

# Exploring playful annotations in interactive textbooks

Engaging the teacher and the learner  
in an active learning process

Thesis Project by:

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Interaction Design Master's Programme

School of Arts and Communication (K3), Malmö University, Sweden

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Thesis Project II

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# 1 ABSTRACT

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This thesis aims at exploring the potential of playful annotations in interactive textbooks, to engage the teacher and the learner in an active learning process. This research focus was taken after a Field study consisting of a range of semi-structured interviews, surveys, and discussions with teachers and students from a pilot school provided with an interactive textbook platform called Gleerups. This latter is a Swedish publisher which spreads a large offer of educational textbooks across Sweden. The thesis topic was chosen in order to find and suggest ways to approach the learning and reading phase in an active way while also focusing on the teacher-learner relationship.

The design contributions include proposals for improvements taking the shape of scenarios and sketches using field research and qualitative studies. It is based on an analysis of related examples and cross disciplinary literature, grounding the research in education and learning theories. Finally, a prototype encompassing the main features raised from our research is presented.

The thesis ends with outcomes and reflections from findings, as well as discussion with stakeholders and teachers that initiated the research.

## **2 INTRODUCTION**

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Digital technologies are increasingly present in our everyday life, and they spread out into the education field in the past decade (Gu et al. 2015). Whether this will completely revolutionize schooling or not, two enthusiastic arguments about bringing these technologies in the classroom are the need to prepare students for the world in permanent evolution (Collins & Halverson 2009) and the fact that these technologies offer new ways for educating students, "*and that schools should embrace these capabilities to reshape education*" (Collins & Halverson 2009, p.9). The perspective of using these technologies in a school environment called into question every assumptions we had about how knowledge should be transmitted. Without always a clear vision of what to improve, new tools have been developed exploring the possibilities of these technologies.

Among the various forms of digital learning, interactive textbooks, also called digital-textbooks, electronic textbooks or e-textbooks (Gu et al. 2015), are major media that will be the focus of this thesis. The teaching materials traditionally presented on paper are progressively going digital in many schools having the capacity to provide digital devices to their students but the task goes beyond a pure transposition of paper textbook content and remains a difficult challenge.

These interactive books offer indeed what seems to be endless opportunities in terms of how to display the content to a screen-based device but interaction design is not only about technology and software. These books brought in classroom settings raise new issues in terms of environment management, which include among others a teacher and learners. These two actors are tightly coupled in the process of knowledge acquisition, and the technology which intervene in the middle should be considered carefully. Book interactivity can be a support for active learning, but how to also consider the place of the teacher in this triangle? How to use the interactive book frame to create better connections between the teacher and the learner? How can the appropriation of a book and its annotations enhance an active reading and a better communication between the learner and the teacher?

### **2.1 MOTIVATIONS**

Digital learning is a growing sector of interaction design and various interactive products are now proposed for schools. Drawing on the experience gained from their first practical uses, it is interesting to take a step back on the offer of supporting tools for teaching and learning. I argue that more attention should be devoted to the issue of the relationship between the teacher and the learner on such platforms. Indeed, such systems are usually treating these two actors separately and the interaction potential of that kind of platform is still under estimated. Moreover, the appropriation of books is also something that became possible with interactivity, ordinary paper textbooks being more of a transition object, passing from one student to another. The question of how the knowledge material can be in itself more engaging through interaction and annotation seems therefore relevant. How can a slightly playful annotation system also be a support for communication between the teacher and the learner?

## **2.2 COLLABORATION**

This project is made in collaboration with Gleerups, a Swedish interactive books publisher specialized in education textbooks. The company's main project is a platform for teachers and students (see <https://www.gleerups.se/>) on which they both have access to interactive textbooks. A large choice of books is available to different grades of learners, and the platform is used by many schools in Sweden. In this research project I therefore met stakeholders from the company, but also users of the platform: teachers and students. I was free to lead the project in the direction that seemed the more relevant to me.

## **3 RESEARCH FOCUS**

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### **3.1 CONTEXT**

The research takes as a basis the current functionalities and uses of the Gleerups interactive books. The platform design has been made by a consulting agency, as the company does not have an in-house design and research department. They are however interested in research and suggest thesis proposals to students.

The content of the e-books themselves matches with the programmes' criteria of the education's ministry and therefore cannot be played with so much, but it is possible to focus on annotations, which suggest to think in terms of layers, without changing the book's content per se.

The context in which I worked is a pilot school in Skåne where I met two volunteer teachers in Swedish and German and in History and Geography, as well as their students aged from 14 to 16. These teachers have been using the platform for two years now and hence have been able to set routines with it. Organizing meetings with teachers and students has not always been an easy task in a short period of time, but having the opportunity to listen to the users and understand their habits with the learning platform has been a valuable resource to conduct this research.

### **3.2 PURPOSE**

The aim of this thesis is to explore how active learning and playful annotations can enhance communication between Teacher and Learner. The choice of bringing together active learning and playfulness is made for approaching the interaction with the textbooks in the classroom in an enhanced way, relocating the couple teacher-learner at the centre of the system.

### **3.3 KNOWLEDGE CONTRIBUTIONS**

The contributions of this research are firstly the findings from observation, interviews, surveys and activities conducted with the platform users. These findings contribute to a better understanding of how the platform is used and the habits that the different kinds of users have developed with it. By giving a voice to the users and by observing them in real settings, the research contribute to enlighten another part of the tool's place in learning and teaching routines. More generally, it brings a picture of how teachers and learners evolve and interact through a learning interface.

Another contribution results from workshops, design proposals, as well as scenarios and prototypes exploring how active learning and annotations can take place on the platform, and how it can be a support for communication between the teacher and learners. These knowledge contributions may have an impact in the way they question the use of annotation, not as something purely functional, but as something becoming playful.

Finally, feedbacks from teachers around prototypes are provided, as well as discussions and reflections with stakeholders as a way to evaluate the research.

### **3.4 RESEARCH QUESTION**

The research question can be phrased like this: how can we design a form of playful annotation system that engage the teacher and the learner in an active learning process?

## 4 RELATED WORK

### 4.1 GLEERUPS INTERACTIVE BOOKS

As a start, an analysis of Gleerups Interactive books and platform is provided to set the context of the research.

All the users of the platform can access the textbooks from a portal (<https://gleerupsportal.se>) by logging on to their personal account. Usually, teachers have access to their own school subjects, and the learners have access to all the subjects they are studying (Fig.1). Users can then enter the books' content by clicking on the book of their choice.

The focus is made here on textbooks for students from grade 7 to 9, so for students usually aged between 14 and 16.

#### 4.1.1 Overall Structure

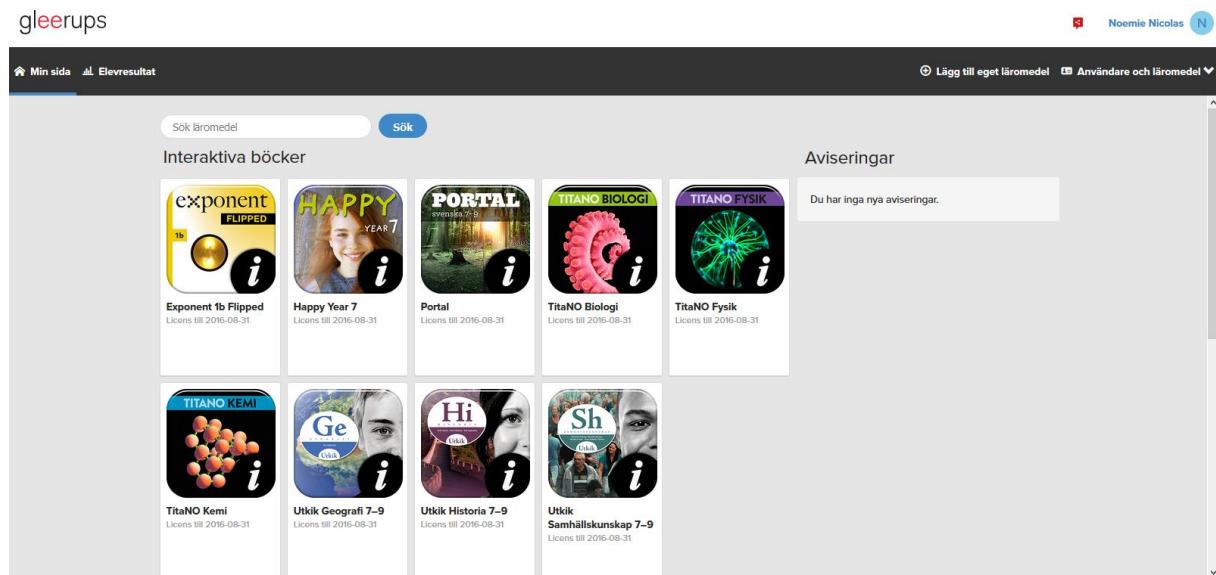


Figure 1 Gleerups' homepage: a view of the available textbooks for a student

The textbooks themselves are all displayed in a consistent manner, regardless of their content: on the electronic version, a table of content is presented on the left which includes all the sub-divisions of the book in chapters and subsections. In the centre lies the content of the book, which is displayed page by page (Fig.2).

Other types of information such as pictures, maps and questions can also be found on the right side of the website, even if they can also occur along the main text block.

In certain classes such as History or Geography, a visual code has been chosen to differentiate the category of each subdivision (blue squares for stories, green circles for explanations, etc.).

Exercises such as quizzes and other questions answering are inserted at the end of modules of a same subject to make sure that the student understood correctly the important points in the chapter or subdivisions.

Users can also listen to the text by clicking a button. The text is then read by a synthetic voice. It is possible to tune the ways the text is read and the text is displayed (for instance highlighting the word and sentences while the text is read).

The screenshot shows a digital textbook page from Gleerups. The top navigation bar includes 'Innehåll', 'Bokmärken', 'Lärmaterial', 'Utkik Geografi 7–9', 'Lysna', 'Inställningar', 'Skapa tillägg', and 'Länka hit'. The user is logged in as 'Noemie Nicolas'. The main content is titled 'Väder, klimat och vegetation' and features the heading 'Finns Maldiverna om hundra år?'. The text discusses the Maldives' location near the equator, its coral reefs, and its tourism industry. A map of South Asia shows the Maldives and surrounding regions. On the right, there is a comment box with two entries:

1. Hur påverkar klimatet levnadsvilkoren på Maldiverna?
2. Maldiverna är en sårbar plats. Beskriv vad i naturlandskapet som gör att situationen är så svår.

Page number 55 av 176 is visible at the bottom right.

Figure 2 Division of the book in the Gleerups platform

#### 4.1.2 Annotation and appropriation

Gleerups has set different possibilities for the users to appropriate the textbooks. First they can highlight words and sentences by selecting them (Fig. 3). This feature works as a classical digital highlighter, with no extra possibilities.

This screenshot shows the same digital textbook page as Figure 2, but with a specific text block highlighted in blue. The highlighted text is: 'Maldiverna är nog mest känt för sin turism och sina orörda sandstränder av vit korallsand. Hit kommer en halv miljon turister varje år för att bada, snorkla, dyka och vindsurfa. Det är från turismen som landet får sina största inkomster. Men öppningen är för många också känd som landet som kanske försvinner på grund av den globala uppvärmningen, dvs. att jordens medeltemperatur stiger. Under de senaste hundra åren har temperaturen höjts med nästan en grad.' A blue callout bubble with the text 'Markera' and a magnifying glass icon is positioned over the highlighted text. The rest of the page layout is identical to Figure 2.

Figure 3 A highlighted block of text in the Gleerups platform

The users can also add comments on the textbook. A new block then appears on the right side (Fig.4). On this side, the user can choose to who the comment will be visible, either to all the group or only for its own usage. For the teachers, an extra feature is currently beta tested which consists in sharing comments and materials with the whole community of teachers using Gleerups.

There is the possibility to attach files such as pictures and pdf documents, as well as links to comments. Basic editing functions (e.g. using a bold or italic police) are also provided.

The screenshot shows a page from the 'Utkik Geografi 7–9' textbook. The left side contains text and a map of South Asia and the Maldives. On the right, there's a 'Tillägg' (Annotation) panel. At the top of this panel, a comment from 'Noemie Nicolas' is displayed: 'Var finns Maldiverna? Det är skrivat i boken.' Below this, there are buttons for 'Fet' (bold), 'Kursiv' (italic), 'Avbryt' (cancel), 'Radera' (delete), and 'Spara' (save). Further down, there are buttons for 'Visa i boken' (Show in book) and 'Vem ska se detta?' (Who should see this?). A dropdown menu shows 'Bara jag' (Only me). The bottom of the panel says 'Inga tillägg eller kommentarer tillgängliga' (No annotations or comments available).

Figure 4 A comment section on the right side

The teacher can choose to display comments above the book content block (Fig.5). In this way, all the students see them directly when they reach the page. Otherwise the comment notification is really discreet, it shows their number with no visible modifications above the book content.

This screenshot shows the same page as Figure 4, but the comment from 'Noemie Nicolas' is now displayed directly above the main content area, enclosed in a box. The rest of the interface is identical to Figure 4.

Figure 5 A comment displayed above the content

In order to imagine future possibilities for the platform and the potentiality of more playful interactions using the annotations, a few other systems besides the Gleerups platform are quickly analysed in the rest of the section, with a particular focus on the practice of annotations. These applications and programs are used in the education field, but also in professional or leisure contexts.

## 4.2 EXPLAIN EVERYTHING

Released in 2011 and frequently updated, Explain Everything is an application and tool that let teachers and students annotate and narrate explanations and presentations. Presented as an interactive whiteboard, it allows to create dynamic lessons from scratch or from imported documents (PDF, PPT, and Keynote among others). An important feature is the possibility to create animated activities through annotation process recording and playback. It is also a collaborative tool on which users can co-create their own layer of extra information.

In terms of annotation, a striking feature of this environment is the amount of editorial choices offered, which give users the freedom to appropriate contents in a very flexible way. Indeed the user can highlight, draw, add shapes, post written and audio comments, but also write over the text. There is then a possibility to record the interactions with the document and to share it and play it back, which adds a dynamic aspect to every presentation.

It also appears clearly that the application has considered the use on tactile devices as one can feel a great 'materiality' in the interaction with the text (Fig. 7). Indeed, the text can be highlighted directly with the fingers, which in itself provides a more direct and playful interaction.

Even if this tool seems to be essentially used for animation with objects (Fig. 6), an example of teacher use found on the web (Wideen 2015) reveals an interesting teacher's seizure of this creation space towards the production of a textual document (Fig. 7).



Figure 6 Editing of an animated presentation

Figure 7 A teacher's use of the application: 'I' refers to an Interesting fact, 'NL' refers to a new learning

Indeed she has used the annotation system to categorize different types of learning and of reactions one can have while reading a text. This method allows the learner to be critical and to remember certain aspects of the text together with a reaction on its content (new learning, misunderstanding, disagreement...)

The teacher applies her teaching process to the tool in use: 'I taught how to reread a text, annotate a text, leaving tracks of thinking while reading, questioning techniques and most importantly, instilling in my students that reading is thinking'

This example is interesting because it is similar to the type of content available on Gleerups. As this latter has relatively scarce appropriation and communication means, it is relevant to draw a parallel with that kind of behaviour. The communication aspect could even be carried further and the Gleerups platform could be seen as another communication channel between the teacher and the learner.

## 4.3 ACTIVE READING ANNOTATION (ARA)

The Active Reading Annotation system is a tool that draws on years of research and experimentation and was released in 2011 (Golovchinksy et al. 2011). According to its authors, the aim of this application is to transpose the experience of annotation in the margins of a paper book on a digital device, more specifically on a tablet laptop.

The authors bring the important notion of shared annotations. This way, a group of students can have access to a common document, then annotate and appropriate it together. This feature is already available in the Gleerups platform, but does seem to be rarely used.

Several aspects of author recommendations draw upon the materiality offered by tactile digital devices. Tablet devices and other tactile devices allow indeed other types of interactions than with simple laptops with keyboards, such as of course direct appropriation mediated by fingers or stylus. In our thesis project, the accentuation is made on computer-based interaction rather than tablets but that kind of direct interaction, which seems to bring more emotion to the act of reading, is worth to be considered also in a non-tactile environment.

Additionally, ARA proposes audio-based annotations as another way of annotating texts. This feature enlightens another specificity of this type of devices: a high degree of mobility. It brings new situations where it may be difficult to write with a keyboard what one have in mind and audio records or even speech recognition might me particularly relevant in such contexts. More generally, it suggests that expanding the ways to interact with the text makes it possible to deal with particular environments (accessibility, mood) and the changing preferences of the user.

Finally, I have noticed with interest the effort to propose a real navigation system on annotations (Fig.8): it offers the presentation of an overview of all annotated parts together with a couple of filters that can display only certain types of annotations, such as highlighted zones for instance.

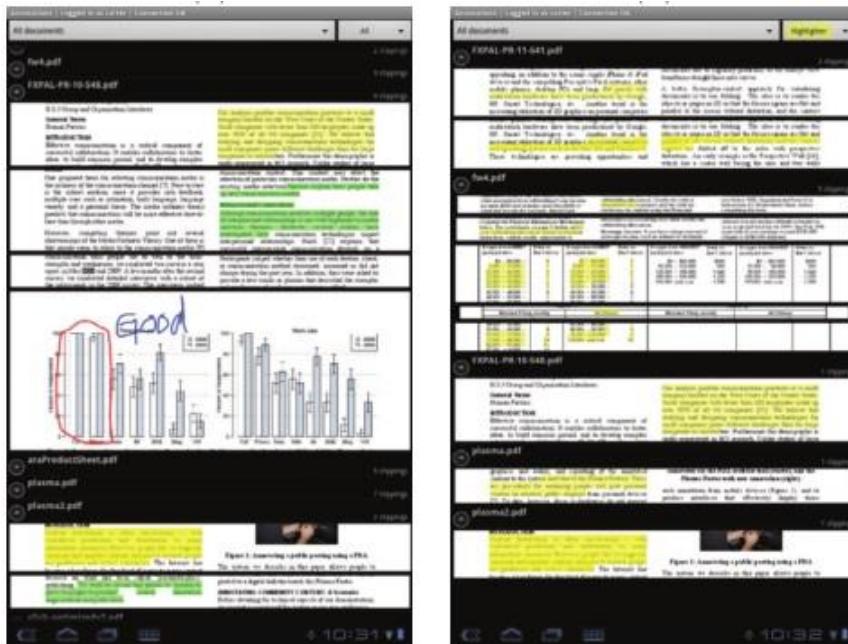


Figure 8 ARA: Overview of all the annotated areas - with filters

## 4.4 PDF MARKUP CLOUD

In the same vein as the previous one ARA, this more recent application allows the same kind of interactions with the content, with even more possibilities in the personalization, specifically in the highlighting options (Fig.9). Indeed the user can choose between different colours to mark the text for example, which seems to be an obvious function but not present in every application.

The different kind of annotations (audio, comments, highlight) also use the margin spaces as a way to localize and to make visual landmarks in the document.

Finally, this application shows a noticeable example making a distinction between different kinds of information by appropriating in diversified manners. Even without looking closely at the text, different levels of information pop up and attract the eye in various ways.



Figure 9 PDF Markup Cloud, a tool which allow to vary the annotations

## 4.5 SKITCH

Skitch is a simpler, ‘screenshot’-based tool, where users can appropriate a document by directly annotating any kind of media and share it with other users. The interaction with the digital material is quite direct, allowing a more emotional kind of annotation, which might be a good inspiration for introducing more playful interactions in a digital learning environment.

Special features and markers such as icons to remember what the user liked about an image, text or document is a manner to include another layer of possible reactions with respect to a given content (Fig.10).

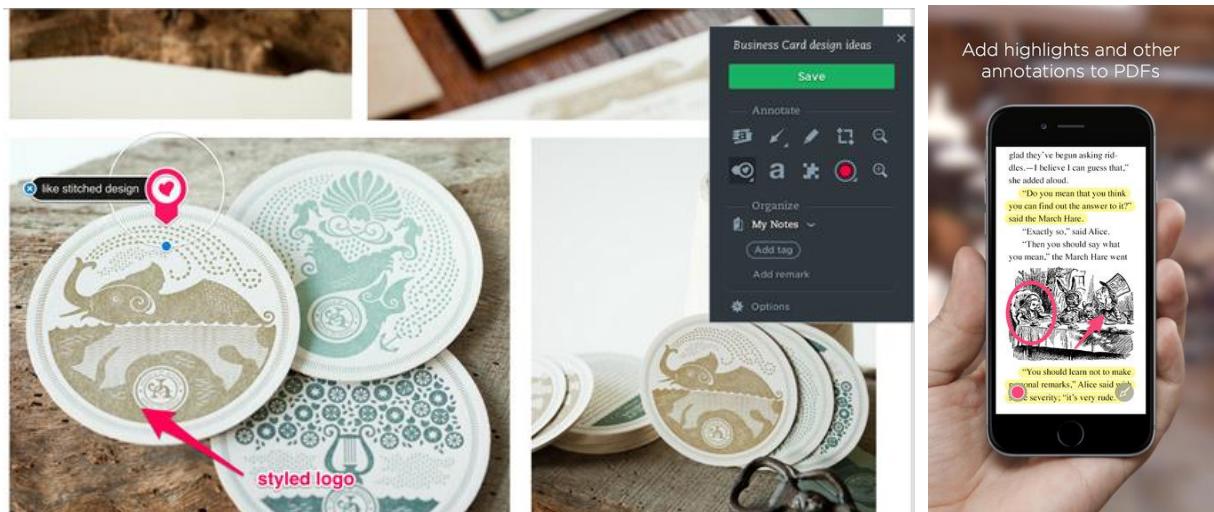


Figure 10 Skitch: a ‘screenshot’-based tool with the possibility to add icons and emotions to documents

With the aim of exploring playful annotation in interactive books, the review of these related systems brings a useful vision of possible ways to annotate textual content and to establish a communication between teachers and learners. The examples provides insights on how a text or document can be appropriated (highlighting, written and audio commenting, drawing) and that users can also go beyond the expected utilization of the tool, by applying their own manner of interacting with the text (Wideen 2015). These findings lead to the inclusion in the interface design research of the concepts of the establishment of a code, the importance to take into account the context and what kind of content is given for appropriation, emotion and affect, personalization.

## 5 THEORETICAL FRAMEWORK

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### 5.1 DIGITALIZATION OF LEARNING CONTENTS

The interactivity brought by computer-based learning creates a specific learning environment that directly impacts the design of digital contents. This section introduces the necessary framework to position my research work on interactive learning environments (ILEs) based on annotations. ILEs allow learners to engage actively in the process of learning (Renkl & Atkinson 2007), a dimension that is often absent in traditional paper-based books for instance. What characterize ILEs is the close dependency between actions from learners and their learning environment. A ‘dialog’ takes place between both of them. The basic components of an ILE are first quickly defined and the key notion of interactivity is then detailed in terms of control.

#### 5.1.1 Components of an interactive Learning Environment

Any ILE has to take into account at least four components or facets, which have been well described in (Sabry & Barker 2009): the Learner, the Technology, the Pedagogy and the Subject Content:

- The **Learner** is of course a key and central component. It is important to remember that there are multiple types of learners to consider, and that each of them have different learning styles, performance levels and attitudes. An efficient ILE should be able to get a representation and to record an abstract profile of each learner.
- The **Technology** refers to the tools that will be used in practice by the learner, including the usability, interactivity, navigation, and all the aspects of the learning system within the Interactive Learning Environment.
- The **Subject Content** is constituted of the subject knowledge information, whether this information is internal or external (supplementary information coming from internet searches for example). The Subject Content also refers to the skills the learners are supposed to acquire and to the course aim and objectives.
- Finally, **Pedagogy** refers to the way a course will be delivered in instructional terms, and which learning theories, strategies, models and approaches will be used.

If these four components depict the general framework of an ILE, two additional elements can be present and usefully complete it (Sabry & Barker 2009), and are of particular interest in our study:

- The **Interaction** component describes how the learners interact with the system.
- The **Dynamicity** component refers to the way the environment and information is aware and adapts to changes made by learners. It addresses the issue of how an ILE should be constantly up-to-date regarding the history of interactions the learner has with it, but also regarding the learned content.

#### 5.1.2 Interactivity and Interactive Learning Environments

Interactivity allows the user to influence or change an object or environment, or to receive or send feedback. Hyperlinks and hypermedia are perhaps the first elements one can think of when discussing about interactivity within Interactive Learning Environments. (Graham et al., 2000). However, hypertextual navigation is not the only factor of interactivity. In ILEs would lie at least five common types of interaction (Moreno & Mayer 2007): Dialoguing, Controlling, Manipulating, Searching, and Navigating. To go in greater details, one of the main element in ILEs compared to non-interactive environments is that the learner has control over a certain amount of components (Sims & Hedberg 1996). These components can be listed as follows:

- **Control over content:** selection of topics or objectives associated with a specific lesson, control over the way of displaying elements.
- **Control over sequence:** refers to the order in which the content is viewed, possible interaction of moving forward and backward along a linear sequence of content, or navigation by hypertext and hypermedia links. Note that it can be a source of conflicts with respect to instructional goals.
- **Control over pacing:** control of the speed and time at which content is presented.
- **Control of the learning context:** for example, mathematics may be linked to basketball, shopping or football and the learner can choose in which environment she wants to study.
- **Control of media:** having the choice between different ways of studying through different presentations: with texts, graphics, video, sounds...
- **Provision of optional content:** refers to additional material, as well as forms of support. It is linked to advisement, level of difficulty...
- **Locus of control:** refers to the extent to which the lesson is under the control of the learner or the computer (instructor).

The aim of Interactive Learning Environments is therefore to give the learner more control over a large set of features. However, this dimension of control is itself supervised by a set of other elements that are essential for the learning goal. This has been further specified in (Sabry & Barker 2009), where the control variable can more or less lean on one side of the following set of dual parameters:

- **Instructor / Learner**, conditions under which the teacher or the learner take the lead over the control.
- **Linear / Hyperlink path**, instructional strategies to manage the focus of attention, avoiding losing the learner's sense of direction.
- **Viewed / Constructed knowledge**, expertise, skills or know-how that is requested for the learner, from simple viewing of content, to the completion of tasks (problem-solving) with or without a toolbox.
- **Discrete / Integrated information**, the way in which the information is structured (in some apps, information may be treated as discrete components, without being associated with a particular context or situation).
- **Informative / Self-Paced environment**, the extent to which learners will get support, with either a teacher controlling individual progress or a freer discovery of some topics.

Underlying all these parameters, there is the important focal point that introducing interactivity in the learning process reveals new issues that must be considered such as for instance disorientation, a common behaviour coming along with the notion of hyperspace that can confuse learners. Designers have therefore to be conscious of this reality and cautious about the way they design the environment. The next section provides a study on the potential of metadata called annotations in enhancing the learning activity of students.

## **5.2 ANNOTATION, ACTIVE READING AND PLAYFULNESS**

### **5.2.1 Annotation and active learning in ILEs**

Active reading consists of a deep and focused reading process. As stated in (Tashman & Edwards 2011), “*In contrast to how one might read a novel, active reading can be characterized by the greater demand it places on the reader and her media and tools. Active reading frequently involves searching, highlighting, comparison, non-sequential navigation, and the like*” (Tashman & Edwards 2011, p.2927). Thereby, active reading is about interacting with the text by doing extra actions around it, while still being focused on the reading task. Regarding education, active reading focuses on the learner, who is active in her knowledge construction by interacting with the educational material. .

Annotation and note-taking are among the most common means of active reading types of interactions. The reader interested by a good overview of what cover these terms can refer to (Marshall 1997), which propose a categorization of annotations that is valid for both analog and digital forms. Mostly, the annotations can be within-text or marginal, in the blank space, and they are either telegraphic or explicit. More details can be found in Appendix I.

Annotations observed in paper textbooks have different forms and functions. From underlining, highlighting, symbols, circled words, short notes, notes and doodles to drawings, all these forms have a lot of different meanings depending on the reader. They can act as a signalisation, as place markers, or help problem-working, interpretation, tracing of a progress, or reflection for instance. The reader has then often her own code to decipher her annotations.

The possibilities offered by digital devices call into questions what must be considered as annotations. There are new components to take into consideration, such as in situ annotation that become potentially distinguishable from the source. Along the same track, the transition between public and private annotation should also be considered. The digital world can also convey a great deal of different forms that enhance the flexibility of annotations and the freedom one can have with them. This may cause new problems because students could put more efforts on the form than the content.

In summary, even if digital devices brings a lot of new opportunities, one must be careful about designing a tool in which reading remains the first activity. Annotations should not be distracting from the initial goal: readers would tend to annotate with the tool in hand, which means that the annotation system should not interrupt the act of reading, or the less possible. On paper, annotation seems to be well integrated with reading (O’Hara & Sellen 1997) whereas on digital devices, annotation could be distracting (Marshall 1997).

While looking for examples of active reading behaviour, some methods were found (Fig. 11) around how to annotate a text. Even if these methods were presented for paper-based texts, they present opportunities in a digital transposition. These systems attest for a remarkable appropriation of the text which can be taken into account in the following research.

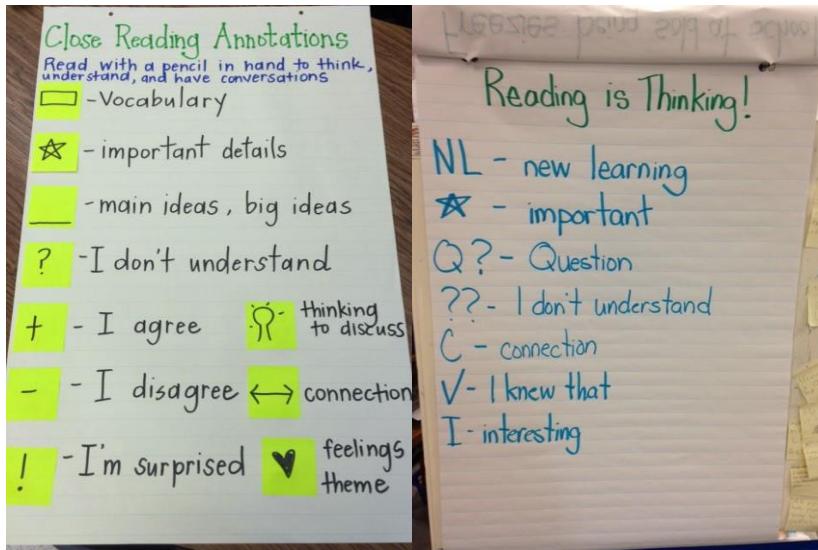


Figure 11 Practices of active reading in class – System of symbols to annotate depending on the reactions (Wideen 2015)

### 5.2.2 Playfulness in annotation

We end this section by exploring playfulness in annotations, a main interest of this thesis. The following points are drawn from the work of M. Sicart (Sicart 2014), who describes precisely the notions of play and playfulness.

Firstly, play is “*a way of engaging and expressing our being in the world*” (Sicart 2014, p.5). It allows us to grasp and perceive the world in a different way, and thus challenge it. This activity is creative and can then lead to knowledge. Play also delivers ourselves from moral conventions, while still letting us be aware of their presence and importance. In an educational context, this might be important to notice because if a playful activity is introduced, it would have to deal with more ‘serious’ content and information. Furthermore, play should not always be connected to the notion of ‘fun’ but more to the pleasurable one, “*opening us to the immense variations of pleasure in this world*” (Sicart 2014, p.3).

Play and playfulness are two different notions, and the one that is crucial is the latter. Indeed, playfulness brings the “*capacity to use play outside the context of play*” (Sicart 2014, p.21). It is a manner to engage with situations and objects that can seem related to play but which still respects the goals of these situations and objects. In the case of interacting with educational contents, playfulness can therefore be brought while the initial goals of learning and grasping information are still respected. “*The main difference between play and playfulness is that play is an activity, while playfulness is an attitude*” (Sicart 2014, p.22). By getting rid of the activity itself, only the posture remains. Two other points which deserve to be noted are the possibility of appropriation through playfulness, appropriating a context for example, and the personal aspect of playfulness, which “*imbue the functional world*” (Sicart 2014, p.29). All these characteristics of playfulness can therefore further be considered and integrated in future design proposals.

## **5.3 CONSTRUCTIVISM AND CONSTRUCTIVIST TEACHING METHODS**

A basis of the chosen approach comes from the constructivist philosophy of education. It tries to provide a theoretical background to the way people elaborate knowledge for themselves. This section introduces the concept of constructivism and discusses its implications on the way to teach.

### **5.3.1 About Constructivist theory**

Constructivism is a theory of knowledge and thus pertains to epistemology. It argues that humans generate knowledge and meaning from an interaction between their experiences and their ideas (Piaget 1967). The two main concepts are Assimilation and Accommodation, which refer to processes at the core of this interaction. Assimilation is about the incorporation of new information in an existing framework (mental representation) whereas accommodation refers to the re-framing of the mental representation. Constructivism in itself is therefore not a teaching method but firstly a theory of knowledge and how we construct it through our experiences.

Other theories of knowledge acquisition exist and co-exist such as behaviourism or cognitivism, but the constructivist approach is particularly meaningful and relevant in the context of Interactive Learning Environments, as it places the direct interaction of learners with the content at the core of the learning process.

### **5.3.2 Constructivist teaching methods**

The so-called constructivist teaching methods build upon constructivist learning theory as described above. In this kind of teaching is emphasized the active role of learners for knowledge construction. In the current ILEs are fostered active behaviours that focus on manipulating learning objects and engage more intensively in the learning environment, by exchanging with it (Renkl & Atkinson 2007). Learners have to take a stance on the issues that are submitted. It is only in this way that the knowledge would be actively constructed from an existing mental model and assimilated, rather than by the mere passive delivery of information given to the learner. Annotation as one way to interact with the text changes the learner involvement from passive to active and engaged.

The role of the teachers is also affected because they have to act as *facilitators* rather than knowledge providers (Bauersfeld 1995). Although common situations still place the teacher as active and the learner as passive, constructivist teaching methods allow the learner to be fully mastering the learning process (Olufemi 2007). The aim is for the learners to get their own understanding of the content they interact with. *"The role of the teacher will not be that of transferring knowledge or 'pouring' some facts into the learner but in acting as a facilitator who encourages learner by giving tasking or activities, organizes and sets probing questions and experiments, while the learner is left to interact with available resources to find meaning of the 'real' world"* (Olufemi, 2008, p. 56). A need for flexibility appears for the learner to reach this state of free interaction with information.

## 5.4 INSTRUCTIONAL DESIGN AND PEDAGOGY

As the aim of this thesis is to explore playful annotations in interactive textbooks, a definition of instructional design is given here to inform the process.

Instructional design consists of creating "*instructional experiences which make the acquisition of knowledge and skill more efficient, effective, and appealing*" (Merrill et al. 1966, p. 2). The idea is to analyse what the learner might need and define the instruction goal. Then an "*intervention*" should be designed in the middle to assist the transition. This latter should be designed carefully and usual phases are: Analysis, Design, Development, Implementation, and Evaluation of this intervention. The aim of instructional design is not only to focus on the mere transmission of information to the learner, but above all to find an efficient way to present it (Mayer 2001) and thus engage the learner more actively (Sabry & Barker 2009). Designing a playful annotation system does not solely consist in either transmitting or presenting educational information, it adds a layer of extra-information produced by the teacher or learner. In any way, I would argue that it is important to have in mind how instructional experiences are created, because designing an annotation system is an experience that comes on top and intertwines with the precedent. A lot of different elements are interconnected in the way the learner will be influenced: "*the relationship between teacher intervention, the tools in use, peers, and instructional design is interdependent: they each influence students' conceptual development in the activity setting*" (Strømme & Furberg 2015). Therefore every component should be taken into account. In contexts where instructional experiences are designed within technological environments, one of the greatest challenge and especially for pedagogy is to deal with computer's limitations (screen and keyboard), which can drastically limit the activity and engagement of the leaner (Španović 2010).

# 6 METHODOLOGY

## 6.1 RESEARCH THROUGH DESIGN AND FIELD APPROACH

The chosen approach for this thesis is Research through design, which refers to “*a research approach that employs methods and processes from design practice as a legitimate method of inquiry*” (Zimmerman, Stolterman, & Forlizzi, 2010, p.310). The term Field approach from Constructive design research, a main sub-division of Research through design refers to “*design research in which construction — be it product, system, space, or media — takes centre place and becomes the key means in constructing knowledge*” (Koskinen et al. 2012, p.5). This thesis is based on the Field approach, in that it focuses from the beginning on in-situ investigation of a teaching class and of discussion with its actors. As explained in (Koskinen et al. 2012, p.69): “*if there is one keyword to describe the field approach to design, it must be ‘context’*”. The idea was also to let the users do some activities to help imagining new things as “*the aim is to turn fieldwork into an exercise of imagination rather than mere data gathering*” (Koskinen et al. 2012, p. 76). I have therefore organized activities and workshops with participants to explore the research area. The chosen approach produced empirical grounded contributions (Löwgren 2007). From a theoretical perspective and to better define my research area, I also gathered references and grounded my work in education, annotation processes and teaching approaches literature, as well as in related work being both connected to interaction design and education or annotation activities. Different kinds of knowledge contributions were produced following this methodology, since the contributions can take many shapes: “*typically, this “thing” in the middle is a prototype [...] however, it can also be a scenario, a mock-up, or just a detailed concept that could be constructed*” (Koskinen et al. 2012, p. 6). My goal has been to design proposals (concepts, scenarios, mock-ups) of possible interactions between the digital platform and the student/teacher couple.

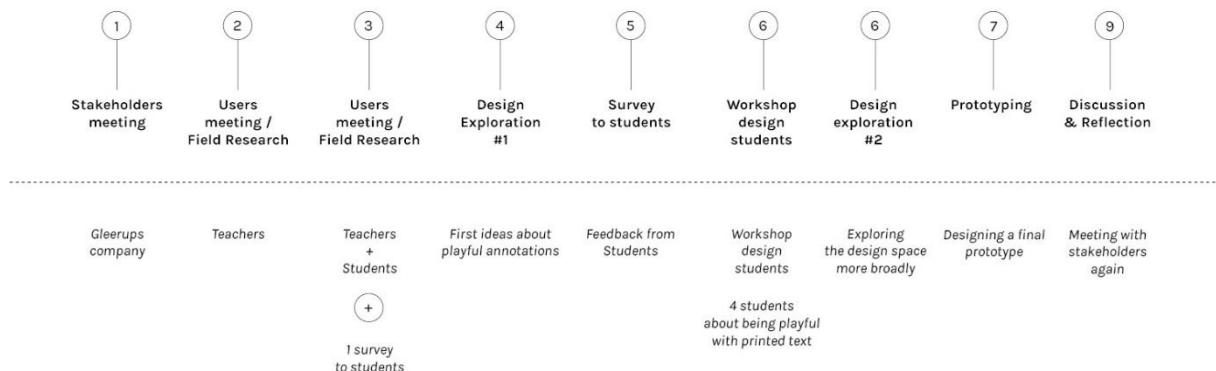


Figure 12 Timeline of the different phases of the project

## **6.2 METHODS**

### **6.2.1 Field research**

As a start and in order to grasp the main problematics of Gleerups, an initial discussion with the coordinator of the platform was conducted. These first insights gave me a broad understanding of the Gleerups ecosystem, actors and users. This step was followed by an in-situ study at the Korsavadsskolan, the main Simrishamn Gleerups pilot school. This latter was conducted with 2 teachers and 31 students to identify issues and gather a maximum of information in order to define a research area. During this opening phase, qualitative and quantitative methods were used. Semi-structured interviews and observation of concrete situations constituted the qualitative part. The interest of semi-structured interviews is "*that the interviewed subjects' viewpoints are more likely to be expressed in an openly designed interview situation than in a standardized interview or a questionnaire*" (Flick 1998, p. 150). Observation in real settings were also a way to confirm practices stated by teachers. Surveys to students were a way to gather qualitative, as well as quantitative data. This whole field research phase allowed me to define clearly research questions and thus initiate the second phase.

### **6.2.2 Design exploration & Prototyping**

Two phases of design explorations were conducted, a first one after the field research and a second one after workshops (see Fig.12). These design phases were successive openings to get an overview of the possibilities in designing a playful annotation system. A series of choices arising from these phases of exploration paved the way for a final mock-up prototype.

### **6.2.3 Participant implication**

After the qualitative data gathering research phase and a first phase of design exploration, workshops were conducted with design students in order to gather more information and findings about annotation processes. Continuing the field research work with the initial students was not possible anymore, therefore I have recruited other volunteer participants with a similar age range. The participants were given tasks they had to fulfill as if they were real students in a kind of role-play experience. These workshops gave me valuable insights to open the last design exploration phase.

### **6.2.4 Discussions & Reflection**

Finally, the last phase consists of a reflection phase on the different findings from the research process. The last concepts and mock-up prototypes were also discussed with stakeholders and teachers (end-users). These discussions, as an addition to the reflection, provide last insights that aim to be valuable insights for further work by the research and design community.

## 7 DESIGN PROCESS

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Having first collected information about the Gleerups Company and their interactive textbooks, as well as on potentials areas they would like to further investigate, I decided to meet directly the users concerned by the research. Therefore a meeting with two teachers was set up as a first step.

### 7.1 USERS MEETING / FIELD RESEARCH

#### 7.1.1 First meeting: Interview and activities with teachers

A semi-structured interview session has been planned with two teachers on the 26th of April in Simrishamn School. This meeting took place in a classroom (Fig.13), lasted approximately one hour and was documented with audio recording, pictures and notes. Quotes from the discussion are given below and the whole interview is available in Appendix 2.

The interview aimed at gathering background facts and general information about the teachers and their habits. Questions about personalization of the content were also included. In a second step, an engagement activity was suggested to engage them in drawing their experience (Saffer 2010) in order to understand how they consider the platform. The task consisted to solve the following issue: 'draw your experience with the platform' (Fig.13, 14, 15). To achieve this task, a large range of icons representing the education and learning field was provided to support their progression. The teachers were however free to match their own meaning to the icons by then describing what they meant in writing. The aim was to get a vision of the actions, objects, people and interactions involved when they interact with the platform. This was also a way to make the discussion playful and to reveal things they might have forgotten to raise in the first part of the interview.

This discussion was informative about the way teachers use the platform and the place it has in their everyday teaching life.

- The key points raised during this meeting were the following:

**Learn at one's own pace:** One major aspect that was present all along the discussion is that the platform enables students to study and learn at their own pace. The teachers raised the fact that all learners are very different (there are also a lot of migrants that came in the last years), and that the digital aspect allows for each of them to find the best manner to match their preferences. Learners have different means to learn, either by reading the texts of the books, watching videos, pictures, but also having the text being read by a synthetic voice. They were really enthusiastic about this latter function "*I think that the pupils who are not so good at reading, or have concentration difficulties, plug-in and then listen, and you don't need to look at it, just listen*". All these different multimedia means are also a way for teachers to learn to know better their students preferences: "*I have more ways to see how they can get their knowledge. It's broader.*"

The teachers also raised the fact that the platform adapts to user needs in some cases: in terms of language for example, foreign nationals can translate the content in their mother language so they can follow the lesson with the other students without the need of a firm basis in Swedish.

**Adaptive teaching process:** When discussing about the teaching process with the teachers, they stated that they do not have a fixed 'set' of processes but that they rather adapt to each situation and each class group: "*I think it's different, not only year after year, but also from class to class, because they are individuals, so I mean we do have a main curriculum but it's very open at the same*

*time. There are some skills they should know but how to get there, that can differ from people to people*". Although the program remains approximately the same each year, the teachers also want to renew their experience each time: "*it can change from year to year, because I want to be amused myself (laughs), otherwise it's boring*".

They seem also open about the way students can show their skills: "*how you reach the knowledge, it's different for everybody. And some of them really want to have a book and some of them need to talk. But you need to show it for me, from the mouth or from the pen, or they can sing a song I don't know (laughs)!*"

**See the students in a new light:** The teachers also claimed that the digital platform enables to get another vision of the students, because of the online training/exercise platform which enables to follow their evolution: "*some students are very good verbally, and they can talk and discuss and explain, and some others are very very quiet, and this (about the notation page using green and red dots for good and bad answers for every exercise), as a complement to everything else gives me a much fuller picture of the students*" or "*I can see the students in a new light. The students who were very quiet before, and then suddenly oops, 30 green dots in one lesson! And some others just one or two, so it's very good. It doesn't replace the teacher but it's a good complement*".

**Connect to the world:** The teachers also raised the importance of a platform "linked to the world": updated with news, which helps students to develop the critical thinking skills.

**Change the roles:** For one teacher, the platform changed the roles of the teacher and learners: "*I think I'm less active, because I've learnt that the students don't come to see me working, I'm here to watch them work. And this Gleerups gives possibility to each student to work at their own pace, otherwise it was maybe too much, hum, me talking and them listening. So it's much better now, it changed the roles*".

Finally when discussing about investing more time in the platform, like adding more personal content to the textbooks, the teachers stated a lack of extra time to spend on the platform: "*It's also a matter of time, there are so many possibilities and so little time*". The teacher is definitely a critical resource and I had to keep it in a corner of my head during my research when looking for new interactions and experiences.



Figure 13 The two teachers doing the activity: 'Draw your experience with the platform'

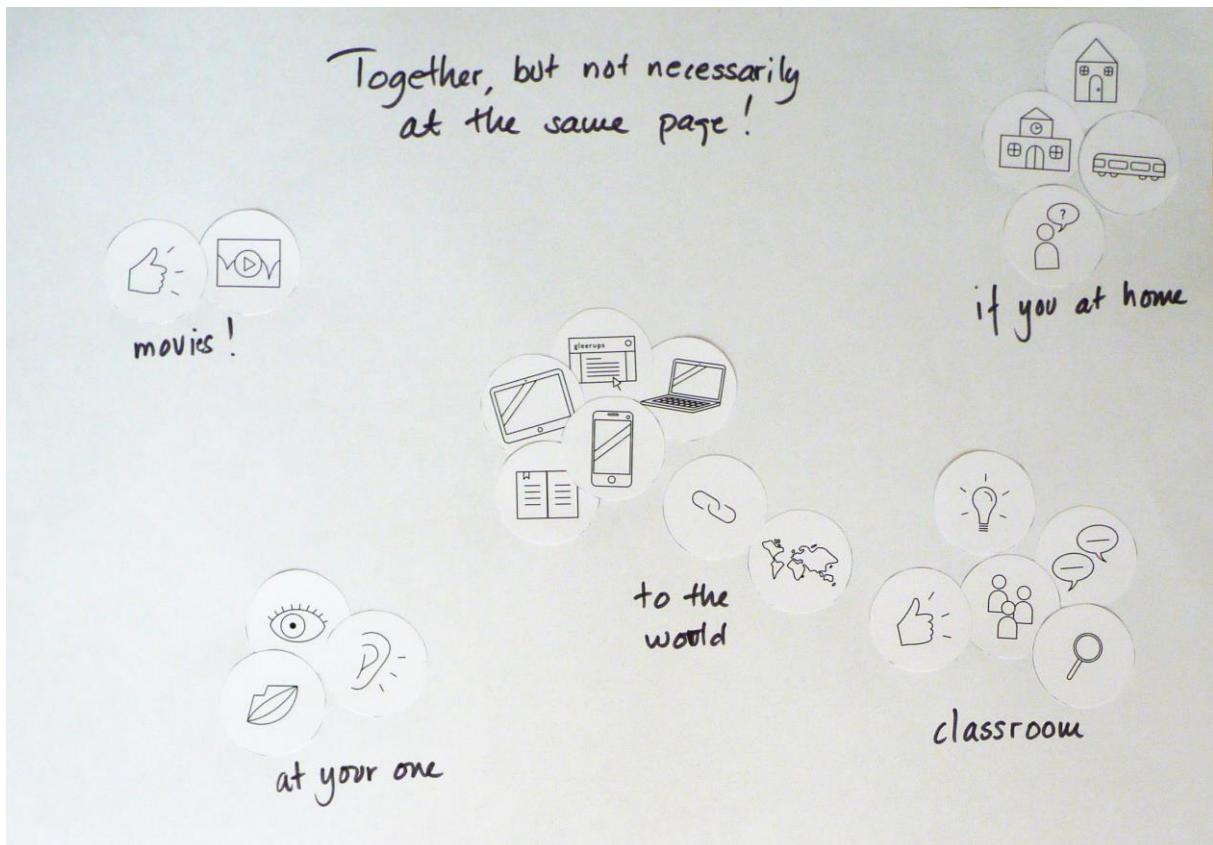


Figure 14 Result from the activity with the first teacher

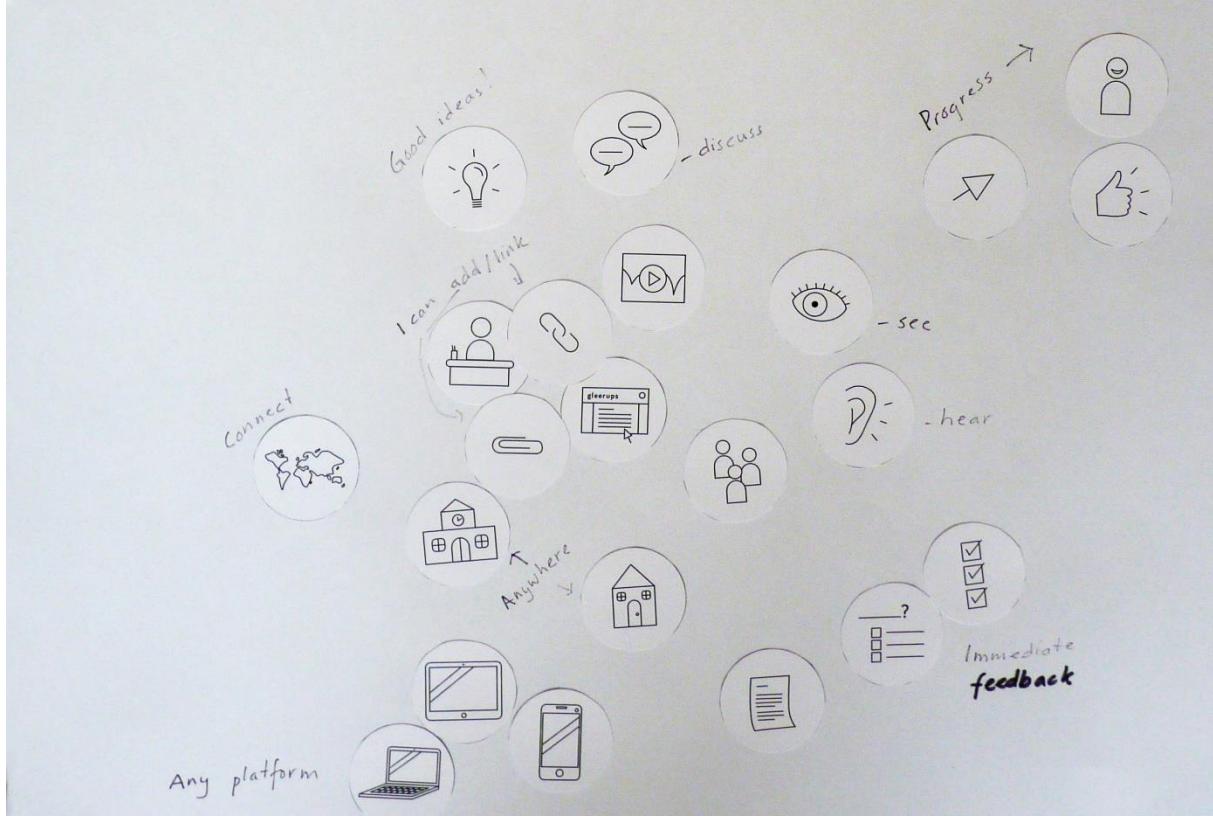


Figure 15 Result from the activity with the second teacher



Figure 16 The classroom and its environment: a place to foster discussion. The students' works are displayed all over the school's walls

### 7.1.2 Second meeting: Observation, survey and discussion with students and teachers

The next phase was to meet the second category of end-users: the students themselves. These were 31 students, aged from 14 to 16, from two different classes. Observation in one classroom of 17 learners of 9<sup>th</sup> grade, in addition to a survey and recorded semi structured interview were conducted on the 16<sup>th</sup> of May for approximately one hour and a half. From observation, survey and discussion, I extracted the following key facts:

**A quasi exclusive use on the laptop:** It appears clearly that the students use almost only the laptop that has been lent to them to read and exercise in the textbooks. Hence, they never use it in public transport, or only seldom for 7 students, neither in other places where a smartphone could be useful. Moreover there is a clear tendency of use only in the classroom. A total of 18 out of 31 students stated to seldom or never use Gleerups at home whereas only 3 use it often.

**A mixed opinion about the platform:** To the question "How much do you like using Gleerups?" half of the students claimed to like it rather much whereas the remaining half stated not to like it much or not at all. Only one was much more enthusiastic about it and liked it very much. The positive raised points were its digital aspect, the questions, films, mobile aspect, how easy it is: "*I learn a lot by just reading 5 min, and they make it so easy to read. No hard words or anything*". Also appreciated the listen function (when no will or time to read) even if the quality of it is mixed in the opinion, the fact that you can login wherever you are: "*no excuse as 'I forgot the book at home'*", and that everything is in one single place: "*it makes it easier to find information, and also to study for tests*".

**Having all information at the same place:** The students were enthusiastic about having a platform which gather all the subjects' matters and information in the same place: "*You have all information you need in one place*". It is perceived as a gain of space and time "*The books are collected there. When you're on the bus you can just pick up the laptop or mobile instead of a big book*", "*It is a good study material when you do not need to bring 10 folders or books home with you*".

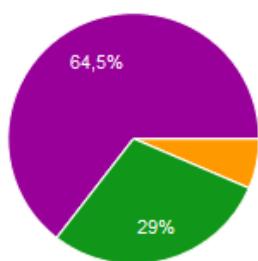
**Interacting with the teacher in class and online:** Students seem to have sometimes some difficulties to interact with the teacher. To the question about the last interaction with a teacher, they are a few to answer: "*it was a long time ago*". They also don't always dare asking questions during the class. Only 11 out of 31 students always ask their questions, against 15 who sometimes do, whereas 5

seldom or never do because they don't dare. About the interaction with teachers online, approximately half of them do it sometimes whereas the other half seldom or never communicate online with them, even if Gleerups "*made it easier*". They like that it's divided "*not too much, but not too little*", so they like that each of them has his own space. They don't seem in general to want to interact more together online, one reason being that they like to talk to each other directly in the classroom. However, one student raised the suggestion to ask directly their questions online. From observation, they seem to be rather close from their teachers.

#### **A lost interest in reading:**

The main action possible with the platform, reading, seem to have a limited success, compared to the interest in games and playing: "*it is kind of boring, not really any games, just a lot of text*", "*it's kind of boring, no games, no competition*". There were quite a lot of statements about the fact that "*reading is boring*", such as: "*I sometimes find it boring to just read and answer questions*".

#### **How often do you post comments on the books?**



Very often	<b>0</b>	0 %
Often	<b>0</b>	0 %
Sometimes	<b>2</b>	6.5 %
Seldom	<b>9</b>	29 %
Never	<b>20</b>	64.5 %

Figure 17 Extract from the survey to students: A poor use of annotations

**A poor use of annotation:** About annotations and comments, most of them never use these functions (20 students out of 31), or seldom for 9 of them (Fig.17), which I argue is an opportunity. Only 2 use them sometimes. About where they take their notes, it depends on the situation: "*If all the fact I need for my assignment is on Gleerups, I take notes directly on Gleerups. But if I need fact from another source I use paper sheets*". More generally, they use either paper, notebooks or other applications on their laptop or phone to take notes, and take pictures of the teacher's whiteboard, which seem to be a popular behaviour. The highlighter function meets a bit more success, but only 6 students use it very often or often, whereas 10 sometimes, and 15 seldom or never. One suggestion is to obtain a summary made of all the highlighted zones: "*it would be nice if it made an own text from everything that I highlight*".

**A lack of a playful experience:** The students seem to miss a playful aspect in the platform: they for example suggest more games and competitions to have "*more fun to learn*" and to change the structure of the books to be more unexpected: "*It's hard to learn when it's boring. From my side, the worst thing about Gleerups is that it's not fun*". A lot of remarks were made about this fact, they would like something "*not as boring as an ordinary boring book but more fun and creative*". Students seem indeed to get bored or distracted really easily: I could for instance observe that they use their smartphone a lot during the class without the teacher being able to know if they are working or not.

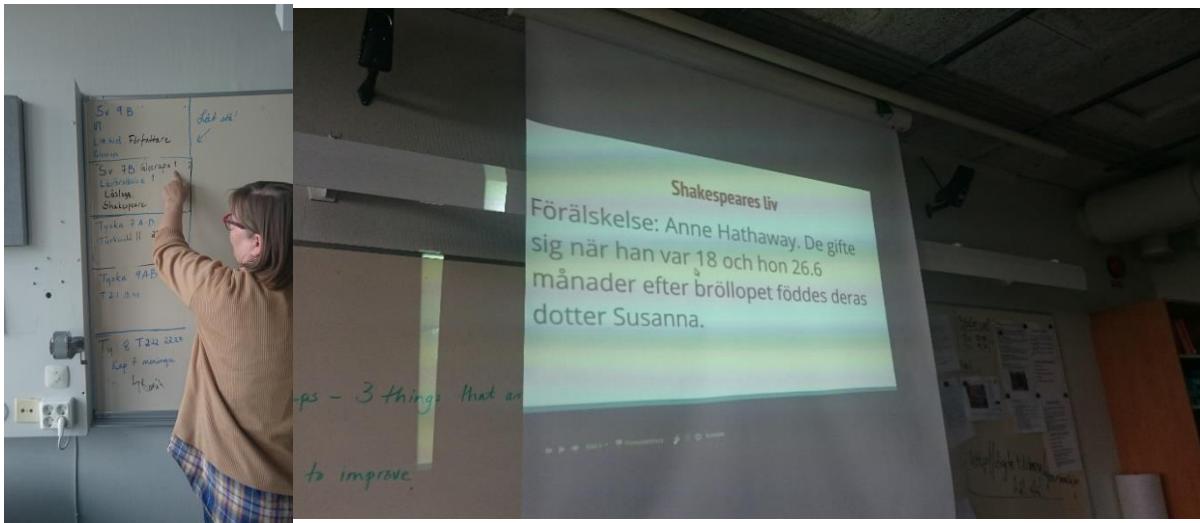


Figure 18 The teacher using the whiteboard, which learners like to take in picture to save the lesson, and a lesson displayed on the video-projector.

#### Debriefing, Discussion with the teacher:

A last semi-structured interview of the class's teacher was conducted on the same day after the observation and collection of impressions about Gleerups. It lasted approximately half an hour.

**Discussing annotation systems:** We discussed the different possible learning methods and I showed different teacher annotation systems collected on the web (Fig. 11) and got a very positive feedback from the teacher: "*I think that's very good! [...] I don't use this kind of things, but it's brilliant! Just one symbol can say so much. We usually, whenever we read and they have to get feedback on each other's presentations essays or whatever, two stars and a wish, like find two really good things and one thing that could be improved, so I think that is quite commonly used. That's another system*". They therefore also use a kind of symbolic system in certain sorts of tasks, but the teacher was not aware of that kind of developed active reading method using symbols and colours. She also stated that it can be used in the classroom for telling one's impression and opinion about a text: "*we can do that on a text as well, find out the two things that you agree with and one thing you don't*".

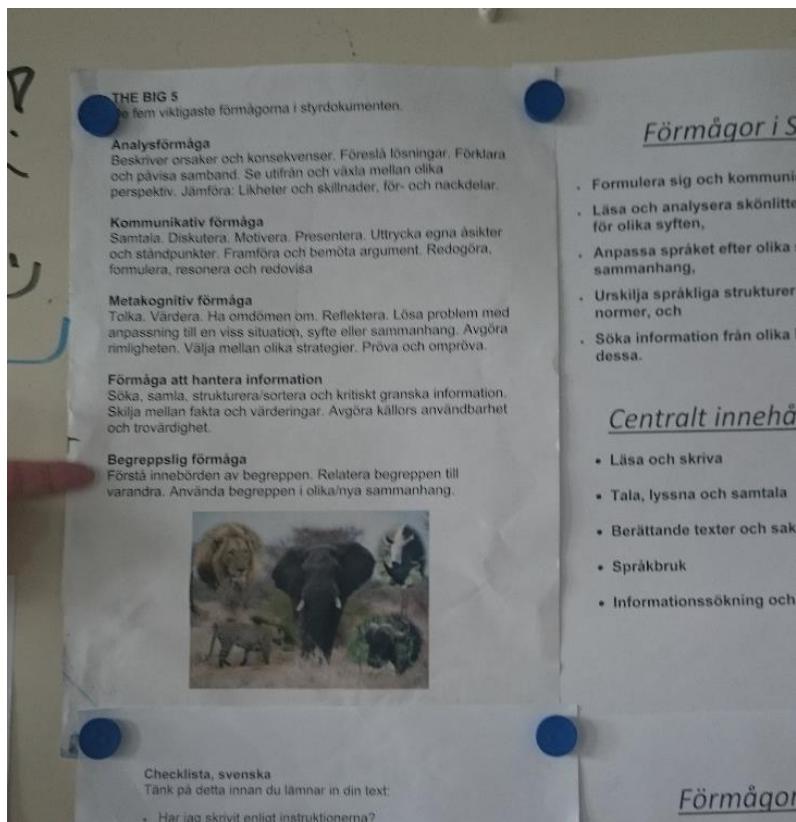


Figure 19 The Big 5": the objectives in each classes: Analyse, Communicate, Reflect, Structure, Conceptualize

**"The Big five"**: The teacher also told me about five key points which are always on the white board and that each student should apply to her work (Fig.19). *"Analyse, Communicate, Reflect, Structure, and Conceptualize"*. These points are objectives for all the subject matters: *"this is for everything, every course"*.

**Installing a dialog with the student**: When discussing how are the interactions between the teacher and the learners, she told me she had different manners to communicate depending on the class: *"It's a bit like you saw today, I go around and sit so I can talk to them, it works very well in this class, not so well in 7<sup>th</sup> grade because the class is bigger and feels really much bigger, but when they use the Gleerups then I see, and we have something concrete to talk about, and I go to them, or I call them up to me, and sometimes they come and they want to see with me, make sure that I really noticed how much they've done"*. Gleerups can therefore act here as an intermediary, a platform to initiate conversation.

For the students experiencing difficulties, she goes to see them and discuss the questions together: *"there are some others who are not so good at reading and writing, some dyslexic for instance, and some people with concentration problems, and then they can do a couple of questions and I can sit by them and we can read the question together and discuss the answer"*. The teacher also tries to foster each student: *"I do it one by one or to the whole group, without naming names. Mainly it's one-by-one. I would say I do it every lesson, in Swedish and in German"*.

Finally, and it confirmed what I observed during the day, both of the actors succeed in establishing a valuable relationship, maybe mainly because of a try to place everyone at the same level: *"I think most of the students and teachers are quite close. They are not strict, the students don't have to raise their hand to ask questions for example"*.

## 7.2 DESIGN EXPLORATION & FEEDBACKS

After having conducted this field research and getting valuable insights from teachers and students, I wondered how to turn the platform into a learning environment which would combine both a serious content and a playful approach.

From the analysis of the platform and other examples, I listed a few points that could deserve improvement and which I wanted to play with:

- For the students, being given different types of reactions could help them recall and remember better the course in relation to the textbook. The linear reading could be turned into a more multimedia reading/watching.
- The annotation system could be developed in order for the teachers to see what the students understand/question (because everyone is different and some of them do not dare to ask questions). It would allow to follow the progression of the student more effectively.

The use of extra tools to foster playfulness with the text is something optional, but it could provide some ways for the teachers to know more about how the student get their knowledge and to have a much fuller picture of them.

A few experiments with a printed text from the Gleerups platform were conducted as a start to develop a playful approach and interactions (Fig.20). The text was played with using different kind of material that came as different layers of extra information: questions, important or surprising facts, connections.

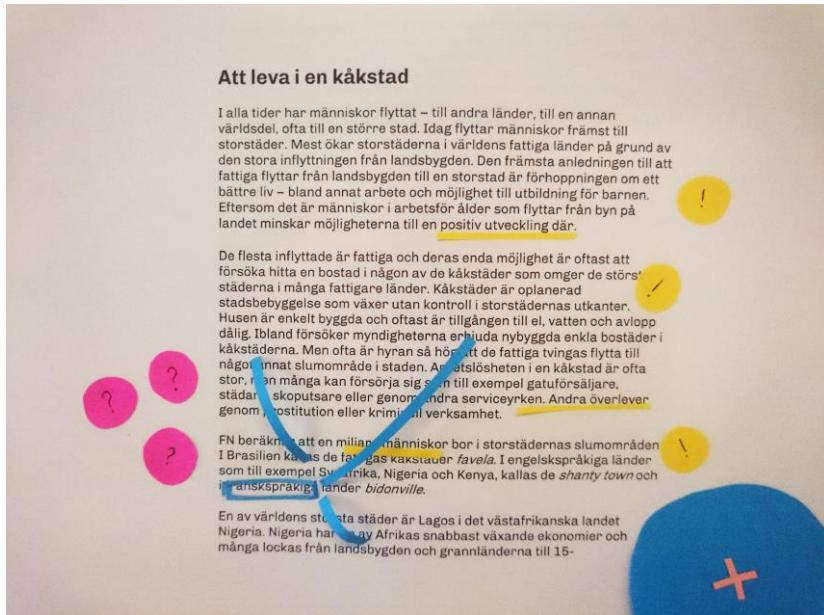


Figure 20 Experiment with printed textbook's text - looking for ways of interacting more playfully with the text.

### Att leva i en kåkstad

I alla tider har människor flyttat – till andra länder, till en annan världsdel, ofta till en större stad. Idag flyttar människor främst till storstäder. Mest ökar storstäderna i världens fattiga länder på grund av den stora inflytningen från landsbygden. Den främsta anledningen till att fattiga flyttar från landsbygden till en storstad är förhoppningen om ett bättre liv – bland annat arbete och möjlighet till utbildning för barnen. Eftersom det är människor i arbetsför ålder som flyttar från byn på landet minskar möjligheterna till en positiv utveckling där.

?

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De flesta inflyttade är fattiga och deras enda möjlighet är oftast att försöka hitta en bostad i någon av de kåkstäder som omger de största städerna i många fattigare länder. Kåkstäder är oplanerad stadsbebyggelse som växer utan kontroll i storstädernas utkanter. Husen är enkelt byggda och oftast är tillgången till el, vatten och avlopp dålig. I bland försöker myndigheterna erbjuda nybyggda enkla bostäder i kåkstäderna. Men ofta är hyran så hög att de fattiga tvingsas flytta till något annat slumområde i staden. Arbetslösheten i en kåkstad är ofta stor, men många kan försörja sig som till exempel gatuförsäljare, städare, skoputsare eller genom andra serviceyrken. Andra överlever genom prostitution eller kriminell verksamhet.

!

!

Figure 21 Experiment similar to Fig. 20, in a digital format, questioning the vision of the students the teacher could have.

The same experience was transposed in a digital version (Fig.21), where the type of reaction is visible in the margins and is connected to a part of the text highlighted with the same colour. It also questioned this time the vision of multiple reactions from several people, and thus a potential vision for the teacher.

I then realized a few screens and visualisations of concepts, which are visible in the figures below. These ideas were suggested in a survey with 14 students from the school I started the research with. This phase aimed at gathering first reactions and feedbacks about the taken directions.

### Results from survey

Reading is considered as a repetitive and unsurprising task for the majority of the interrogated students. When asking why they consider reading boring, a lot of answers came about the repetitive and “not fun” aspect of the task: “*you just look at the screen, no moving, nothing*”, “*you just keep scrolling and scrolling it's not even funny*”, “*since it's always the same screen, it can sometimes feel as if you're not going anywhere*”.

- Presentation of the concepts

When asked about the different possibilities, the students seem to have a preference for the following functions: “*highlight when I don't understand or write my questions to remember them, mark words I didn't know, important passages so I could find them again later, say when I agree or disagree with the text*”. The other reactions are less selected, but they still have been chosen by a few students (Fig.22).

Highlight when I don't understand or write my questions to remember them	<b>7</b>	50 %
Mark passages I like	<b>3</b>	21.4 %
Create connections within the textbook	<b>3</b>	21.4 %
Add my own pictures/videos to help me	<b>2</b>	14.3 %
Mark passages where I was surprised	<b>2</b>	14.3 %
Add my own discoveries	<b>3</b>	21.4 %
Mark words I didn't know (i.e. when learning a new language)	<b>6</b>	42.9 %
Mark important passages so I could find them again later	<b>5</b>	35.7 %
Say when I agree or disagree with the text	<b>5</b>	35.7 %
Autre	<b>0</b>	0 %

Figure 22 Results from the survey: Imagine that you can add reactions to the text while you are reading. "I would..."

When being shown a concept screen about a text being annotated with different kind of reactions using symbols and colour code (Fig.23), and asked about what they think : 10 out of 14 find it interesting or very interesting and would use it, whereas 3 would prefer to have their own code and one does not think he would use it.

 <b>Question</b>	Klimat och vegetation  När du vaknar av att solen skiner från en klarblå himmel tänker du kanske att idag blir det vackert väder. Men att det är vackert väder idag säger inte mycket om klimatet där du bor. Dagen efter kan det ju faktiskt bli störtregn. Begreppet klimat kan beskrivas som medelvärdens av alla väderobservationer som gjorts under minst 30 år. För att kunna skilja olika klimat åt är det viktigast att studera lufttemperatur och nederbörd. Då kan vi dela in jorden i olika klimatzoner. Sverige ligger i den så kallade tempererade zonen eftersom klimatet varken är bland de varmaste eller kallaste på jorden. Kartan visar namn och utbredning för Jordens klimatzoner: tropiska zonen, subtropiska zonen, tempererade zonen och polarzonen.
 <b>Surprised</b>	För att kunna skilja olika klimat åt är det viktigast att studera lufttemperatur och nederbörd. Då kan vi dela in jorden i olika klimatzoner. Sverige ligger i den så kallade tempererade zonen eftersom klimatet varken är bland de varmaste eller kallaste på jorden. Kartan visar namn och utbredning för Jordens klimatzoner: tropiska zonen, subtropiska zonen, tempererade
 <b>Important</b>	
 <b>Image</b>	

Figure 23 Screen concept with a text annotated with different kinds of reactions.

**Your side**  
Your reactions and comments appear here

**Highlight**  
You can highlight zones with your mouse or finger

**Teacher Side**  
His/her answers and comments appear here

**Landskap**

**Klimat och vegetation**

När du vaknar av att solen skiner från en klarblå himmel tänker du kanske att idag blir det vackert väder. Men att det är vackert väder idag säger inte mycket om klimatet där du bor. Dagen efter kan det ju faktiskt bli störtregn. Begreppet klimat kan beskrivas som medelvärdens av alla väderobservationer som gjorts under minst 30 år. För att kunna skilja olika klimat åt är det viktigast att studera lufttemperatur och nederbörd. Då kan vi dela in jorden i olika klimatzoner. Sverige ligger i den så kallade tempererade zonen eftersom klimatet varken är bland de varmaste eller kallaste på jorden. Kartan visar namn och utbredning för Jordens klimatzoner: tropiska zonen, subtropiska zonen, tempererade zonen och polarzonen.

För att kunna skilja olika klimat åt är det viktigast att studera lufttemperatur och nederbörd. Då kan vi dela in jorden i olika klimatzoner. Sverige ligger i den så kallade tempererade zonen eftersom klimatet varken är bland de varmaste eller kallaste på jorden. Kartan visar namn och utbredning för Jordens klimatzoner: tropiska zonen, subtropiska zonen, tempererade

**Jag förstår inte här.**

**Förklaringar här:**

Du kan också titta på dessa video. De är bra :-)

Figure 24 Screen concept: Scenario of a student who doesn't understand a part of the text and gets an answer from the teacher.

About the fact of having one side for their reactions (left) and one side for the teacher's (Fig.24), 10 out of 14 stated that it would be very useful or useful, whereas 4 think that it would be little useful or not useful. About having personalized answers to their questions, students are rather positive: "it would be a bit more fun and helping".

This first quick session of design exploration and feedback collecting was a first step in questioning playful ways to interact with the text, both from the teacher and learner perspective. This session was the last time I could have access to students from the school and their reactions were rather positive, but I still wanted to continue to explore new possibilities. The next step was then to organize workshops to observe annotation behaviours with other participants, which played the role of students.

## 7.3 WORKSHOPS: HOW TO BE PLAYFUL WITH THE TEXT?

I have organized two workshops exploring the role of playful annotations on paper. It served several purposes: to broaden the exploration of the design space, to think about how to include more materiality, and to get inspiration from the observation of paper annotation behaviours (pros and cons). For these workshops conducted with 4 design students, semi-structured interviews were led to give maximum freedom to the participants and let them express their views about the tools they used during the workshop.

### 7.3.1 Workshop 1: Annotation with traditional paper-based interaction

In order to explore playful ways of annotating texts, a first workshop was conducted with design students. A text and map from the Gleerups Geography book was chosen for the experiment, for more relevance.

Each participant was given a paper sheet with the text as well as a paper sheet with questions related to the text that should then be discussed in class. The participants were also asked to remind important things for later use, and to note one thing they were surprised about, and would like to further investigate.

The goal was to find natural ways to note different kinds of information around the text, and when possible, to differentiate between them.

In order to realize the task, participants were given an assortment of materials to encourage a playful attitude with the text while answering and working on a ‘serious’ task. Materials included different sorts of highlighters, pens, scissors, brushes, as well as different kind of papers, post-its, coloured and translucent paper, little wood sticks (Fig.25).

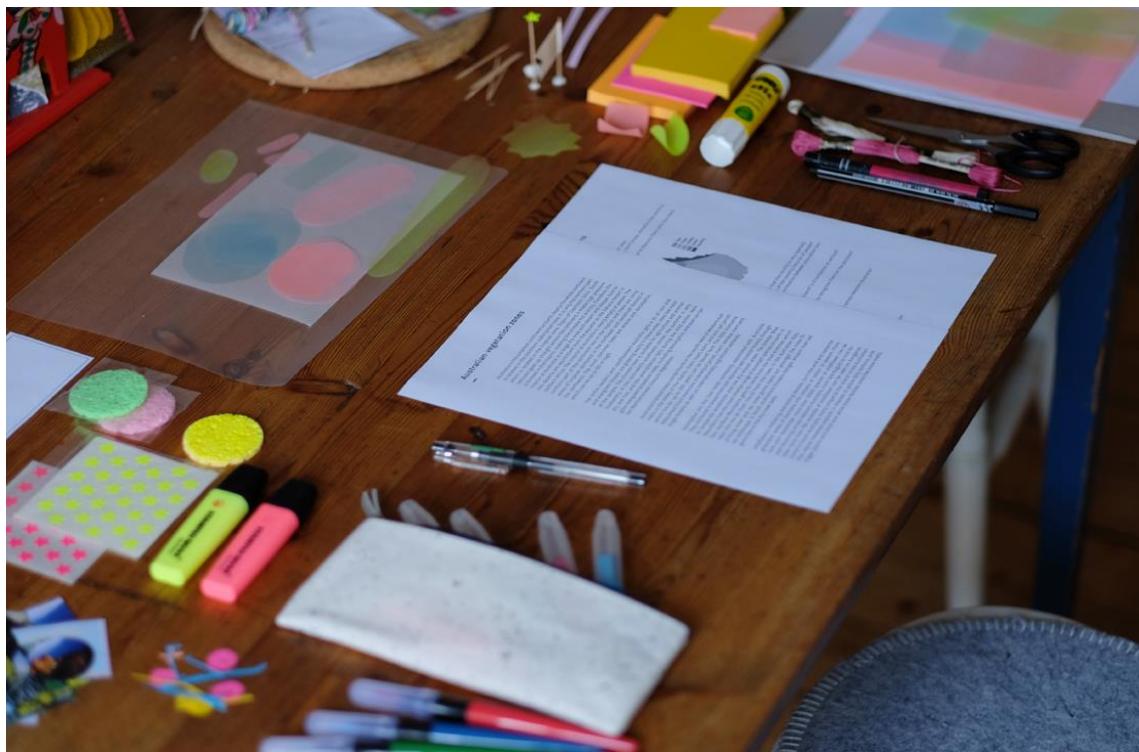


Figure 25 The workshop configuration and suggested material to realize the task: multiple kind of papers and pen among others

From this workshop, different findings can be noted:

### **Marking the interrogations:**

Marking the questions seemed to be one of the first step in the reading process of the participants: "*I marked the questions, and I added a question mark to the parts I think I found the answers*". A symbol was sufficient to indicate an unclear part or a question: "*there are some parts which are more complicated to understand in the text, and I don't know if I should remember them for later therefore I put an exclamation mark, in case we have to discuss it in class*". One participant noted all her questions on post-it, in the perspective to write the corresponding answer later on: "*post-it are useful, because for example here I put all the things I didn't understand but I could then write the answers to these questions on another little post-it stuck on the first one. Having answers to my own annotations. I like the ephemeral aspect*".

### **Making provisional traces:**

Talking about the ephemeral aspect, the participants stated that they appreciated having the possibility to play with elements they knew were adaptable, like using pieces of paper (Fig. 26): "*I think it was different, because you could move things around, because sometimes when I underline, like you know the cliché where the students underline the whole text because everything is important, then here I could change it and play around and choose what actually could make more sense, and then it wasn't decided as I did it so I could structure and choose which parts I actually want to underline. So I think that was nice if you could play around how it could actually looks like, which forms do you use for what*". Some marks and annotations are therefore thought as transitional and intermediary steps. Talking about students who highlight everything, one participant was in this case because of the need to "feel" the text: "*usually I use a pen that you can see from far away for important things to 'feel' the text, to understand it. I need to make things visible while I am reading, to remember them for answering the questions later on*" because "during the reading time, it helps me absorbing the knowledge and the facts". However, two participants then regret this action for the reason that the text is not readable anymore.

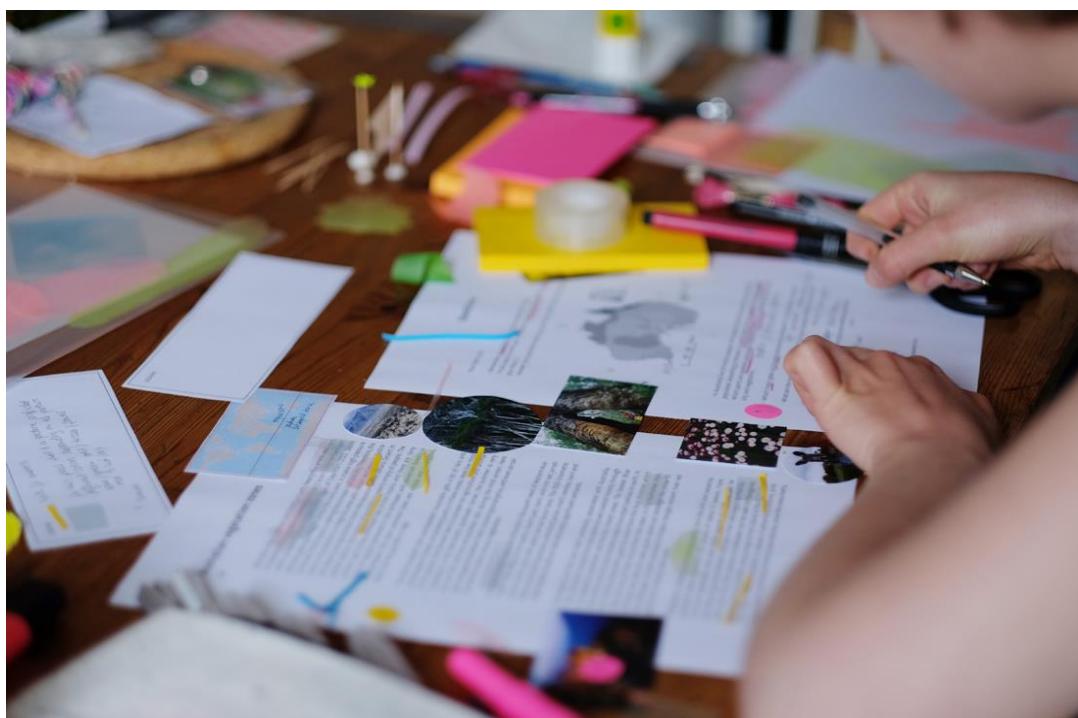


Figure 26 Workshop in progress: using paper elements which can be moved around

### Creating levels of importance:

In order to organize all their reactions towards the text, participants tried to create levels between the distinct information and facts (Fig. 27): “*there was a fact and surprising thing and there I used the 3D thing (the flag), it doesn’t have to be that, but I think it’s nice with a more outstanding symbol to mark that part*”. Being a paper workshop, it was easy to literally create different layers by playing with the volume.

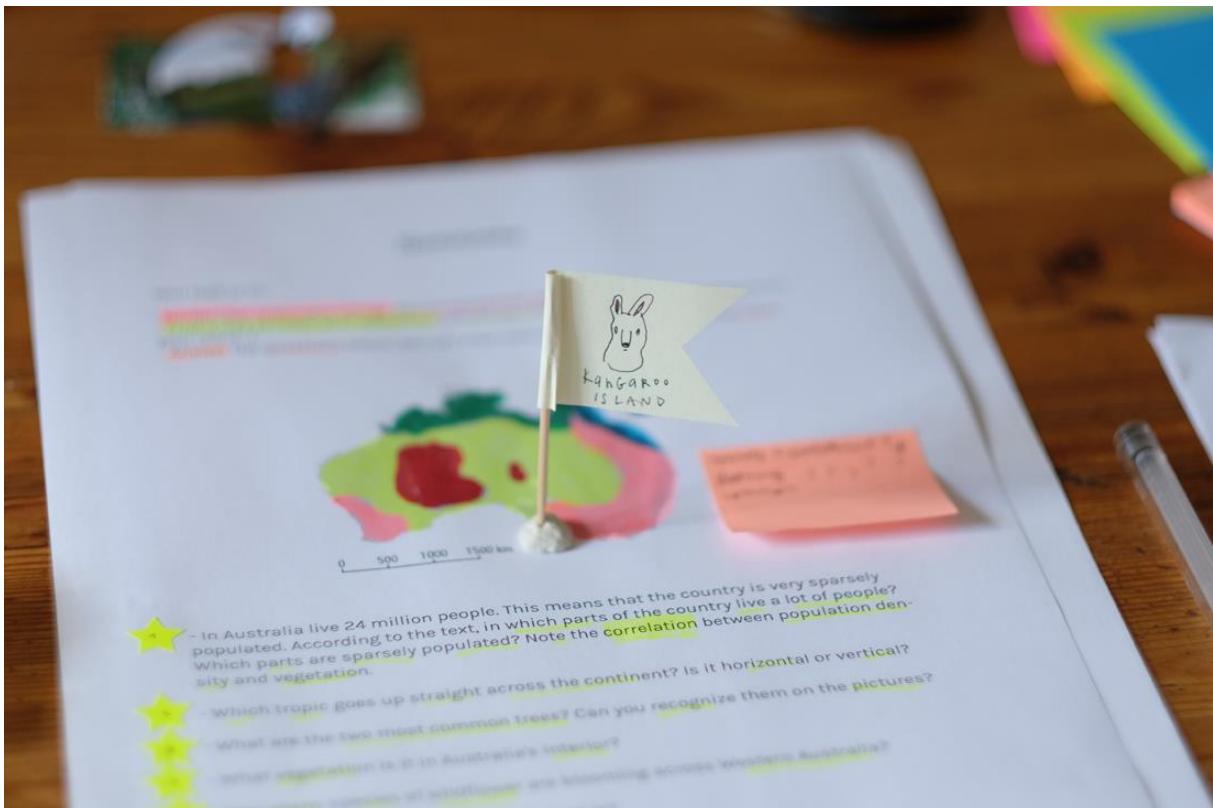


Figure 27 Workshop result: Playing with volume elements

Moreover, creating levels of importance seems to be crucial, especially for this participant: “*normally if I need to remember things I underline quite a lot and then I don’t know anymore what is important. Then I would like to have a different colour to highlight more important parts compared to already underlined things (laughs). Then I’d like to have different colours, like one colour first and then for the second time, another one*”. The participant himself suggested ways to distinguish some important facts compared to less important facts. Some participants have nonetheless a clear manner to organize their annotations and notes: “*I used the highlighter to highlight important things, I underlined only a few words to answer the questions, and I underlined with waves when I didn’t understand*” or “*all the text is highlighted for the answers. The underlined things are less important and highlighted parts are more important. Sometimes I start highlighting everything, and then I try to alternate with underlining to create a ‘rhythm’. It is like there are different importance levels*” (Fig. 28). Finally, getting a “*readable*” text once the reading phase is over is essential: “*I don’t want to highlight all the text, so I use a combination of highlighting and underlining. So I can read the text again without being confused*”.



Figure 28 Workshop result: creating different levels of importance using different kinds of highlights and papers

### Mixing suggested options and own choices:

To the question: why did you decide to choose this code, the participants often used a combination of what was suggested as material, and their own choices: "*I chose this code because I think some of them where already made, but I think it's nice if you can decide on your own which sign you use for what, that you can make your own legend*". They also used for some symbols which they had since their childhood: "*When I usually take notes, I often use icons and I've always used icons like this one for something important (exclamation mark in a triangle), and always draw like a little planet if it's something I have to think about to do later on. So this is the way I usually do things and that's why I put them here*". When asked about if they would prefer to have an already made set of symbols and colours, or to be free to decide of their own, participants preferred the latter choice: "*I think I would prefer to do it myself because it makes sense that you have already pre-set but at the end maybe it doesn't suit you or it's not that fun to use. I would rather do it myself, do my own combination*" or "*I think it's better to be free because everybody has a different way to understand and put marks in the text*". It was the same statement for the last participant, even if being free turns out to be stressful: "*if you would have given me an already made legend, it would have been less stressful maybe, because you don't have to wonder about how you will make things, but at the same time, I think it's nice to be free. Everyone does with what he's more comfortable with*". This means that a good balance must be found between suggesting an already made code and letting the learner deciding on her own.

### Dealing with too much choices:

The suggestions and all available material can either be perceived as "overwhelming" for some participants: "*I think it was nice to have a lot of things but at the same time I was kind of confused, should I use this or this, I was kind of distracted sometimes*", "*there are a lot of tools, I didn't feel forced to use them but was a bit overwhelmed, I would have like to use more but I didn't know how to use it*", "*the fact that there was a lot of material was a bit stressing too sometimes because I wanted to use everything but didn't know what to do with it (laughs)*" or instead be a good source of inspiration: "*it's good to have some kinds of suggestions already, because these one I wouldn't have*

*made for example (flags)". I think giving the maximum of material to the participants was necessary to let them be playful, and observe different kind of attitudes, with an evident risk of being overwhelmed.*

#### **Reducing playing time while reading:**

The participants often used what was at their disposal to complete the task, but did not take extra time to produce new or more 'elaborated' shapes: "*I used the flag to mark the place of the island, and put the kangaroo picture on it (Kangaroo Island). I like the little flag, actually if there would have been more little flags around I could have use flags like this for the pictures of the trees for example*". Moreover, one participant stated that she was not sure to be able to spend that much time in real conditions: "*it was playful, but I'm not sure I would have done all this in a 'normal' context, because it takes a lot of time*". Having a reduced time between reading and reacting is therefore a key point to consider, also to avoid distraction.

**A support for recalling facts:** Participants stated that it could help to remember better or recall memories when they see the annotated text later on: "*I think if I see it like this again, I know more about what the text was about and about the different parts. The things which I would remember most would be the text connected to the pictures, but also the parts about the surprising facts, and that here the part was somehow difficult*". Two other participants confirmed this statement: "*the different marks help recall the different questions and different kind of facts*", "*I think it would be easier to remember if I see it later on, especially with the pictures and symbols*" (Fig. 29). After having interacted with the text, participants also raised the point of aesthetics, indeed the document seem to be more appreciated with all the different marks on it: "*I think the text is a bit nicer to read or to look at*", "*I think if I have to go back to the text later for an examination, it's nicer to have this kind of text with all the colours than a blank one, without pictures. It is more playful*".



Figure 29 Workshop in progress: the use of pictures perceived as a key point to help remembering

### **Sharing annotations with mates/teachers:**

Participants seem to be open to share their annotations with the teacher, even if there are a few concerns: *"I think it depends on the teacher you have and the way you mark the text, like for example if you don't understand the text it should be clear that the teacher don't say 'ok you're stupid because you didn't understand the text' and that because you didn't understand the text you get a worse grade in class"*. It also depends on the culture: "in my country I always had the feeling that they would judge me if I did something wrong but here in Sweden, I think it's different and they seem closer to their teachers".

**Perceived lacks in digital text annotators:** Issues about creating striking visual cues in text annotator were raised: *"I tried to do it in pdf markers sometimes, like in the comment field, I also have sometimes a question mark, but it doesn't pop-up, you can find it again on the comments part on the right side, but it would be nice to have it on the side of the text also. Exclamation marks also"*. One participant even created her own annotation using an editing software: *"I don't really use them (text annotators), but sometimes I used Photoshop to annotate my text. I used like a square brush with a pink shade to highlight things, I liked to do it on Photoshop because I could really do what I wanted, I didn't like the 'basic' one you can find in other appliances"*. Another raised suggestion was *"taking some parts of the text and putting them somewhere else. It could be more intuitive in some ways. I could take some parts of the text to 'my little box' or something, like for words I would like to remember"*. Finally, more digital reactions were suggested to annotate a text: *"for example I would like to add emojis and stuff like that, because right now you can just more or less highlight the text, on Mac it looks kind of cool because it looks like a real marker, but that's all. So it could definitely be a lot more fun"*.

### 7.3.2 Workshop 2: Annotation with digital-based interaction

For this second workshop, the same kind of task was performed, except that for this one another kind of material was provided for the annotation of the text. The participants had to answer questions from a biology text this time, with the same extra demands about finding a fact they were surprised about and would like to do more research on and noting important things for later use.

Participants were given two paper sheets with text and questions. The material provided this time included 'digital' forms of reactions one can find on the web, in a paper version. Bubble comments, hashtags, smileys, icons, gifs (picture version) among others were provided for the task, as well as auxiliary tools such as pens and scissors (Fig. 30).

The aim of this experiment was to test the use of different kinds of annotation and reactions inspired from digital and social media to observe how users felt about using it, especially on an educational task.

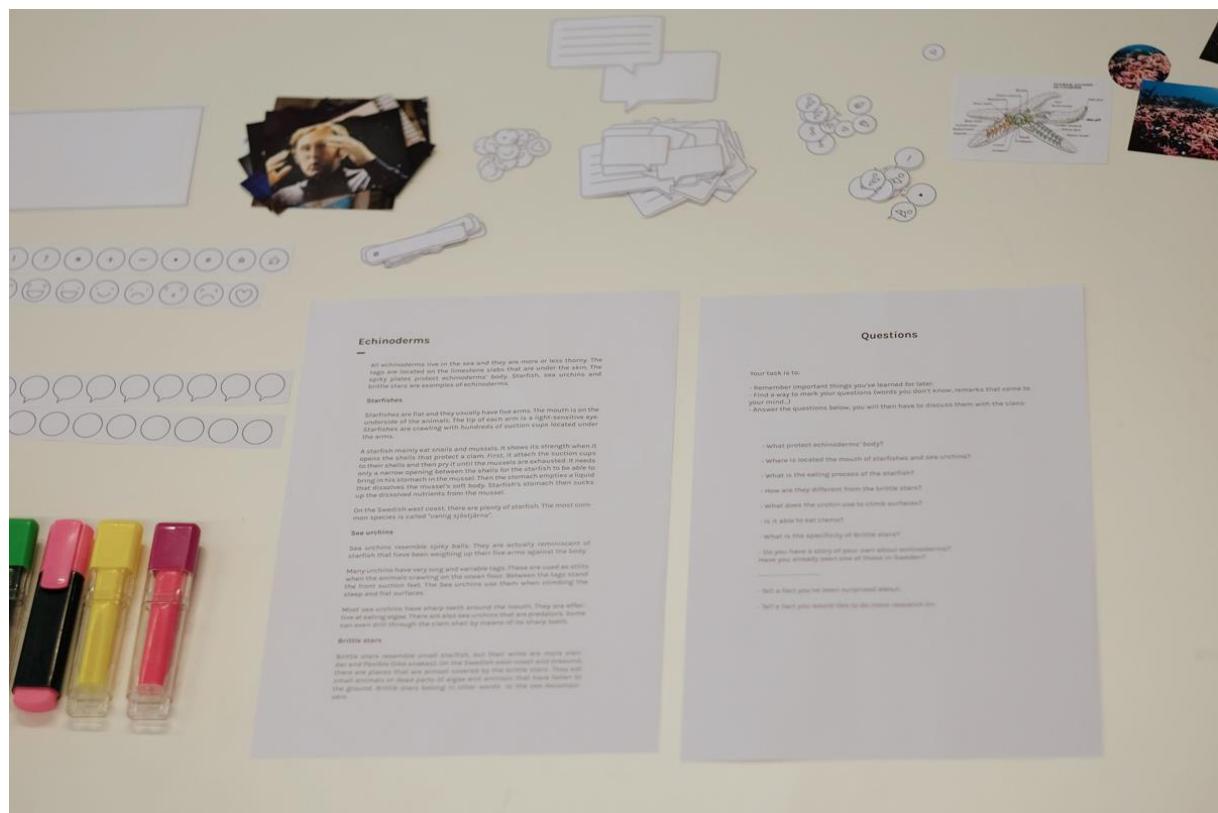


Figure 30 The workshop suggested material to realize the task: icons, smileys, bubble comments, hashtags, pictures and Gifs

From this workshop, different findings can be noted:

**Expressing direct feelings:** The digital inspired reactions, and especially the smileys seemed to be useful to express immediate reactions: "*I used the surprised smiley for the moments I was surprised*" or "*I like the smileys to express the things that you don't know about or when you're confused, and I think thereby you make it little bit easier for somebody to put it on the text, if you think you're confused for example, because it's not only a question mark*". Gifs were also often used, even if it comes from a social media use: "*for me Gifs are for friends on Facebook and so on, but here it was fine to put some Gifs for things that were disgusting (laughs). And I think when I see that again, it comes to my mind that it was disgusting and I can remind perhaps better the facts around*".

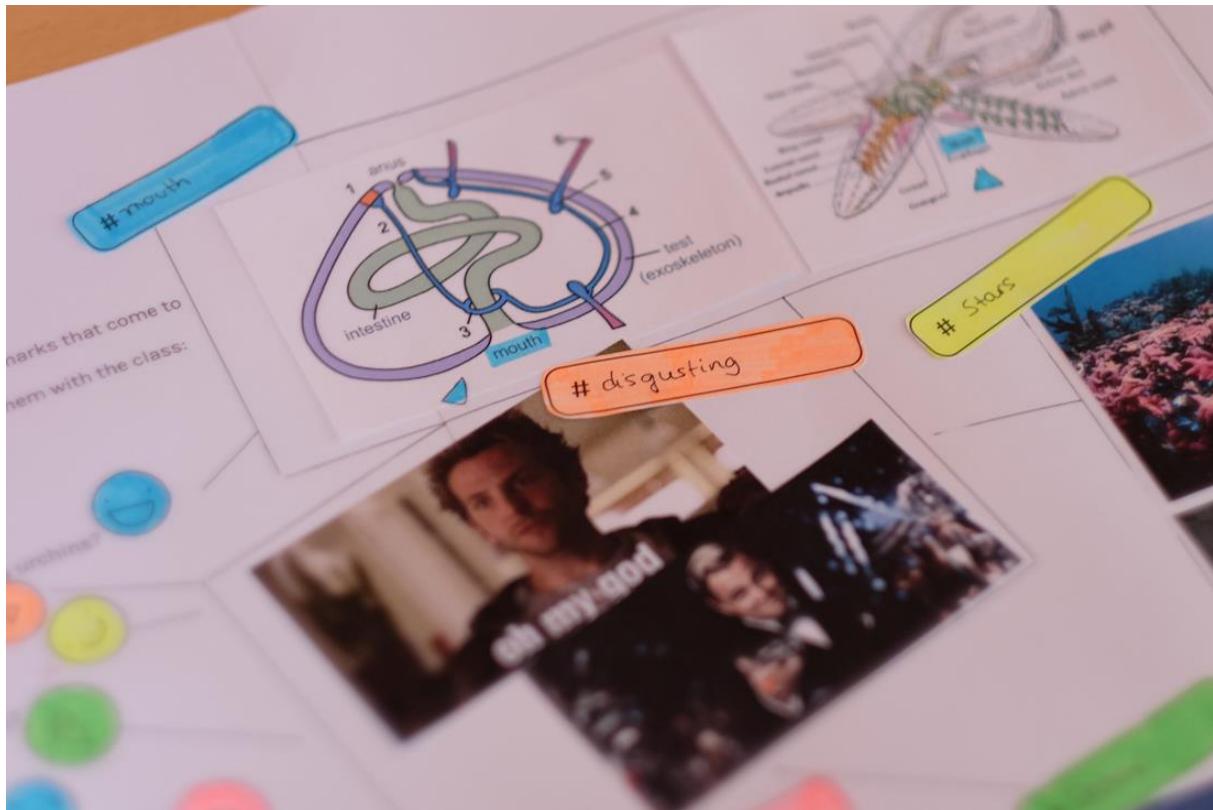


Figure 31 Workshop result: Using a combination of hashtags and Gifs to express a feeling

**Expressing a variety of emotions:** Smileys and Gifs especially, allow for expressing a large range of emotions and feelings according to one participant: “*if you want to know more about something, or if you’re confused, maybe you need to express a little bit more the variety of the confusion (laugh), like you can be confused in different ways, if you didn’t understand the question or if you think it’s not true, to be more critical, or if it’s difficult to remember. Maybe it’s more direct to use smileys and Gifs*”. These latter offer a large choice to express multiple shades of a thought: “*there are so many gifs about not understanding for example*” (Fig. 31). Moreover, smileys seem to bring a clarity to a symbol, even if at first participants were doubtful about using them in a school task: “*if it’s a question mark, it could be anything, and with a smiley it’s maybe more clear. I wonder how much you would use it, but at the beginning I was ‘ok, I’m not going to use it’ but I changed my mind (laughs)*”. Combining the symbols was also a behaviour observed on participants: “*this smiley is for where I was a bit confused, I also put this one which is a little bit surprised. I think I have two signs for being confused, this smiley and the question mark*”.

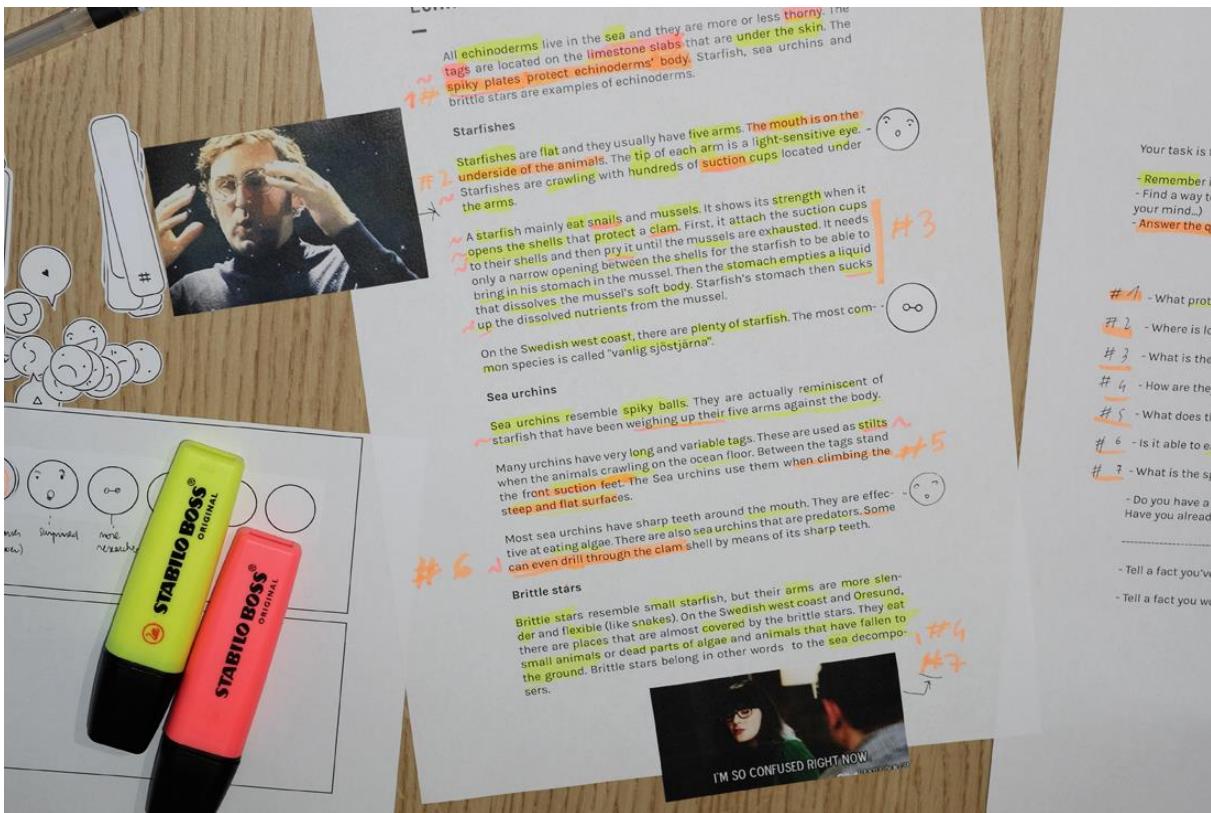


Figure 32 Workshop result: The Gifs among others let the participant express a broader range of feelings such as confusion

**Using icons to point at something:** As a whole set of icons were provided for the task, participants were enthusiastic about using them: "*I didn't write a lot, I just put a lot of signs, icons and colour to remind things. I changed my habits even if it took a bit more time*". Moreover, icons were also used to point specifically at something: "*I used an icon with a little pointer with a map for one question because the question was related to a location (part of an animal digestive system)*" or "*another one was because it made me think of climbing so I used it in the text when I found it related to this*".

**Appropriating icons and symbols:** Furthermore, icons were sometimes diverted from their original meaning: "*for example I used this one for expressing 'climbing things' whereas it's supposed to be the sign for a picture (laughs), but I could have use these kinds of symbols for all the questions and then use the same in the text*". In this way, participants really appropriated the material they had in hand to express what they wanted without restriction. In the same logic, another participant attributed a meaning to an icon: "*I chose the icon which looks like a pair of glasses for the things I would like to find more information about, because it symbolizes the research for me*". Everyone chooses something different to express him/herself, which means that reacting is very personal: some of them used smileys for marking being confused whereas others chose symbols: "*I chose the little icon with the wave for things I didn't understand, because the shape looks like and remind me something... confusing*". One participant did not adopt the icons for their meaning, but just for the drawing, becoming abstract for her in some way: "*I didn't really use the symbols for their meaning, more to have a colour code and match the questions to the answers. For example the angry smiley didn't mean I was angry (laughs)*" (Fig. 33). Finally hashtags were appropriated by one participant to create keywords: "*I like to use hashtags, because it's like keywords, it's fast to see what we wanted to say, it's my way to answer the questions, I just put keywords and hashtags are perfect for it. I use it a lot when texting my friends also*".

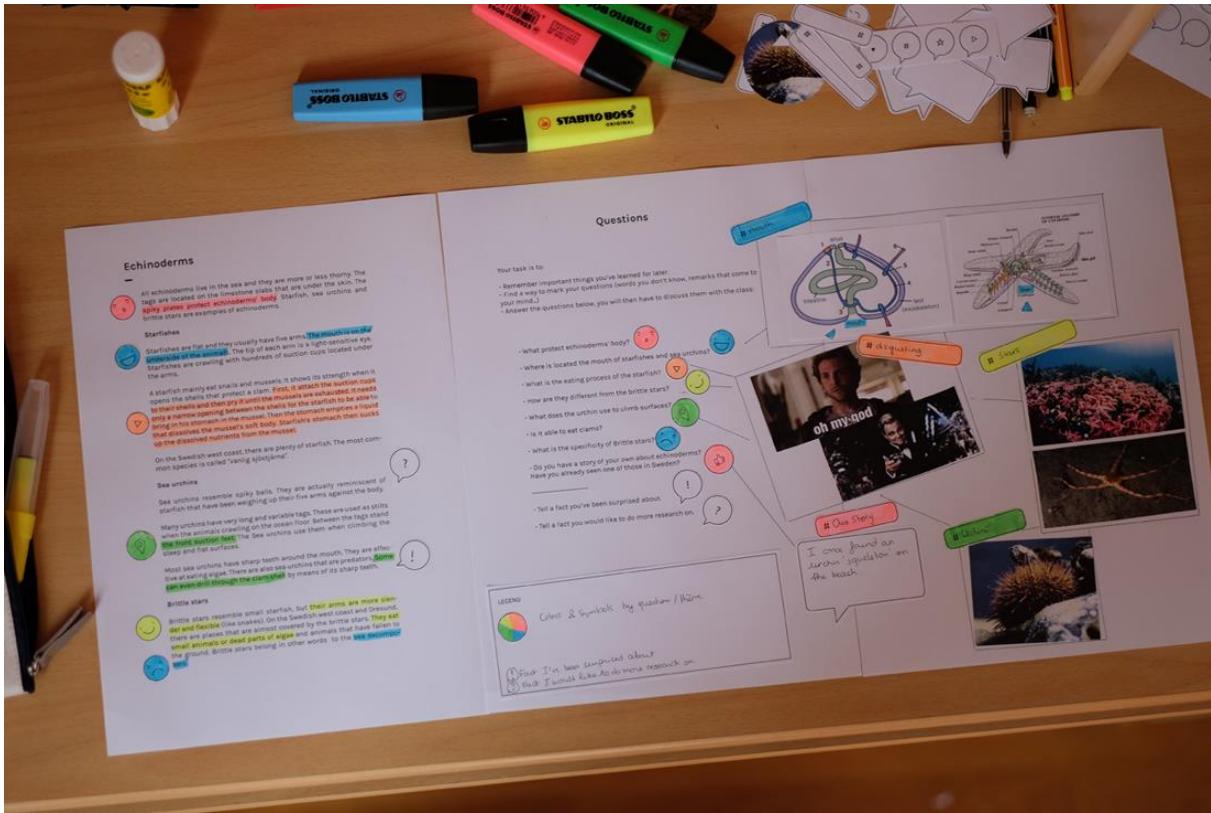


Figure 33 Workshop result: Use of icons and smileys to match questions to answers, diverting them from their original meaning

**Mixing suggestions and own choices:** Compared to the last workshop, more suggestions were given and it seemed to help the participant a bit: “*I think it was also a bit faster with the task, to decide what sign was for what. Last time there was a lot of different shapes and colours (talking about last workshop), and this time you already had bubble and suggested symbols*”, even if for another participant it was still difficult to make choices: “*it was convenient to have already suggested symbols, you save time and think a bit less about inventing completely a new code. There was a lot of choices though, so you still need to make a choice and you want to use them all because it’s fun! So you have to think a bit to make something relevant*”. One participant wanted to make her own code, even if she did not take her efforts to the end: “*to begin, I started to draw icons which represent the question, but it was easier to use the already pre-set ones*”. In the same vein, the last participant suggested the creation of an own set of icons: “*you could create your icons, even if on digital devices it would maybe be a bit difficult... It could be like a lot of different pictures*”. In general, they all found that giving freedom to the user is a key point: “*I think it is always good to have some kind of flexibility, because everybody reads it in a different way*”.

**Daring expressing oneself and sharing reactions:** Using digital reactions such as smileys and Gifs seemed to give the participants more strength about expressing things you might not dare to otherwise: “*it can be strange to do it on these kind of tasks but I think it’s quite interesting to express things like this, because you are scared to tell people that you don’t know what it is about, and somehow maybe it helps to express things*”. All the participants were prone to let their relatives see their reactions: “*I think it’s not too personal, because it’s done in a funny way if you don’t really understand something. So then I think it would be fine for me that other people see my reactions, my classmates or even the teachers, it would be ok*” (Fig. 34). Another statement confirmed this fact: “*last time (during the last workshop) I was scared to share what I didn’t know with the ‘teacher’ and this time with gifs it’s a bit different*”. Moreover, it appeared that it would help other people to

decipher what the participant wanted to express: “*If someone else read my text, he can easily understand which parts I want to highlight*”. Finally, a potential issue was raised about uncontrolled events which can possibly happen: “*I am okay to share it with others people, but maybe if I use Gifs, the teacher would not be happy (laughs) but for the other students it's okay. But if everybody share them, it can quickly be a mess. If a contest starts for example, it can be unproductive (laughs)*.”

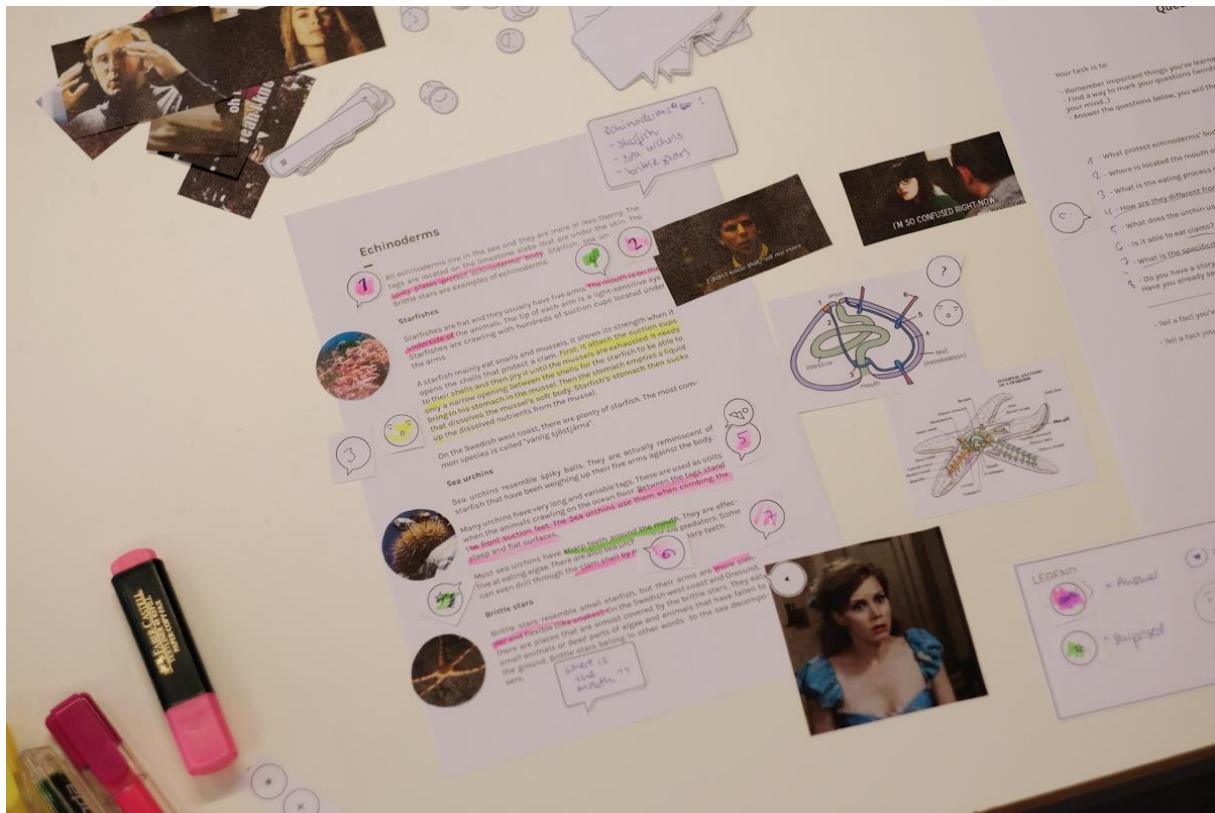


Figure 34 Workshop result: using Gifs and smileys is perceived as less stressful to share with teachers

### Recalling in a better way:

After the task was completed, participants stated that their interaction with the text could help them memorize things more efficiently: “*I think all kind of visuals help me to remember things better. It can structure the text, and if I try to remember and memorize things then I always try to remember where it was exactly in the text. If the text is blank it's difficult, you may be only remember the book or the page, but not precise parts*”. Even in the perspective of a late re-reading, one participant claimed that it could help her to recall quickly: “*if I look to my text, I can maybe remember easily, especially with having keywords and pictures. And if I have to read it again in two weeks, it will be easier too*”. The knowledge and facts would be connected to these visual helps for the last participant: “*It can be more significant and memorable for me if I use visuals like this, my knowledge becomes connected to them. And if I want to read my text again it will be more pleasant, clear and readable*” (Fig.35).



Figure 35 Workshop in progress: the use of pictures and visual elements turn out to be a help for recalling facts

## 7.4 DESIGN SPACE EXPLORATION

Based on the findings of the previous steps, discussions, surveys and workshops, the next step consisted in brainstorming and exploring the design space more broadly. In this section, I present a few concepts and sketches around the use of playful annotations (Fig. 36). I explored both tangible and digital interactions with the education material, but finally focused on digital interaction, to keep the properties of the material I had to deal with at the beginning. I argue that these concepts can still be of interest for the exploration of the annotation field and interaction with a text, even if not kept as a final direction here. The concepts and sketches are shown in Appendix III.

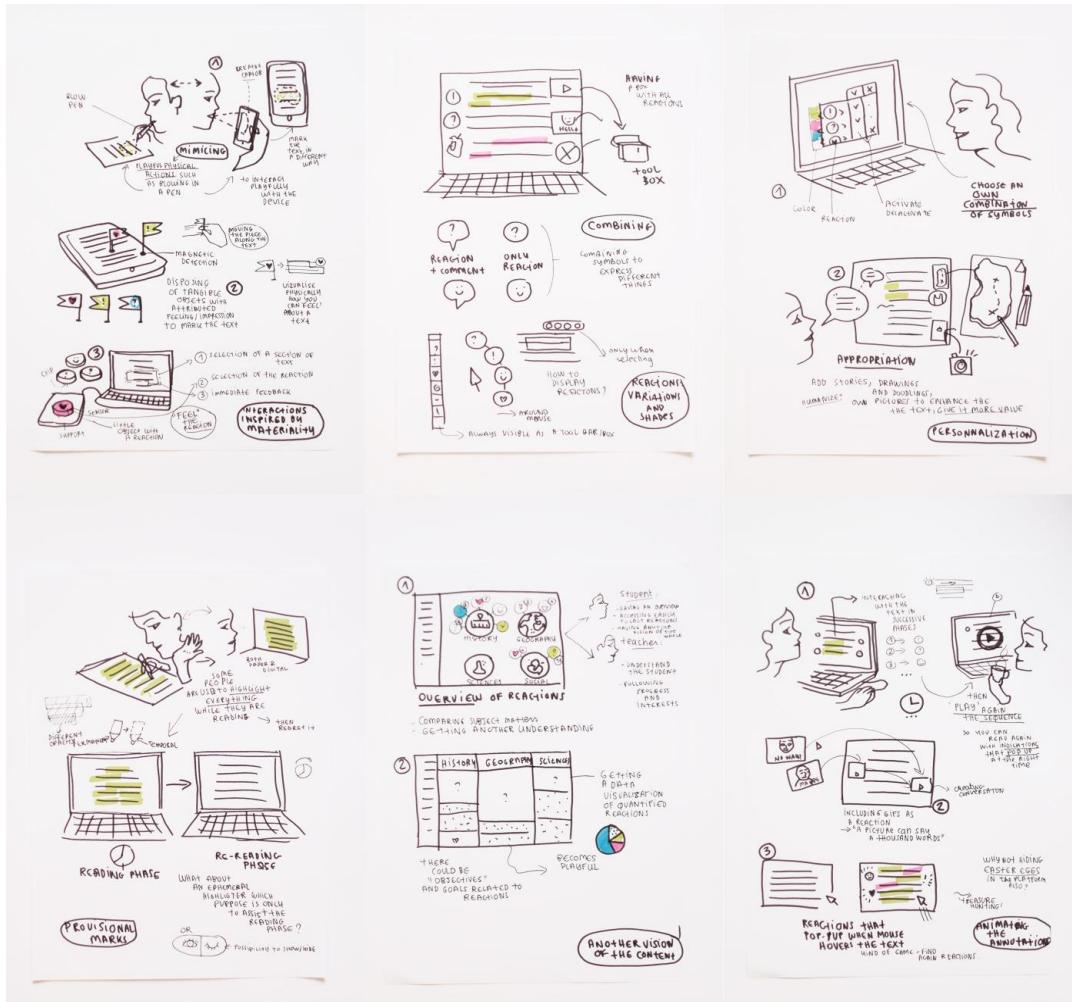


Figure 36 Sketches and concepts from the design exploration phase

Defining a typology of reactions was a next step, and resulted from the previous phases:

- **Acquisition:** Important facts, new learnings
- **Incomprehension / Reflection:** Question, exclamation
- **Emotion / Feeling:** Like, dislike, surprise
- **Opinion:** Agree or do not agree
- **Addition:** Picture, video, gifs, own stories, links

## 7.5 PROTOTYPE

Once the design space was sufficiently delimited, I designed a first prototype of an interactive book platform, where users can annotate the text playfully. For this prototype, the basic structure of Gleerups interactive books was used. I did not assume however the current state of the Gleerups existing platform, as the intention was to work in a more open framework and be explorative with the research subject.

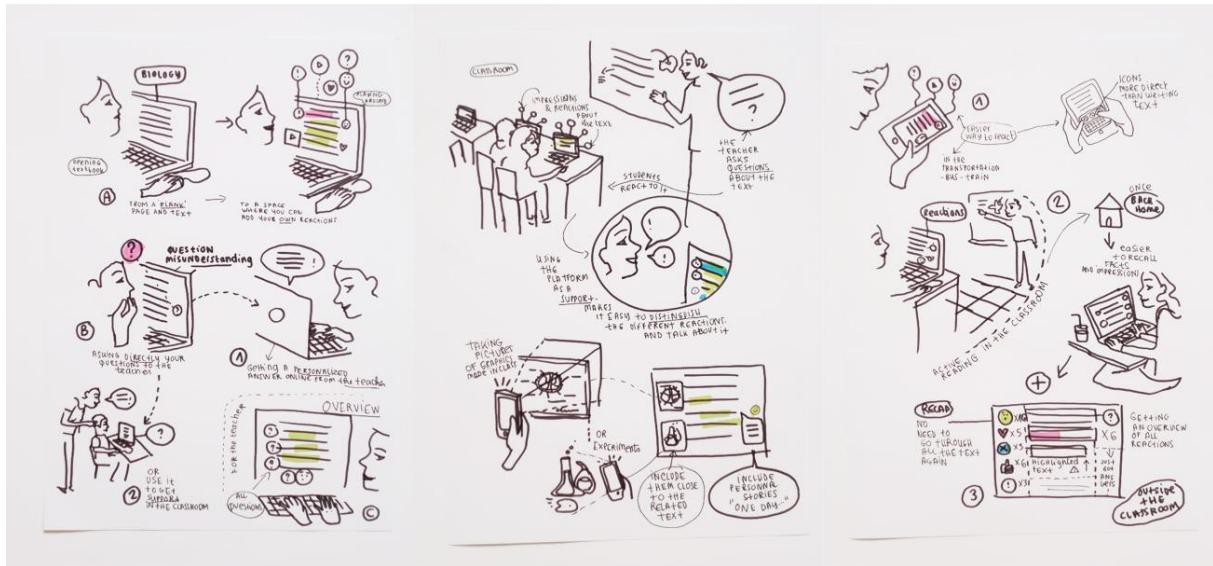


Figure 37 Sketches and scenarios for prototyping a solution

I imagined a few scenarios (Fig. 37) using these ideas, which can also be found in Appendix IV in larger size.

The prototype was elaborated from the findings gathered in the different meetings, surveys, and workshops results.

It consists in a series of clickable screens which show possible interactions with the text for the student and offer a vision of students' reactions for the teacher, plus the possibility to interact with each other. The prototype can be tested here: <https://invis.io/NX88VVJ8U>.

### Characteristics of the prototype

- **Appropriating the text playfully for active learning**

In this prototype, the students are able to interact with the text in various ways. From the survey and the previous workshops, the need for a platform which gives more freedom to the user was central. Different major reactions are suggested and shown in the prototype.

This freedom was pushed further here by allowing the student to match reaction gifs or personal doodles on the text for example. This freedom can be unproductive and even ineffective, and produce non-related forms of annotations in the text. Nonetheless, they appeared in the workshops to be a special shape of expression which brings an extended expression range compared to other forms of annotations.

This major part of the concept I propose introduces the possibility to express an 'affect' part towards the platform and the text, mainly by enabling to react to the text in different ways. It concerns not

anymore ‘basic’ actions such as highlighting and commenting, but enables reacting for instance, or combining a reaction with a comment.

This aspect also builds upon a more sensible, material approach, which is usually related to interaction with a tangible text, like in doodling for example.

The platform becomes a sort of ‘playground’ where educational content is the material for playing around with. Playful is not incompatible with serious tasks. Every game must follow a set of rules. So a playful environment should have rules, even implicit, to be able to study without stepping out of this combination of learning and being playful.

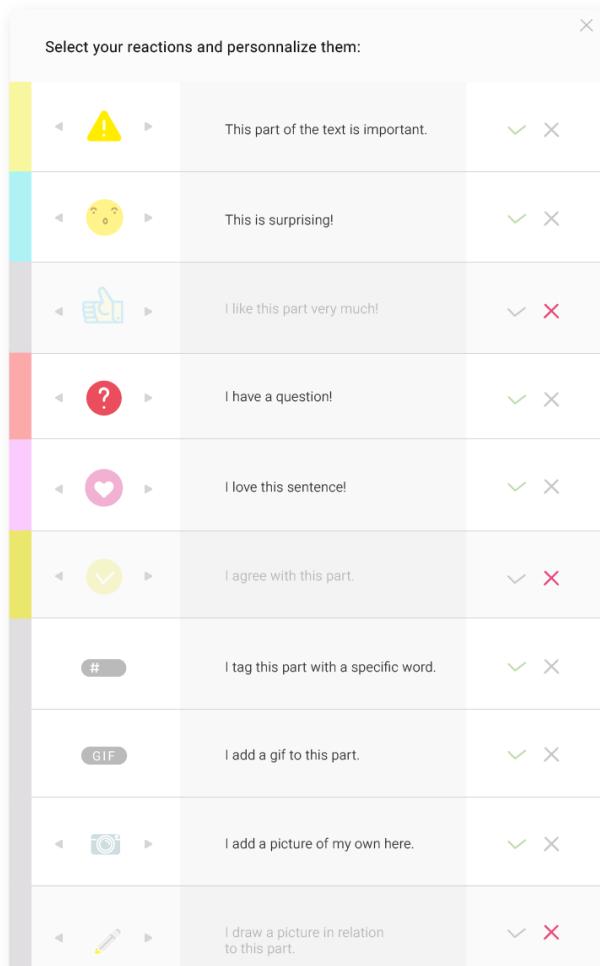


Figure 38 Access to all the reactions, which can be personalized

#### - Personalization and identification

Moreover, the idea is that this system of annotations can be customized, by choosing the form and colour the student wants to give to a special reaction (Fig.38).

Another point is also to let the student identify to a far greater extent to the text, for example by adding her own stories to the text. If little stories are often better remembered, it can be a good way to increase the learning of the content in a playful way, just by matching impersonal and personal stories/contents.

- Taking into account different steps and levels of interaction with the text

From the different workshops appeared also steps and ways to interact with the text which are worth taking into consideration. For example, some participants need to highlight almost everything while they are reading, which is an active reading attitude but they eventually end up confused with their all-highlighted text after reading. This behaviour which seems to be spread out, deserves to be treated specifically in digital environments because they allow an easy appropriation of the highlighted surface.

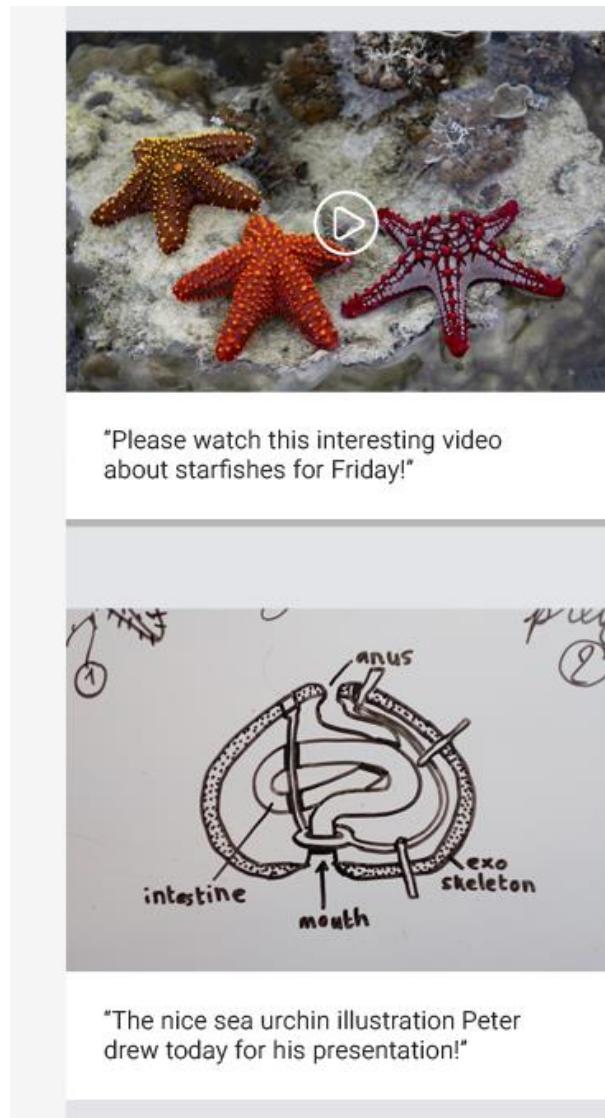


Figure 39 Addition of video and pictures of activities from the class

- Linking the class and classroom to the platform

Another element of the prototype is the possibility to create a continuity between the actual class, the discussions in the classroom, and the interactive textbooks platforms. From the discussions I had with teachers, one recurrent interaction within the class was for the students or the teacher to 'document' the class by taking pictures of the whiteboard or the projector to avoid taking notes. This attitude, which can be criticized if generalized, is however interesting in the way students now 'take

notes'. In the prototype, teacher and students can therefore add pictures taken in the class to enrich the already given material of the textbook (Fig.39).

#### - Connecting the student to the teacher, enabling another level of dialogue

Additionally, the student and the teacher can communicate online on a platform which allows them to have their own 'expression space' on each side of the page margins. In the continuity of the previous point, this gives the possibility to create more natural connections between the class time and the platform, but it also becomes an extended support tool for a conversation between them (Fig. 40). This possibility is suggested in the prototype, and could for instance be used as a reminder for the students who then want to ask their questions in the classroom.



Figure 40 The possibility for students to ask questions and getting answers

Here is asked the question of confidentiality and sharing private annotations, which was already tackled in the original platform, and which could be apprehended in the same manner here.

The issue of a potential extra worktime spent on answering questions for the teacher can also be raised, but both types of users would be free to appropriate this extra space at their convenience, finding the best balance in order to avoid any waste of time.

- Giving an overview

For both the student and the teacher, an overview of the annotations is provided, which gives another perspective and a global meaning to the accumulation of single annotations. For the student, this overview could consist of the possibility to have a 'box' with all the reactions one had on a chapter or a book in its entirety. Having this recap could allow the student to visualize in a different way the text and how she interacted with it, plus by including this new step in the studying process, giving another point of view of the book itself and what one retains of it.

The screenshot shows a digital platform interface for managing student annotations. On the left, there's a sidebar titled 'See' with dropdown menus for 'All group' and individual student names: Ida Andersson, Doris Bengtsson, Julia Eklund, Maya Hemmer, Oliver Lindberg, Glenn Maya, Leo Nilsson, Anja Olsson, Matthias Per, and Paul Wolf. Each student name has a red question mark icon next to it. The main content area features a title 'Echinoderms' and a text block about echinoderms living in the sea and their protective spiky plates. Below this is a section on 'Starfishes' with a detailed description of their feeding habits, mentioning they eat snails and mussels using suction cups on their arms. A large image of a cluster of pink starfish is shown. Further down, there's a section on 'Sea urchins' with a description of their spiky appearance and climbing abilities, along with an image of sea urchins on a rock. At the bottom of the main content area, there are two more red question mark icons. The bottom section of the interface contains a summary of all the questions students asked, including the ones from the sidebar.

Figure 41 An overview of all the questions the student asked on the platform

For the teacher, it is a way to see her students in a new light, both individually and from a group perspective. Disposing of the same kind of overview of the reactions, it could allow her to visualize the reactions addressed to her, like questions (Fig.41), but also if the students let her see their personal reactions, what the students find important, what they like about a text, what they agree or disagree with, how they appropriate the text by adding drawings or pictures.

Lastly, for the company itself, if all reactions are turned anonymous, such a system could also give a lot of indications about how textbooks and textbook contents are perceived by their community of users.

## 7.6 FEEDBACK FROM TEACHERS

The prototype was sent to the teachers with who the research process was initiated with. A survey with open questions was sent and the collected feedback was really positive.

### **Dividing the space teacher/ learner**

Offering one side for the teacher and one for the learner was appreciated: "*the students have their own annotations and the teacher, who sees all, can choose to expand on items that are important for the individual student, or for groups of students. This gives the teacher feedback and allows them to plan/continue the work according to the students' needs/interests*". This teacher projected herself in establishing a dialog and observing what motivates her students.

### **Having a set of new reactions**

Being provided with a range of different reactions was well received as well: "*it's an easy way to express and convey emotions and approaches, makes it so much easier for teachers and students*". According to her feedback, it seems that it can help to have a more direct approach to the textbooks.

The other functions such as seeing the questions and being able to answer them, visualizing the whole group reaction, and including activities from the class in the platform were really appreciated too.

More generally, I received positive feedback and I opened questions that the teachers did not always think about: "*there are many creative ideas that can make teaching and learning so much better!*", "*when I saw what you have come up with, it's like you have filled a void I wasn't aware of, given me something I didn't know I had missed. I really hope these visions will come true*".

These feedbacks were comforting me in the fact that a crucial issue was raised, even if it was difficult to detect and name for the teachers. However, these feedbacks do not result from a prototype tested in real conditions of use, so a cautious critical stance should be taken towards them at this stage.

## 7.7 FEEDBACK FROM GLEERUPS

Finally, a meeting and discussion with Marcus Ander, one of the stakeholders I initiated the thesis with was conducted on the 17<sup>th</sup> of August. Discussing the different steps, findings from the meetings and surveys, workshops, design exploration and last prototype (performing a demonstration of it) brings another perspective on the research process and findings. The main points raised in this discussion were:

### **Dividing the space teacher/ learner**

The idea to divide the screen in two for the teacher and the learner was well received: "*I think it's good to separate what I said from what the teacher said, if I am a student*", even if this concept should further consider the use on other kind of devices.

### **Having a set of new reactions**

Giving the learner a set of different reactions was also appreciated "*it's a good idea, because it serves different purposes, some of them require an interaction with the teacher like the questions, but other*

*ones don't necessarily".* The fact that the reactions were optional and that the students can make their own choices among them was also a good point. Also he raised the fact that "*they aren't used to work with text in this way, they aren't used to make their own notes because they often have paper textbooks and they aren't allowed to write anything in it*" and that with this more playful system, it could make it easier, especially because of the "*spontaneous*" aspect it brings.

### **Connecting class activities to the platform**

Some of the teachers already do that, but it's a minority and also the links are not as visual as in the prototype. We discussed also the fact that teachers could add the suggestions from other teachers to their communication side, as this is already a possibility, but which is not so used.

### **Getting an overview**

*"It might be interesting, the only thing I wonder is when they will use that overview, for what purpose".* From the discussions I had, some of the students suggested an overview of all the highlighted zones to learn their lesson for example.

### **Interest for the company**

For the company, he stated that it could also be a good thing to have an overview of all the students and teachers reactions for the data analysis. It could be made anonymous. *"This could be a part of a communication between the student and the teacher, but it might also be interesting for us at Gleerups, maybe not to know what students said what, but if it's a text that is hard to understand for example."* They are not considering it for now but reflect on integrating such an analysing system: *"for now we don't analyse in details, but this could be the next step.*

### **Future directions**

About the possibility to establish a conversation between the teacher and learner, he raised the fact that *"maybe the teacher could answer the questions but I could also send the questions to my classmates, it might be an option"*.

We also talked about the possibility to establish a conversation between the learners and their teacher with a comments option on each publication to make them more dynamic.

More generally, the design proposals were well received and he *"would love to take it further particularly because: anything that makes the student interact and dig in the content, I think it's good, because the problem is that often they are not engaged in it, or they struggle with the reading"*.

## **8 REFLECTION – DISCUSSION AND CONCLUSION**

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### **8.1 CONCLUSIONS**

To conclude, starting from an observed dissatisfaction of interactive textbooks end-users, I explored and designed playful annotations systems to improve learning. This meant finding new ways to create and offer a playful experience while teaching and learning.

I used a Field approach (Koskinen et al. 2012) to grasp and understand the issues both actors in the classroom, teachers and students could have with the Gleerups platform specifically. In this way, I acted as an intermediary between the company and their end-users. I truly think that observing and discussing with them in-situ was fundamental in this thesis project, firstly to frame and re-frame the research area by progressively grasping the different challenges, secondly, to make them reflect about their own use and thus engage them actively in the process.

By focusing on this topic of exploring playful annotations in interactive books, I tackled two issues which were the attitude (be it playful (Sicart 2014)) one can have towards the activity of learning and reading, but also the relationship between the teacher and the learner. This latter can be forgotten in the design of the learning experience (Sabry & Barker 2009). These two points above were intertwined and I would argue it was necessary to address them simultaneously.

The successive phases of the research process (meetings, workshops, and concept sketches) enabled me to end up with a final prototype, which embeds a selection of features and interactions arising from previous findings such as reactions, personalization and appropriation. Also, conducting paper-based workshops gave me valuable insights and I could observe a range of attitudes I might not have using screen-based workshops.

More generally, this thesis brought a broader focus on enhancing content appropriation through an extra layer in charge of emotion and humanization of the information through playfulness.

### **8.2 DISCUSSION AND LIMITATIONS**

Including end-users from the beginning was very rich in getting entries to address issues. Moreover they were really interested and engaged. I would argue that this relationship between end-users and designers and developers should be extended and included in the very beginning of the project, before to think about any change on the platform. The chosen process as a whole surely gave me more insight than merely sending surveys to my users.

Setting the meetings on a short period of time was not always an easy task because of the limited availability of the end-users, therefore I needed to adapt my research process to find other ways to get some findings and conclusions. This was partly made possible with the inclusion of other volunteer participants, which took the role of potential students.

The last prototype was not tested with end-users, because they were unreachable at this time, which can be seen as a weakness for this research project. For now it is therefore difficult to evaluate the prototype. However this would require a work likely worth of occupying a full new master thesis. Furthermore, first positive feedbacks from stakeholders and teachers gave me first clues about how these suggestions can be further received.

### **8.3 FURTHER WORK**

Regarding future possibilities for this research topic, the next step would be to engage a full range of user testing sessions using a working Hi-Fi prototype. These sessions would enable to reveal patterns of use and evaluate the quality of single-use interactions or of the relationship between the teacher and the learner. Conducting both short and long-term sessions would allow to dig into particular directions and to give up on some others.

Particularly, the evaluation could consist in focusing on which kinds of reactions are more frequently used for example, or how related they are to the learning content (to detect any misuses). Another step would consist in selecting and improving the main interactions observed. Above all, the research should focus on the quality of the interactions, so that it enhances the teaching/learning experience, and not so much on the mere addition of a lot of extra unused features.

Future directions could have a greater focus on a learner/learner interaction using a playful annotation system or more broadly taking into account a whole community of thousands of learners. What if one can suddenly have access to all reactions of her mates across Sweden?

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# 11 APPENDICES

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## 11.1 APPENDIX 1. CHARACTERISTICS OF ANNOTATIONS IN BOOKS

Characteristics	Within-text	Marginal or blank space
Telegraphic	Underlining; Highlighting Circles and boxes around words and phrases	Brackets, angle brackets, and braces; Asterisks, and stars; Circles and boxes around whole pages; Arrows and other deictic devices to connect within-text markings to other marginal markings
Explicit	Brief notes written between lines, especially translations of words in foreign language texts	Short phrases in margin; Extended notes in margin; Extended notes on blank pages in the front of the book; Problems worked in margins

Figure 42 Characteristics of annotations written in books, taken from Marshall 1997, Table 2, p.135)

## 11.2 APPENDIX 2. SEMI-STRUCTURED INTERVIEW (26/04/16)

E. is a Swedish and German teacher, and G. is a History/Geography/Social sciences teacher.

-*What are your teaching routines, use of the Gleerups platform?*

E: I use it mainly in the classroom. I don't give my students much homework, **we do much of work in class**. That means, it is in the class that they use it. Not every lesson, but when I do use it it's in class. Usually I introduce the subject myself, that's why I am teaching (laughs). I use the whiteboard a lot, after that we move on to Gleerups. And also if my boys give up completely it's good to have this.

G: I really like the films: "**please look at it at home and then we can start**". (Or we can also start it in the classroom). Then we can start to discuss the subject. **I agree with Eva, I like to talk and to introduce the subject myself**, and then I use Gleerups mostly in the classroom.

E: For the introduction, **we use the projector**. When the students work by themselves, **they can use headphones, if they want to listen to it, or they can just read**. Many of them use headphones, but sometimes they listen to music while they are in the classroom...

G: I really like the **news page**. And then they have a quiz for the week's news and then we have a good discussion in the class. So I really like it, and it's (showing the platform) the little bit bigger article of the month, it can be the war in Syria but it can also be finance problems in Sweden, so it's a bigger article, and then we can discuss it. It's always updated.

E: That's the good thing, it's **always up-to-date**. When there is a new Nobel Prize in Literature then it is there, a new president in the country...

G: This is the week 17 (showing the platform), this is the quiz and you have 12 questions, you can discuss and also with the whole class. There are every kind of news, so it's really nice to have them up-to-date.

G: The questions come already made. It's like a newspaper, you can read it and then you have a discussion. It's not "This is right and this wrong", it's "**What do you think? What should we do?**" and **they start to think**. So it's not wrong or right, this is the problem in the world today, how should we face it.

The larger article is uploaded each month.

E: I teach Swedish, and we don't have news like this but **whenever anything happens the book is changed**. And Swedish grammar doesn't change really much or Greek poets don't change (laughs). But I like the book portal because it covers every aspects of Swedish, and it is always there and it's always updated.

G: In Sweden, we have a test for the ninth grade in English, in Swedish, in Mathematics... We have the civics... This is (showing a document) what the education ministerial have decided they (students) should know, and when I look at these books (online), it's on spot, it's really good. I can check it up.

E: Same in Swedish. We have different types of texts, reading comprehension in Swedish as well, they have to read different types of texts and not only tell what the text was about, but also **combine, analyse, compare**; to be able to say: "this is that type of text. Is it a news article, a novel" ..

E: And also they have an essay writing where they have three subjects to choose from. One of them was write a short story, another one was write a text for a newspaper, or write a debate article on this. And so that's good.

G: This is an exercise in Economy, and then you can see, this is a really short quiz and then you can go more into it. When they have essays they can write it on it as well. And at the end of this chapter (showing on the website), they have a film, and then they have essays **so they can answer a little bit more than quizzes**.

E: In Swedish, we don't have long essays in this, there are also like words, terminology, and some questions on the content. And sometimes they have to correct the texts, no big letters, no full marks, no commas, so do that. But for other lessons, writing exercises, **they use Google Documents or do presentations like PowerPoint. Then they share it with us**. They do it at home or in class.

G: **It's really good because if you are ill, you have the computer at home and you don't miss a lot. You can talk to me. And I'm not sure that the students always think it's a good idea** (laughs). You know you have the computer, "I know you can still work"! (both laugh)

E: And even if you haven't your computer, you have your mobile phone (laughs), you can work on it as well!

E: And another good thing is that I can see what every student does, like the results, when they do an exercise, when they started, it comes up on the result page. And I can see if they've done it, and see if it is correct, there is a green dot, when they have done it, either it hasn't been marked yet, or not approved (red) so they have to work more. **So I can see: you got 15 right answers out of 16, so let's discuss question 16.** And it's brilliant, because all the time I see exactly where the problems are or...

So sometimes when the students work, of course I go around the classroom and help them but **sometimes I just sit at the desk and watch my computer and see who is doing what and I can say: "Eh, good Philip, you made it!"**

G: So here you can see, I have one class here (showing the page with all the pupils and the dots)

E: So it's a graphic, it's so easy to see.

G: And sometimes, that's not a bad thing, but if you write a word with a capital, and it should be a small, then it's wrong for the computer. They have spell it wrong but it is alright with me. I cannot change it if it's wrong but I can do it by myself in my notes.

E: And we can always contact Gleerups and say: "You should accept that as well" and I think they are working on it continuously.

**E: Some students are very good verbally, and they can talk and discuss and explain, and some others are very very quiet, and this, as a complement to everything else gives me a much fuller picture of the students.**

-*What is your main goal, interests in the platform?*

**G: I think that the pupils who are not so good at reading, or have concentration difficulties, plug-in and then listen, and you don't need to look at it, just listen and it's a lot of my students, so if I say: "This you should read today" "Oh, no!" "Just listen, then". It's really good, and I really like the films, because it's a lot of them who need to learn by the eyes and see, when it moves it is good (laughs). And some of them need to read, so I have more ways to see how they can get their knowledge. It's broader. I think that's the main, I really want to have it.**

**E: I like it a lot, it's good as a complement to what I always do. And one big thing is also for newly arrived students, they hear the Swedish pronunciation and it's also very easy to translate it just with one click. We can get the same text in every language. So they don't have to wait to learn Swedish first, they can get the same knowledge and that is brilliant.**

**G: Just like Eva said, I know it is in Swedish, and then pupils have it in the language that suit them. I can say it in Swedish because he's going to learn it, but he can read (in his own language) and say "Yeah, I know what you are talking about". It's really really good.**

And you see, we have a lot of alternatives, all these languages..

-*Do you have many foreign students?*

**E: In the past couple of years, there has been quite a lot coming, refugees... They start in a small group where is assessed how much has been done before, and then gradually they come into the class in various subjects. And even before they come in the class, they do study the same. Subjects as we do, in smaller groups with teachers who can help them. So we have Arabic speaking teachers who can help. The goal is that they should come out into the class as soon as possible, be part of the school.**

**G: I have two Arabic boys in my class, and that is the schedule (showing an agenda with time divided for special lectures in Arabic and others with the Swedish group), if they want to study Swedish they must be together with the Swedish pupils. But they really need to learn their own language as well, and they have homework help in their own language when they need to know what they should do.**

**E: They can get help in their mother tongue, and get better at their own mother tongue.**

**G: And I think we have mostly Arabic students (when they are foreign students). Some speaking Urdu...**

-*What is your Pedagogy? Way of teaching, tasks of the students...*

**E: They do researches on internet, but one trap is how to do it and how to be critical at the sources, and don't believe everything you read. When they have to write about Swedish authors, that means**

they have to find information somewhere, and they have to use different source and compare them, analyse... **It's funny, one student said just last week "Can you imagine how it was just 5 years ago when they don't have computers". It's a big change.**

G: And I think we talked about being more critical to the sources, not only the internet but books, but what people say to you and you need to be critical and I think about a joke on the internet: one day of the year, the people are critical and it's the first of April, they're all "Is this true?" but you should be like it every day!

E: Sometimes, they believe everything that they read, and a couple of years ago, one of my students was writing about Danish author Christian Anderson, who wrote many children books. And this student he wrote in his paper that C. Anderson was born in 1805 and died in 1875, and he was 75 when he died, and I say "One of these numbers must be wrong!" "But it's true, it says so on Wikipedia!" "Yes, but it's not possible!" **That was a wake-up call for the whole class, you really have to think, not just copy-paste.**

*What is your process, how do you prepare the class, does it repeats itself year after year?*

**E: I think it's different, not only year after year, but also from class to class, because they are individuals**, so I mean we do have a main curriculum but it's very open at the same time. Because **there are some skills they should know but how to get there, that can differ from people to people.**

For the preparation, I've been a teacher from 1978, so I got a lot in my head (laughs). So to prepare, of course I look at the chapters in the book myself. I got a paper book so if I just want to flip over...and then I can see the online book, and see how they are phrasing the things that I want to teach.

G: In my subjects, you have 5 skills, and I have 4 four classes?: 1, 7, 8 and 9 and I always do the curriculum by myself (showing the sheet on the cupboard with all the skills and what are the best skills you can reach) This is the A (grade), and I can see it in the book and they can work with it and they can reach the highest grade, and that's like Eva said, it can change from year to year , **because I want to be amused myself** (laughs) otherwise it's boring. **But how you reach the knowledge, it's different for everybody. And some of them really want to have a book and some of them need to talk. But you need to show it for me, from the mouth or from the pen, they can sing a song I don't know** (laughs)!

**E: Make a piece of art, whatever!**

G: So it's from the minister, what they have decided, but it's really good because these books really help, they take it all.

**E: Many of the skills are the same in all subjects**, I mean, read and understand what you read, have the terminology to be able to talk about it, analyse, compare, use the sources in a critical way,

G: One of mine is also to talk, to argue...

- *Do you use books to prepare the class?*

G: I can have a book to prepare for myself, but **the most of it, we have it online**. We can make comments and they see it. Sometimes they see it and "I don't care" but sometimes "Oh, I understand"

E: Sometimes it is interesting to use other sources, I mean if I teach literature, it is quite interesting to take out book, or literature history from 1893 and see what they have written. "Oh there is a new

Swedish author called August Greenberg, he lives in France as well, who has just published his first work, and he will probably not be very popular.." and then he was one of the greatest dramatist poet in Swedish literature. So, get the time perspective as well, how do they think at their time and how do we think about it now.

-*Can we find that kind of example in the book?*

E: It's not in the book, it's in my head, and sometimes I can scan it and show it on the projector.

G: I have bought the book by myself so it's just for the pupils if they want to, they can look at it, and I don't know, it will still be here when I'm gone I think (laugh) but, **it's a good complement to the computer.**

-*Do you add your own content to the textbooks?*

E: Sometimes, yes. **Sometimes I do exercises as a complement to what there is and then I can just add a link from the book online.** But we also have an educational portal where I post assignments for them so they can go in there and look as well. So it's not all linked to Gleerups.

It's a platform for communication (the other one), we had it before we got Gleerups. I just have to remind my students to look at that as well.

G: And you can also make links to Youtube films in the book.

E: And we can share that link with our school or with the whole world! (laughs)

-*Do you create links and connections between different books?*

G: No I haven't done that. Geography and civics it's a bit together so I could do that, but then they have the Geography book and they switch between them. **I think it's easier for them to separate them.**

E: Swedish and civics have also a lot in common, but **I can't access the civics book**, I can only access the Swedish book. But we do cooperate a lot between the subjects, like for instance you (G) have something about the Romani people and in Swedish we have something about minority languages, and neighbour languages, Danish, Norwegian and such. We can work together with civics and Swedish to see how the situation has been for the minorities in Sweden. Quite often we have connected subjects.

G: I work a lot with the Swedish teacher here.

-*Do you do class together sometimes?*

G: Not together, but she starts with it and then I take over. Sometimes we start with the Swedish, and then I can tell my colleagues "Please can you continue with it" "Can you make a longer lesson for it on the same subject" because we work so tight.

E: And also when they write essays, civics or history, they share it with me as well **so I can see it with my Swedish teacher eyes**. But they have to share it with me actively.

We can't see the student's results in other subjects.

-*Do you have frustrations?*

E: I think it's got better now, the first half year we had it there were problems and some things didn't work, I think they sorted it out.

G: I think this book, together with Google is really good because we share on Google Drive and they complement each other very well. Sometimes it's the computer who has problems but not the platform, I think it's really good.

E: It's logical, it's easy to navigate.

-Do you create your own exercises?

E: I can write a document and then link it, but I haven't try to do quizzes connected to this. I think it's possible, I think it's just that I haven't learnt it yet.

-What do you think of the navigation?

E: It's really easy [...] Everything is just two clicks away.

-How do you envision the book's content?

G: You can really pick whatever you like, and this block we don't use now so take this one. **It's not necessary to take A to B to C**, or at least I can.

E: And also something I link within the book, like when we read about drama then maybe we read about the Renaissance and then I go there and then I come to Shakespeare and there is a link to drama. **It's really interlinked**. Different types of texts, and then go to novels and then poetry, and newspaper texts of different kinds.

G: And it's between books here as well.

-What about re-modeling the content?, when adding content for example?

E: I think they (students) see it, they see the links to the right side of the book. **I think it would be too difficult if it were built into the book**, then that would be different books for different people and I think **it's better to have that option on the side** to do...

-What do you think of a platform that would provide more adaption? To different settings, contexts...

E: I don't know, I never thought about that.

G: I think it's really necessary to be critical to the source, so **I don't have the time really to do my own book adds**. Sometimes, but I think I know this (the platform's content) is from the ministry, I know it's alright, the sources are good. I don't know I don't have the time to do it. **And I really need to know if it's correct**, if I'm allowed to take it, and it is the law I mean...

E: But to personalize the book itself, the civics book...

G: That I can do that, but not a whole theme.

E: And also if we could access each other books, I mean if I read about, let's go back to Shakespeare or to the Renaissance, or whatever. I could write in my Swedish book and post a link to whatever it's about in the History book. **It's also a matter of time, there are so many possibilities and so little time.**

-What about making it easier?

G: I think it's really easy, if you know how to do it...Well I think we will talk about it (laughs)

E: It would be good to make my own quizzes, in this so the students could take them. So we could have other discussions in class and I could make some questions about it.

-*What about giving more control to the students?*

G: **They can already write comments and then they can tell others, “look I have found this in Youtube” and that, and all the class see it, or just me, or just themselves. So they can choose between 3 levels.**

*Activity: Map your experience with the platform*

E and G: Exciting! (both laugh)

[...]

G: (see paper sheet at the top of the picture) I think I'm done, I think this is Gleerups for me. I think it's really important because **they're together and they discuss but they don't need to be at the same page. (or the same pace!).**

I think Gleerups it's possible on all of these (pointing at the devices) and on the books as well. And **it's linked out to the world.** You can search in the book, or in Gleerups or in the web. And if you're at home, you don't really need to be at home **you can be in school, at home but you can also be in the travel, in vacation** (laugh).

G: **Or in the school bus!**

E: And **if you're on your own, you can see it, you can read it by your own.** (Then pointing at the movies) And then the movies I really like it.

You get ideas together in the classroom, in discussions, and you can search, yeah I really like it.

E: (see paper sheet at the bottom of the picture) That's Gleerups and that's me, **and I can link things and add things which I have done.** I also like the films because students can see and hear, and then discuss what we see. Also the connection to the world, you can use it anywhere, at school or at home or on any platform and you **get immediate feedback**, which is very interesting, **and the students' progress and they are happy!** I mean, even some of the students who don't get really high grades and aren't very interested in school, **when they see “Oh I got a green dot, yeah!” It really pace them on.**

-*What would be your dream platform? (Supposed to be an activity but not enough time)*

G: I think it's pretty close! I think there is more to Gleerups than I know now, I think it's possible to do more things, like creating other quizzes, connections to other sources...

**It's a totally new way of teaching.**

-*Do you see a difference between using paper/digital textbooks?*

E: Yes I think I'm less active, because **I've learnt that the students don't come to see me working, I'm here to watch them work.** And this Gleerups gives possibility to each student work at their own pace, otherwise it was maybe too much, hm, me talking and them listening. So it's much better know, it changed the roles. Plus I can see the students in a new light. The students who were very quiet before, and then suddenly oups 30 green dots in one lesson, and some others just one or two, so it's very good. It doesn't replace the teacher but it's a good complement. And that we can cooperate online, chat with me and chat with each other, that's good.

## 11.3 APPENDIX III. DESIGN EXPLORATION, SKETCHES AND CONCEPTS

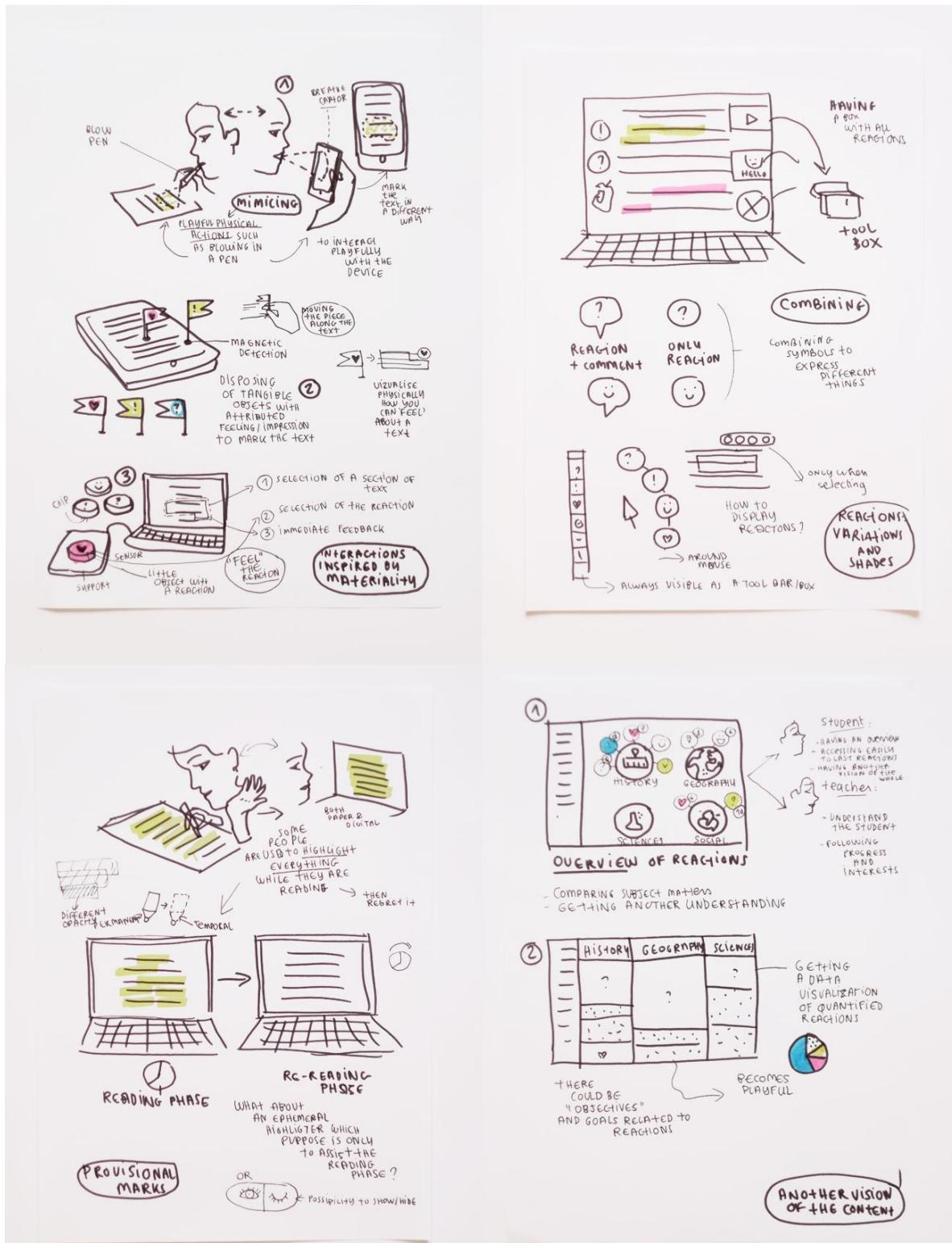


Figure 43 Sketches and concepts of the design exploration phase

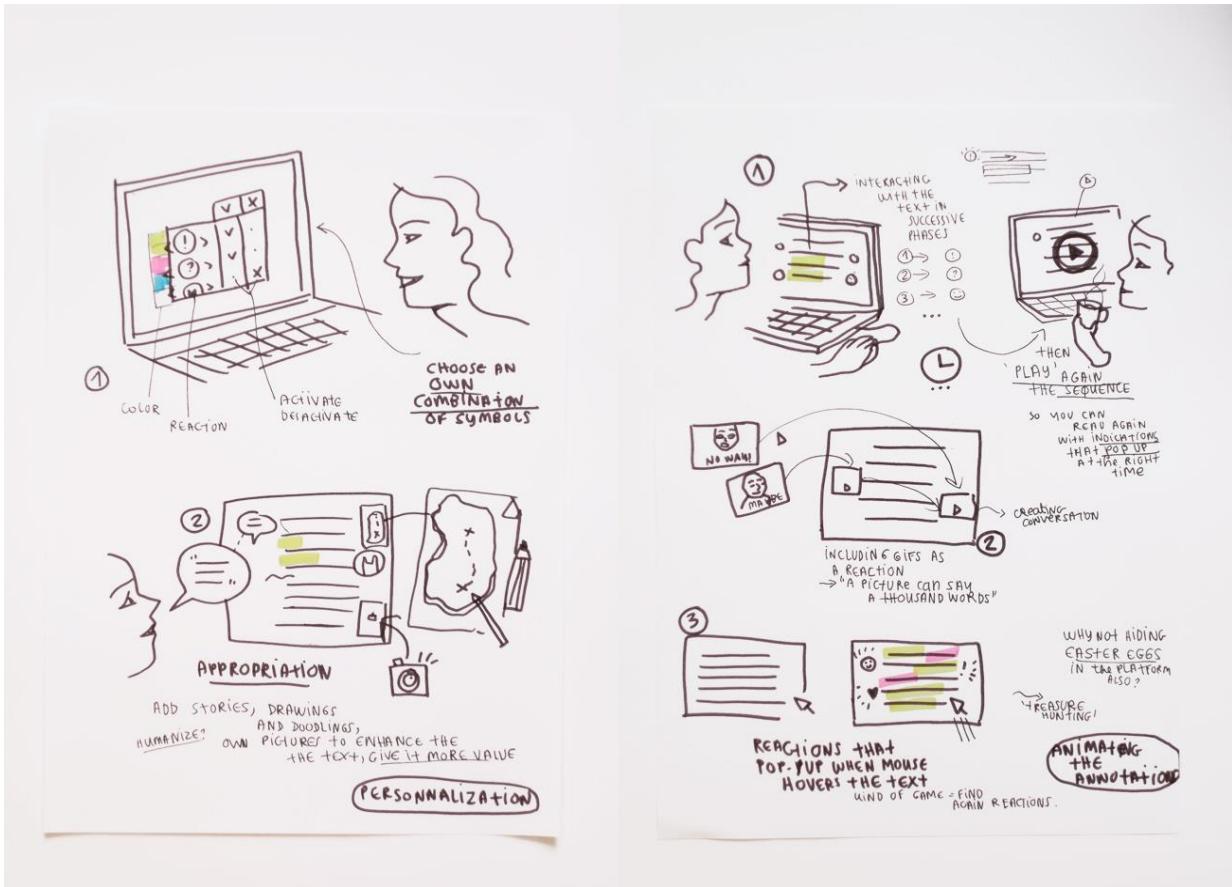


Figure 44 Sketches and concepts of the design exploration phase

Multiple sketches of concepts and scenarios are suggested as a way to explore playful annotations in interactive textbooks. Some concepts play with the materiality and tactile devices (Fig. 43, top left), these ideas were not kept but could be used in further research exploring the tangible aspect of annotations.

## 11.4 APPENDIX IV. FINAL PROTOTYPE: SCENARIOS AND CONCEPTS



Figure 45 Sketches and scenarios for the last prototype