital teaching materials (Heider, Laverick & Bennet, 2009). Research has reported on the change in distribution from printed textbooks to digital teaching materials not only as a paradigm shift (Heider, Laverick & Bennet, 2009) but also as a dichotomy in favour of digital teaching materials (Kim & Jung, 2010). The findings demonstrate tensions, where teachers have stopped using printed textbooks and instead, they use digital teaching materials where students themselves can search in Internet-based content (Olsson, 2014). This shift towards digital teaching materials has led to questions about the very definition of textbooks in relation to digital teaching materials. In general, a textbook is defined as texts produced for educational purposes which "convey a special form of approach to knowledge" (Wikman & Horsley, 2012). Hammond (2019) critiques the knowledge transfer metaphor indicated in the printed textbook format, arguing that traditional printed textbooks serve as manuals for teachers to follow where they transfer the textbooks' scheme of work to the students.

Digital teaching materials seem more difficult to define, for reasons such as varying media formats due to varying layouts and structures. In its simplest form, digital teaching materials can be structured as a PDF copy of the printed textbook (Al-Qatawneh et al., 2019). Regarding layout, digital teaching materials can contain text, photos and illustrations as well as multimodal material such as videos and animations (Kim & Jung, 2010) and interactive quizzes on the content. Other characteristics of digital teaching materials concern the interactivity between the content and the user, for example, through search functions, illustrations of connections between concepts and automated assessment and instant feedback. The digital context and rapid development have challenged the knowledge transfer metaphor. Grönlund, Wiklund & Böö (2018) argue for a new concept regarding cDTBs, where digital teaching materials have a form of platform functionality with opportunities for student–student and teacher–student collaboration with the content.

Studies on teachers' experiences with digital teaching materials are few. We found studies both on practice (Bock & Macgilchrist, 2019; Al-Qatawneh et al., 2019; Håkansson Lindqvist, 2019; Lee, Moon & Cho, 2015) and on the usability of digital teaching materials (Gelderblom, Matthee, Hattingh & Weilbach, 2019). Regarding the practice studies, in a small-scale interview study, Håkansson Lindqvist (2019) reports how digital textbooks become a precondition for technology-

enhanced learning. Questionnaire studies report on teachers' approaches to the selection of content (Magdas & Dringu, 2016; Reichenberg, 2014). For example, Reichenberg (2014) reports that teachers with long experience were worse than young teachers at selecting material based on the layout, structure and content. We understand these findings, as teachers with long experience have criteria for selecting books but lack criteria regarding the broad array of content in the digital format, with its varying layout and structure. Hence, Reichenberg's (2014) findings point to a much broader question regarding teachers' digital competence (Krumsvik, 2014). Similarly, Lee, Moon & Cho (2015) also indicate that students need digital competence to gain higher academic performance when digital teaching materials are used. As previous studies indicate, the digital teaching material and its content format can take many forms. Kempe & Grönlund (2019) contribute further on this issue through the analysis of five cDTBs, from which they could identify three types of cDTBs. Type 1 is characterized as a traditional textbook in digital format; type 2 as traditional content but with multimodality, possibly for teachers to add material and online feedback; and type 3 as a bottom-up model where teachers solely add content to the platform. Kempe & Grönlund (2019) argue similarly to Bock & Macgilchrist (2019) that based on how the material is compiled and designed regarding its layout and structure, different teacher–student relationships and learning processes emerge.

Material

The empirical material was collected during 2019–2020. At that time, three publishers Bonniers, Gleerups and Natur & Kultur offered digital teaching material on the Swedish market and were also well established in Swedish schools. Based on our diverse research interests about teaching materials, national minorities and the digitalization of schools, teaching and learning, the topic of Sweden's five national minorities was chosen. The topic of national minorities was especially suitable since it is relatively new in the Swedish national curriculum of 2011 (LGR11), first established as added syllabi in year 2000 within the previous national curriculum from 1994 (LPO94) but further emphasized in national curriculum of 2011. Regarding the newness of a text, Fairclough (1992) notes that text carries its own history, with traces from different traditions, and with our selected topic, this risk is minimized. As a young topic, national minorities do not carry the same organizational, chronological, or content-based traditions. Using such a limited topic means that more teaching materials can be studied, which, in turn, can provide greater insights into layout, structure and content as well as the types of knowledge that the teaching materials strive for. Further, in the curriculum, topics on national minorities were found in the areas of History and Civics. These subjects are within the same field and are among the subjects that use textbooks to the greatest extent (Hartsmar, 2001; Olsson, 2014). Therefore, the selected empirical material ranges from grade 4-9 and comprise twelve digital teaching materials in both Civics and History.

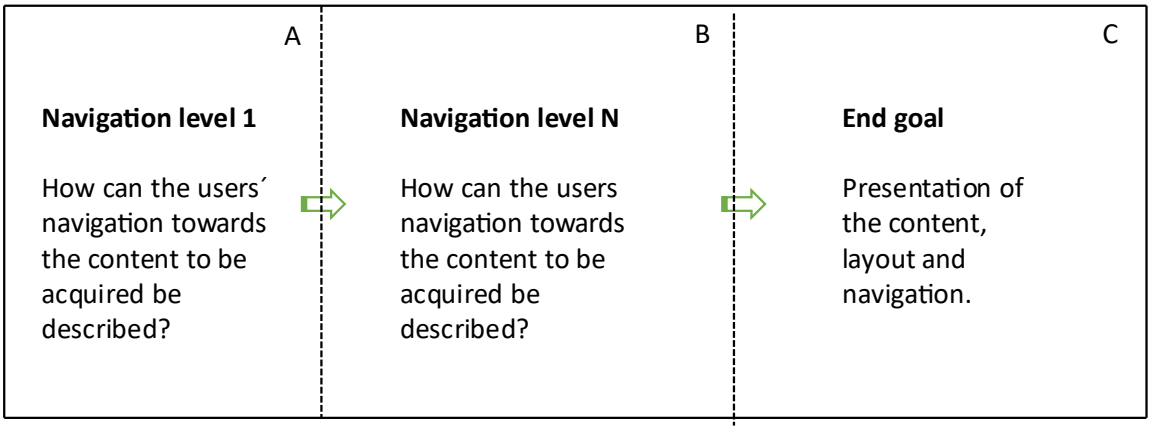
The publishers were willing to give us access to their digital teaching materials for analysis, but did not allow us to use screen shots from the materials. The materials have been analysed according to their layouts, structures, and content.

The analytical approach

To analyse digital teaching materials, we developed and tested an analytical approach consisting of three interconnected dimensions: layout, structure, and content. The approach emerged from the observation that existing approaches tend to focus either on textbook content, technical characteristics of digital resources, or multimodal meaning-making. Our intention was therefore not to replace these approaches but to combine insights from them into a method capable of analysing digital teaching materials as integrated digital environments. The analytical approach combines three complementary analytical dimensions which are applied sequentially and interpreted in relation to one another.

Principals for analysing layout

Figure 1



A principle of layout analysis

Figure 1 illustrates the first analytical step regarding layout. Layout concerns the disposition of the overall design, in this case, a web page (Oxford English Dictionary, 2024). This dimension summarizes the user's path to reach the goal of finding the content teachers wish students to acquire, similar to what Kempe & Grönlund (2019) address as users' navigation patterns through, for example, clickable paths or hyperlinks. To illustrate similarities and differences in the three digital teaching materials, a figure was developed, which was divided into three boxes: A, B and C. Box A and B illustrate the first and second levels of users' navigation in the teaching material. One complexity concerns the teaching materials' navigation. When navigating, we realized the teaching materials often have more than three levels for finding the information, but this illustration uses only three levels due to the visualization of the main navigation principle in the digital teaching materials structure. Therefore, the headline in Box B is (1…, N).

Principle for analysing "structure"

The term "structure" is defined as the interrelation or arrangement of parts in a complex entity (Oxford English Dictionary, 2024). The method for analysing structure in printed textbooks has a long tradition, whereas the approach of analysis for digital teaching materials is not yet standardized. One exception is studies about multimodality using the socio-semiotic theory applied in studies on both printed textbooks and digital teaching materials (e.g., Danielsson &

Selander, 2016; Kress, 2010). Social-semiotic approaches to multimodality primarily examine how different resources are selected, combined, and used to create meaning. Related approaches, including multiliteracies, also emphasise the use of multiple modes in meaning-making and communication (New London Group, 1996). These studies have largely been characterised by qualitative and interpretive analyses of content, representation, and meaning-making.

The approach for this paper is related to these traditions but has a different analytical purpose. Rather than primarily interpreting how meaning is constructed through the interaction between semiotic resources, the structure dimension provides a systematic and comparative description of the composition of a digital teaching resource. The purpose is therefore to make the structure and multimodal composition of digital teaching materials empirically comparable across resources by quantifying its distribution of components that constitute the digital teaching material.

Quantitative approaches remain relatively uncommon within multimodal research. However, some studies have used statistical techniques to examine multimodal data. For example, studies of interactional video data (Bower & Hedberg, 2010) and large-scale audiovisual news media (Bateman & Tseng, 2023) have analysed the distribution and co-occurrence of multimodal features across larger datasets. In contrast, the present study focuses on a limited sample of digital learning materials. The aim is therefore not to establish generalisable statistical patterns but to demonstrate how digital learning materials can be systematically described and compared through a theoretically informed analytical framework. The descriptive statistics used in this study serve to make visible aspects of digital learning materials that are difficult to capture in analyses of conventional textbooks, including navigation structures, hyperlinks, and the configuration of different digital resources.

To operationalise the structure dimension, an approach was developed for analysing the composition of digital teaching materials. The approach conceptualises structure as consisting of four interrelated components: sentences, assignments, hyperlinks, and photos/illustrations. These categories were selected to capture prominent textual, pedagogical, interactive and visual components of digital teaching materials examined in this study. The categories are not intended to represent an exhaustive classification of all possible digital or multimodal elements.

The sentences category covers the total number of sentences, including both informative sentences and sentences in tasks and assignments, regarding the topic of national minorities. The assignments category covers the number of sentences in those sections in the digital teaching material that specifically communicate a task or an assignment regarding national minorities. The hyperlinks category entails only hyperlinks in the digital teaching materials regarding national minorities and does not cover sentences, tasks, or assignments. The photos/illustrations category covers all pictures, photos, and illustrations regarding national minorities. Based on these four categories, the amount of information for each category was coded and then counted and summarized. Such descriptive statistics indicate how much information about national minorities was included in the digital teaching materials and how it was presented.

Taken together, these four categories provide a systematic description of the structural composition of the digital teaching materials. In combination with the layout and content dimensions, this enables the analysis to consider not only what content is represented, but also how digital resources is organised and what types of textual, visual and interactive components constitute it.

Principle for content analysis

The method for analysing content was inspired by comparative analysis in textbook research traditions (see for example Spjut, 2020; 2019). This analysis took its starting point in the curricula's *Overall goals and guidelines* that says all Swedish students in compulsory school shall have "[…] acquired knowledge of the culture, language, religion and history of the national minorities (Jews, Roma, the indigenous Sami people, Swedish Finns and Tornedalians)" (Lgr11. p.12). Since there are five Swedish national minorities (Jews, Roma, indigenous Samis, Sweden Finns and Tornedalians), we have in the teaching material counted if the content covers all five national minorities operationalized into four categories based on the curricula's *Overall goals and guidelines*: "name of national minority", "name of minority language", "culture connected to national minorities" and "history connected to national minorities". In the analysis, a yes-or-no scale was used. Hence, a "0" means that the category was not found in the material, while a "1" indicates that one category was found. The maximum sum can be 5 based on the five minorities (Jews, Roma, indigenous Samis, Sweden Finns and Tornedalians). The criteria in the curricula cover that all five national minorities shall be represented in the analytical categories. The number (0–5) represents the sum of the national minorities; if no national minority are mentioned, we labelled it "0", if the teaching material covers four out of five national minorities, we labelled it "4", and if it covers all five, the box says "5". Accordingly, if all five national minorities were found, it indicates that the teaching material covers the curricula.

One challenge regarding the interpretation of the analysis in history and culture is if the text content is explicit or implicit, if the minority is presented or represented. Some of the content is so short that it is hard to analyse if the text is a perspective of a Swedish national majority perspective or the minority's perspective. The curriculum only says "culture" and "history", which could mean both different perspectives and only a sentence of history connected to the minority. In this study, we have interpreted the curricula's writing as simply a sentence (or more) about history regarding the different minorities. According to the content of culture, there had to be a text about something connected to culture. Pictures of minority flags are not enough to count as culture, but one sentence or more about culture is included in the analysis. In the Findings section, we comment further on this challenge.

Findings

This section presents the findings, which demonstrate the application of the developed analytical approach to the material.

How digital teaching materials' layout can be described and understood

To demonstrate the layouts of the three digital teaching materials, three principal figures were used to illustrate each publisher's approach.

Figure 2

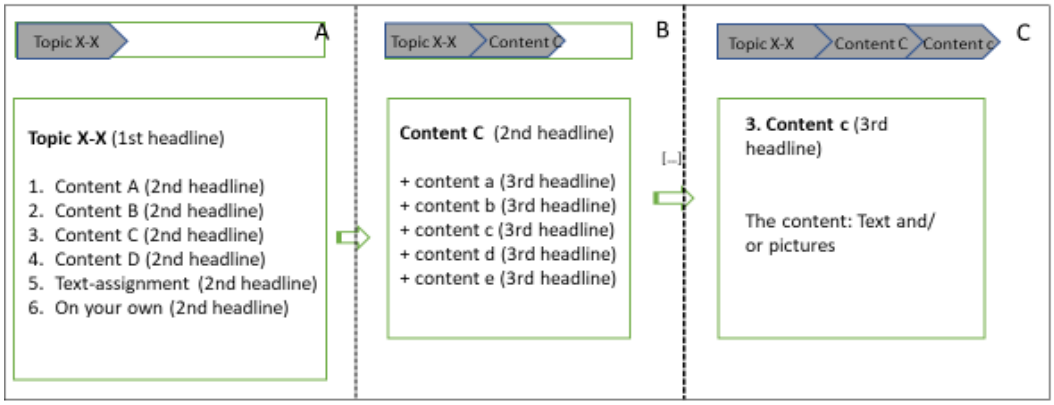


Illustration of the layout in Digilär, Natur & Kulturs' digital teaching material

Figure 3

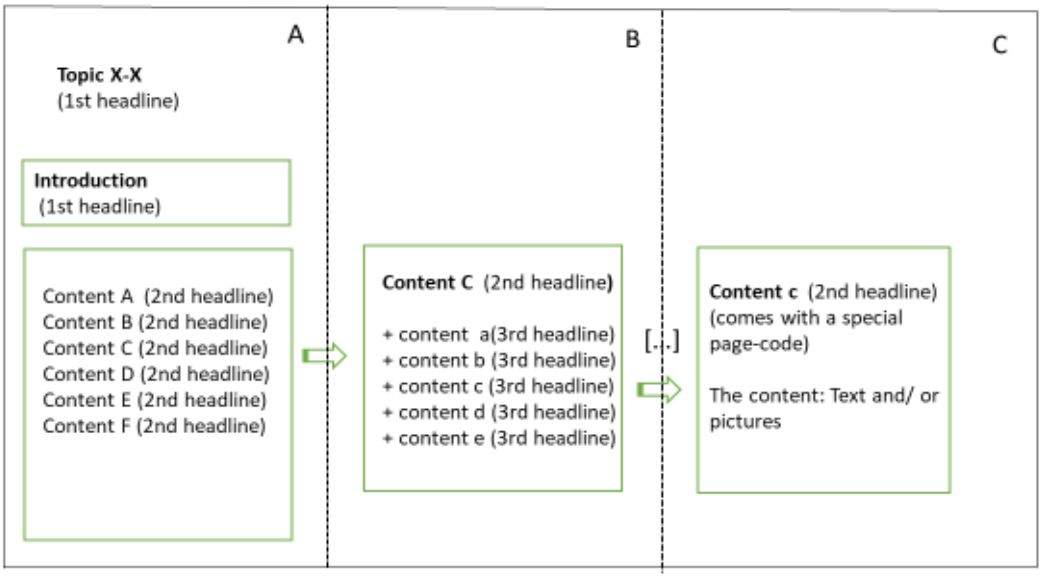


Illustration of the layout in Gleerups' digital teaching material

Figure 4

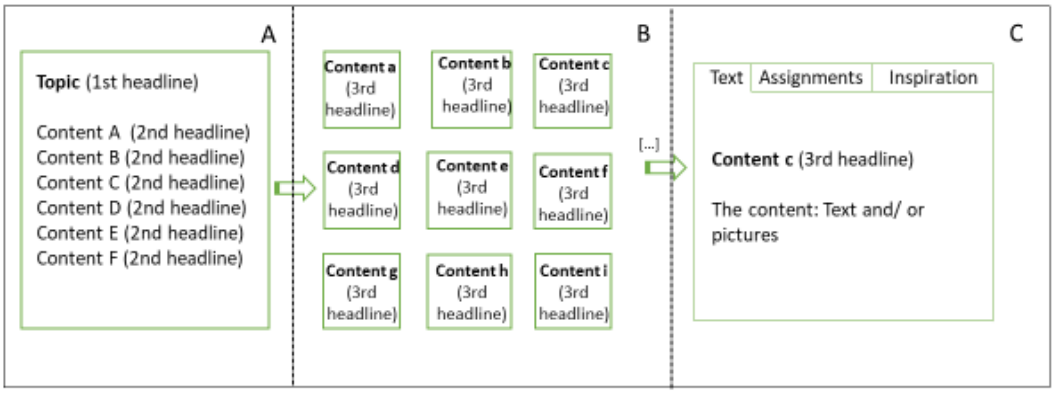


Illustration of the layout in Clio, Bonniers' digital teaching material

Figures 2, 3 and 4 illustrate the three publishers' digital teaching materials, which in a repetitive structure cover two sets of grades (4–6 and 7–9) in the subjects Civic and History. The findings demonstrate the varieties of layout and navigation in common in the three boxes: A, B and C.

Box A demonstrates few variations in the user's navigation. The user starts in the main content (History or Civics) and selects content topics, for example, national minorities. Box B illustrates when the user has made their first choice and enters a sub-topic within the area of the choice in Box A. Box B is illustrated in two different ways. Either as text (Figures 2 and 3) or as clickable images and illustrations (Figure 4), following the examples of national minorities the user can employ to make a more detailed choice in the teaching material. The choice in Box B leads to the detailed teaching content illustrated as Box C.

Box C illustrates the content students shall (hopefully) acquire. At this level, the content is compiled of texts (sentences), assignments, hyperlinks and photos and illustrations. The three publishers show variations in this presentation. One variation from Boxes A–C concerns the user's navigation where they can follow their recent choices through a "timeline", as illustrated in Digilär (Figure 2). A second variation concerns the presentation of the content. As illustrated in Figure 4, Clio (Bonniers) uses a tab-structure divided into texts, assignments, and inspirations, while Digilär and Gleerups present text alone or text with photos and illustrations.

Variations between the different digital teaching materials regarding structure

The variations in structure in the twelve digital teaching materials are illustrated in Tables 2 and 3, focusing on History and Civics. The three publishers (Bonniers, Gleerups and Natur & Kultur) represent two digital teaching materials each, for example, one in Grades 4–6 and one in Grades 7–9. The structure varies in relation to the four types of content categories regarding sentences, assignments, hyperlinks and photos and illustrations.

Table 2

The structure of the digital teaching materials in History

Content category	Subject and grade	Digilär (Natur & Kultur)	Gleerups	Clio (Bonniers)
Sentences (Reading)	History 4–6 History 7–9	42 169	15 88	38 115
Assignments	History 4–6 History 7–9	0 0	2 3	14 19
Hyperlinks	History 4–6 History 7–9	0 6	1 0	8 12
Photos and illustrations	History 4–6 History 7–9	3 10	3 3	10 10

Table 3

The structure of the digital teaching materials in Civics [For table 3, see appendix 1]

Content category	Subject and grade	Digilär	Gleerups	Clio
Sentences (Reading)	Civics 4–6 Civics 7–9	51 25	74 82	214 131
Assignments	Civics 4–6 Civics 7–9	0 1	5 3	31 36
Hyperlinks	Civics 4–6 Civics 7–9	0 1	8 0	12 12
Photos and illustrations	Civics 4–6 Civics 7–9	9 4	6 1	19 14

Tables 2 and 3 illustrate variations in the structures between the three publishers' teaching materials in History and Civics. In the next section, descriptive patterns of the variations are presented regarding the sentences, assignments, hyperlinks and photos and illustrations.

Sentences. In Table 2, the number of sentences in the History teaching materials indicates that Digilär provides a more extensive textual presentation of the topic, followed by Clio and Gleerups. This pattern is similar in both Grades 4–6 and 7–9 in History. For Grades 4–6, Digilär has three times as many sentences as Gleerups, while Clio and Digilär demonstrate almost equal numbers in Grades 4–6. For Grades 7–9, Digilär has almost twice as many sentences as Gleerups and 30% more sentences than Clio.

Table 3 shows that in Civics 4–6, the number of sentences is the richest in Clio, with almost three times more sentences than Gleerups and more than four times that of Digilär. In Civics 7–9, Clio has more than five times as many sentences as Digilär and more than fifty percent more than Gleerups.

Assignments. Table 2 shows Clio has between fourteen and nineteen assignments in History 4–6 and 7–9, while Digilär and Gleerups have none or just a few (N=2–3). Table 3 shows Clio has thirty-one to thirty-six assignments in Civics, while Digilär and Gleerups demonstrate 0–5 assignments.

Hyperlinks. Table 2 shows Clio demonstrates the highest number of hyperlinks (N=8) in History 4–6, while Digilär and Gleerups show one or no hyperlinks. On the other hand, Table 3 shows that for Civics 7–9, Clio has twelve, which is twice as many as Digilär, while Gleerups has no hyperlinks.

Photos and illustrations. Table 2 shows that for History 4–6, Clio has more than three times (N=10) as many photos and illustrations as Digilär and Gleerups. For History 7–9, Clio and Digilär have ten photos and illustrations each, which is more than three times as many as Gleerups (N=3).

Table 3 shows that in Civics 4–6, Clio (N=19) has more than double the number of photos and illustrations than Digilär and more than three times as many as Gleerups. In Civics 7–9, Clio has fourteen photos and illustrations, while Digilär demonstrates a few (N=1-4).

The variations between the different digital teaching materials regarding content

Concerning the variations regarding content, we start with a quotation from the national curriculum's overall goal, saying that all Swedish students in compulsory school shall have "[obtained] knowledge about the cultures, languages, religion and history of the national minorities (Jews, Roma, indigenous Samis, Sweden Finns and Tornedalers)". With these curricular directions in mind, the twelve teaching materials from the three publishers have been read, compared and analysed. The findings are illustrated in Table 4 according to the four categories: "name of national minorities", "name on minority language", "culture connected to national minorities" and "history connected to national minorities".

Table 4

Content about Sweden's five national minorities in the teaching material

Category ———— Teaching material	**Name of national minorities**	**Name on minority language**	**Culture connected to national minorities**	**History connected to national minorities**
Digilär (N&K)				
History 4–6	1	1	0	1
History 7–9	5	2	1	4
Civics 4–6	0	5	1	1
Civics 7–9	5	5	0	2
Gleerups				
History 4–6	1	0	0	1
History 7–9	1	5	1	2
Civics 4–6	5	4	0	2
Civics 7–9	4	0	0	4
Clio (Bonniers)				
History 4–6	3	0	0	3
History 7–9	2	2	2	3
Civics 4–6	5	4	5	5
Civics 7–9	5	5	2	1

Table 4 illustrates the variation in the content. In general, the teaching materials mention the national minorities and their languages. This is indicated in the first two categories, which illustrate if the teaching material mentions the name of the national minority and the name of their minority language. Specifically, two out of five teaching materials from Digilär (History 7–9, Civics 7–9) mention all five national minorities by name and two teaching materials mention all five languages (Civics 4–6, Civics 7–9). Gleerups demonstrates one teaching material that addresses all five national minorities (Civics 7–9) and one that mentions all minority languages (History 7–9). Clio's teaching materials in Civics mention all minorities by name (Civics 4–6, Civics 7–9).

As indicated in Table 4, the third category, "culture connected to national minorities", Clio indicates that all five national minorities are mentioned (N=5 in Civics 4–6). In the other teaching materials (Gleerups, Digilär), culture is vaguely mentioned, which is indicated by the low numbers (N=0–2).

In the fourth category, “history connected to national minorities”, there are variations. Clio presents some history of all five national minorities mentioned (N=5 in Civics 4–6). In the other teaching materials (Gleerups and Digilär), minority history is mentioned, but they do not cover all minorities.

Table 4 indicates that Clio cover most frequently the four categories about all five national minorities and mentions them all. In the close reading about the content, the texts are quite short, and the teaching material contains some factual errors about Sweden Finns. Gleerups and Digilär put greater focus on one or more minorities, so the texts are more detailed, but they do not cover all minorities.

One observation from analyzing the three teaching materials is that there seem to be a limitation on text space. The teaching materials demonstrate choices on whether the authors of the teaching materials would write in-depth texts about one or some of the minorities or if they would cover a little about all of them.

Analysis of the presented and tried out approach

This article represents a starting point in developing, testing, and critically examining an analytical approach for analysing digital teaching materials in terms of layout, structure and content. The analysis was done via a study of a specific teaching topic regarding national minorities in compulsory school curricula. The research questions were: How can layout, structure, and content be operationalised and combined in an analytical approach for digital teaching materials? 2. What are the strengths and weaknesses of the approach?

To move the research field forward, we saw a need to combine different methods for analysing textbooks, users’ navigation patterns and multimodality (Kempe & Grönlund, 2019; Danielsson & Selander, 2016; Ammert, 2011; Englund, 2011; Kress, 2010; Hartsmar, 2001; Långström, 1997. This work resulted in an analytical approach that considers the layout, structure and teaching content. The approach begins with a qualitative layout analysis to provide principal visualizations of the user navigation followed by a quantitative structural analysis presented as descriptive statistics of sentences, assignments, hyperlinks and photos and illustrations. These two analytical steps did not inform us about what the quantitative numbers represented; therefore, the final analysis is a qualitative content analysis.

One limitation of the present approach is that it does not analyse how different semiotic resources interact to create meaning. The structural analysis identifies the presence and distribution of textual, visual and interactive resources, but it does not examine how these resources work together in specific instances of communication. From a social semiotic perspective, multimodality concerns how modes such as text, image, video, hyperlinks and tasks are combined and orchestrated to support meaning-making (Kress, 2010; Danielsson & Selander, 2016). Future developments of the method could therefore integrate multimodal analysis at a more detailed level, examining not only the frequency of different resources but also their functional relations and pedagogical roles within digital teaching materials.

The first research question addressed how can layout, structure, and content be operationalised and combined in an analytical approach for digital teaching materials. The findings demonstrate how the approach enables systematic analysis of user navigation, structural composition, and content within digital teaching materials. In relation to layout, the approach made it possible to identify both common and distinctive design principles across the analysed materials. For example, the layouts of Digilär and Gleerups resemble traditional printed textbook, where the organisation of chapters and subchapters can be represented through the categories “Topic” and “Content”, as illustrated in Boxes A, B and C (in Figures 2 and 3). In Box C, Clio, by contrast, applies a different layout principle, in which content is organised into “Text”, “Assignments” and “Inspiration” (see Figure 4). Further, Figures 2, 3 and 4, demonstrates how the analytical approach can be used to describe user navigation through Boxes A, B and C, and thereby identify both similarities and differences between the digital teaching materials. The analysis indicated that all three materials could be represented through a similar overall structure of Boxes A, B and C. Hence, the user navigation is rather similar, even though differences exist. A particular similarity concerns navigation in Box A where clickable headings guide users towards selected content. When user reach Box B, differences emerge in the how the selectable content is presented, either as text in Gleerups and Digilär or as images in Clio. Another difference concerns how the user is informed of their location within the content. For example, Digilär provides a visual hierarchy showing where the user is within the digital teaching material, whereas Gleerups and Clio lack this form of navigation support.

Regarding structure, Tables 2 and 3 illustrate how the analytical approach can be used to identify and compare differences in the structural composition of digital teaching materials. By examining the distribution of sentences, assignments, hyperlinks and photos and illustrations the approach makes visible variations in the multimodal composition of the materials. While the present dataset is primarily suited to frequency counts and descriptive comparisons, larger datasets could possibly support more advanced statistical analyses in future research (Bateman & Tseng, 2023; Bower & Hedberg, 2010). The contribution of this article, however, is methodological: to illustrate how the structural and digital features of contemporary learning materials can be analysed in ways that complement existing social semiotic, multiliteracies, and content-analytical approaches. In the present study, Clio contains higher frequencies of assignments, hyperlinks, and photos/illustrations than Gleerups and Digilär, indicating a stronger emphasis on multimodal resources. The approach thereby provides a systematic basis for relating structural characteristics to existing classifications of digital teaching materials. Following Kempe and Grönlund (2019) Clio shares characteristics associated with Type 2 content, which combines traditional textbook features with a broad range of multimodal resources. In contrast, the structure in Digilär and Gleerups indicate characteristics of Type 1 content, representing a traditional textbook in digital format in digital form (Kempe & Grönlund, 2018).

Considering layout, structure, and content together illustrates one strength of the analytical approach. While a separate analysis of content (Table 4) might suggest that Clio provides more extensive coverage, the combined analysis reveals how layout and structure shape the conditions under which content is presented. For example, Clio’s higher numbers of assignments and hyperlinks (Table 2 and 3) becomes analytically significant not primarily as a quantitative difference, but because these structural features influence how curriculum content is distributed

and accessed within the teaching material. The analysis indicates therefore how examining layout, structure, and content as interconnected dimensions enables a more nuanced understanding of digital teaching materials than would be possible through content analysis alone. In this case, the analytical approach reveals how structural design features contribute to curriculum coverage and how differences between publishers become visible through the interaction of these dimensions.

The distinction between Type 1 or Type 2 digital teaching materials illustrates another strength of the analytical approach. By combining analyses of layout, structure, and content, the framework makes it possible to identify differences not only in what knowledge is presented but also in how knowledge is organised and communicated through the teaching material (Wikman & Horsley 2012). While traditional textbook analysis has often focused primarily on content, the present approach reveals how assignments, hyperlinks, and other structural elements constitute part of the representation of knowledge. In this respect, Type 1 (e.g. Digilär and Gleerups), and Type 2 (Clio) teaching materials can be understood as reflecting different approaches to knowledge organisation rather than merely differences in content coverage. The analytical approach therefore extends textbook analysis by making visible how layout and structure contribute to shaping educational meaning and curriculum representation.

Final Discussion and Conclusion

The developed analytical approach has shown us a functional way to analyse the three publishers' digital teaching materials regarding connections between layout, structure, and content. We have proved that the approach is functional and is a way to better combine studies of technical perspectives of layout and structure in digital teaching materials, connecting both quantitative and qualitative aspects of content and perspectives of knowledge and learning. This article contributes to the textbook research field by using the inspiration and ideas of multimodality when addressing the digital format. That highlights the fact that digital teaching materials contain variations through a combination of, for example, text, images, films, hyperlinks, and assignments. Further, printed textbooks have limited possibilities for layout and structure, while digital teaching materials demonstrate a greater variation. The developed approach of analysis presented in this article does not stop there; it also includes a qualitative analysis of content. This article contributes to the development and application of an analytical approach for digital teaching materials. The approach contributes to the analysis of layout, structure, and content, separately and in combination. The latter approach contributes to an analysis of a more complex and complete way of examining teaching materials through quantitative and qualitative approaches which is accomplished through methodological triangulation. When trying out this method, we achieved a result which echoes the Type 1 and Type 2 definitions of digital teaching materials. This concerns a wider perspective, which reflects on types of knowledge regarding connection between layout, structure, and content, as well as the very aim of a teaching material.

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Clio Historia 7–9, (Bonniers) [Clio History 7–9]

Clio Samhällskunskap 4–6, (Bonniers) [Clio Civics 4–6]

Clio Samhällskunskap 7–9, (Bonniers) [Clio Civics 7–9]

Digilär Historia 4–6, (Natur och Kultur) [Digilar History 4–6]

Digilär Historia 7–9, (Natur och Kultur) [Digilar History 7–9]

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