

Design of a time-shifted dialog concept to support the educational environment: A Top-Down Approach

Master's Thesis

by

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Abstract

One of the most essential challenges of the modern communication society is opinion forming in the digital space. For this, people are having discussions online to convince others of their point of view. Unfortunately, these discussions leave an objective basis rapidly and become completely emotional, prohibiting any possibility for a compromise or constructive exchange of arguments.

A possible solution for this might be that online discussions have to be part of school much more regularly, so that students learn to discuss objectively early on. Therefore, the goal of this thesis is to develop a concept for the use of a time-shifted dialog in school. This way, students learn a constructive way to exchange opinions and arguments as part of class.

For this, we take an overview over the existing scientific literature regarding the use of Digital Media, cooperative learning and Computer-Supported-Collaborative-Learning scripts (CSCL scripts). On the basis of this and a conference with teachers, various requirements were identified for the successful use of digital learning application in schools. Following, we determined which requirements are already fulfilled by the existing applications that use the time-shifted dialog. On the basis of these, we present the concept for the use of a time-shifted dialog in the educational environment.

Following, a new interface is presented to discuss in continuous media like YouTube videos or podcasts. The user argues by highlighting sequences on the timeline of the video or podcast and uses this as a reference for his or her argument.

Finally, we take an overview over the existing applications for discussions in schools. We present each approach on online discussions and examine which requirements are fulfilled. Subsequently, we compare these findings with our concept.

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Chapter 1

Introduction

One of the most essential skills a person in the 21st century must have is to debate objectively with others. Without, we are not able to find a satisfying solution. Especially the discussion online gets emotional and aggressive very fast, prohibiting a constructive exchange. Therefore, students need to learn to discuss appropriately both online and offline.

In the last two centuries, humankind builds a massive infrastructure for communication, internet-based services and media. These services and media have become a building block of our social reality [Hep18]. For students, the digital space is part of their life as much as the analog world is. This allows us to teach them a constructive exchange of arguments early both in the analog and the digital world by introducing a concept for regular discussions in class.

However, the use of Digital Media is often neglected by schools. They use it only on an irregular basis. In a survey, 77% of the students stated that the extent to which Digital Media are used in class is too low, and even 50% stated that the lack of use of Digital Media is the most important problem [Bit]. This is troublesome because research has shown that the use of learning applications has to be on a regular basis if it should have success (Chapter 3). Nevertheless, teachers are interested in regular online discussions in class, as they stated in an interview (Chapter 4). Still, a practical application for this is missing.

Notably, the corona crisis shows that schools are lagging behind. Students are left to themselves most of the time, and the critical exchange with class and teacher is missing. Additionally, we see one of the dark sides of modern communication in shape of conspiracy

theories which are becoming more popular. Especially younger students are missing media experience to classify what they have seen correctly. Teachers miss a tool to discuss those topics with their class, like a teacher who wrote an article on Zeit Online recently [Zei]. In the article, the teacher reported that a student of him send him a YouTube link for a conspiracy video about the corona crisis. He was not able to get in satisfying dialog with the student to help him to comprehend the video correctly. Nevertheless, even without the corona crisis, students would benefit from a regular discussion. They would learn to argue critically and objectively, both online and offline.

1.1 Goals of this thesis

The goal of this thesis is the design of a time-shifted dialog concept to support the educational environment. Particular emphasis is placed on taking into account both the theoretical view of current research and the practical view of teachers.

Students should get the possibility to engage in discussions about topics from class regularly. This exchange should be beneficial for students in different ways. On the one hand, students should participate in a new learning activity, and by this, comprehend the information on a deeper level. On the other hand, they should learn to express themselves more clearly and to debate objectively.

Teachers should get another high-quality learning activity for the class. Therefore, the learning application has to be easy to use. Otherwise, they might not use it regularly and by this prevent a lasting effect. Additionally, the application should give the teacher detailed information about the behavior of each student. This can be used to help students more individually.

1.2 Structure

At the beginning of the thesis (Chapter 2), we take a look at already existing implementations of the time shifted dialog, *D-BAS* and *discuss*, and how they use the argumentation graph to structure the debate.

In Chapter 3, we get an overview of the current research regarding the use of Digital Media in schools, cooperative learning, and the combination of both, the CSCL script. With this foundation, we are able to identify the requirements which are necessary to use a digital learning application in class.

Subsequently, in Chapter 4, we take a look at the main focus of the work, the concept of the time-shifted dialog in an educational environment. Therefore, the chapter examines the use of already existing applications *D-BAS* and *discuss* and what problems are yet to solve for the use in schools. Afterward, the concept for the time-shifted dialog is presented with an example use-case.

In Chapter 5, we take a look at a new interface for the time-shifted dialog to debate in continuous media like videos or podcasts and in what context a teacher might use the interface.

The last chapter (Chapter 6), is a comparison between the concept of time shifted dialog and various discussion applications for schools.

Chapter 2

Time-shifted Dialog

This chapter gives an introduction to the concept of a time-shifted dialog, how it is applied in different applications like *D-BAS* and *discuss* and how the data are stored in the argumentation graph.

2.1 Motivation

The internet has become an integral aspect of modern communication. Many people get their information and form their opinion online. Therefore, they need a way to exchange proposals and arguments with each other. Classical systems like forums allow the user to express their opinion, but often fail to facilitate a constructive discussion. Therefore, concepts like the time-shifted dialog were developed to provide an alternative to these classical systems.

2.2 Definition

The time-shifted dialog is the abstract concept that structures the exchange of arguments between the users. A new user enters a dialog with others who have participated in the discussion at an earlier stage. The system presents the new user the arguments contributed by the other user time-shifted and the new user can interact with these arguments by contributing his or her own statements or use already existing arguments.

2.3 Dialog-Based Argumentation System D-BAS

D-BAS is an argumentation system that uses the time-shifted dialog to provide the users a structured online discussion.

In contrast to previous approaches like forums, D-BAS structures the discussion in a dialog form. In this dialog, the system presents the user with arguments made by other users at an earlier stage. Therefore, the users do not interact with each other directly.

One important aspect in this dialog is that the user only follows the argumentation he or she is interested in. The system presents the user with a list of positions (claims to the topic, made by users) to talk about. The user then selects the position he or she would like to debate (Figure 2.1). This reduces the cognitive complexity because the user only has to focus on one argument at a time. In a typical online forum, the user would have to read all posts made by users to find the argumentation he or she is interested in.

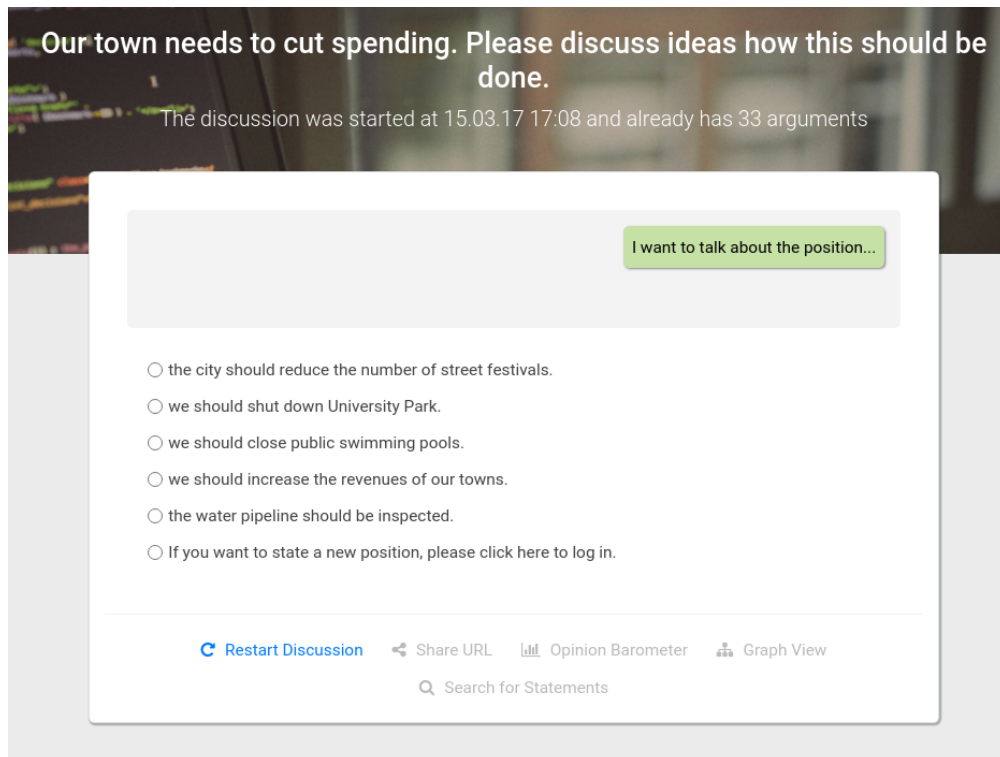


Figure 2.1: A list of positions for a discussion in D-BAS [DbA]

If the user wants to state his or her own claim, D-BAS demands to keep the text short. By

this, the system prevents long nested and hard to read texts.

After the user selected the position he or she would like to talk about, the system asks if he or she agrees towards the given position. Otherwise, it could be challenging to understand the attitude of the user towards the position; leaving room for misinterpretation.

Following, the system asks for the most important reason regarding his or her attitude. If other users already stated reasons for the given claim, the user can select one of these. Alternatively, he or she can state an own reason.

As a response to the selected reason, the system presents the user a counterargument, if one exists. The system allows the user to choose different responses for this. He or she can agree/disagree to the statement, or agree/disagree to the point of view.

2.4 Discuss

One aspect of modern online news media is the ability to enable the reader to give feedback or discuss the article in the comment section. However, these discussions are often confusing because it is difficult to separate the different argumentation if more than two users express their opinion towards the article.

Therefore, *discuss* [MKM17] embeds the structured online discussion from D-BAS into the article of the website. The user is able to integrate parts of the article directly into the discussion by selecting the appropriate text passage and connecting it with any statement in the discussion (Figure 2.2).

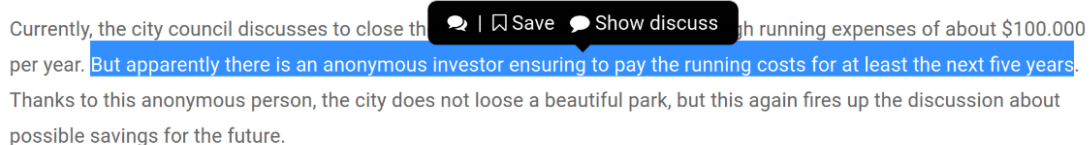


Figure 2.2: Popover when the user selects a text passage in the article [Dis]

The rest of the discussion follows the concept of a time-shifted dialog like *D-BAS*. The user exchanges positions with the system and is shown arguments made by other users at an earlier stage.

2.5 The Argumentation Graph

The argumentation graph is the data structure behind D-BAS (Figure 2.3). Every argument is stored in it and the structure of the graph is formed by the discussion itself. In the following, an overview of the graph components is given.

Issue “In D-BAS we assume that every online discussion is identified by a topic that describes what the argumentation is about” [Kra+18]. This topic or issue is the core of the argumentation graph. It is an entry point for the discussion.

Statements Statements form the building block of the discussion in D-BAS. They are the most basic parts of the argumentation graph. Every node, except the issue node, is a statement. However, the purpose of the statement is solely given by usage within the graph. It can be a conclusion or a premise.

Positions The positions are statements that are connected with the issue node. They are the statements that recommend or demand a certain action towards the topic of the discussion [Kra+18]. The user can agree or disagree with a position and the system then asks for the reason for this action.

Argument An argument consists of a conclusion and a set of premises. The conclusion is a statement that follows from this set of premises, and they are the reason for the given statement.

[Kra+18] explains that in *D-BAS* we distinguish between first-order and second-order argumentation. A first order argument is a premise-statement, a conclusion-statement and a reason relation between both. A second-order argument allows the user to discuss if a statement really supports or attacks another statement by arguing if the reason-relation of this argument does not hold.

2.5.1 Graph-Relations

Support/Attack A support or attack is an argument that indicates the attitude of a user towards a position.

Undercut If a user suggests that the premise of an argument is wrong, he or she uses an undercut to attack this relation.

Rebut A rebut claims that a statement does not hold and offers a counterargument.

Undermine An undermine attacks the premise of an argument.

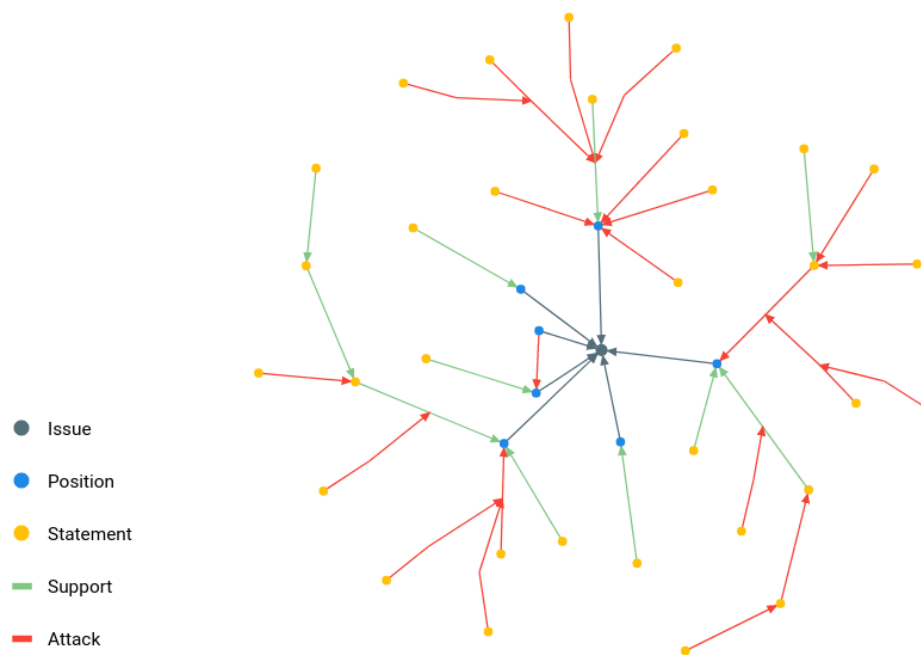


Figure 2.3: The argument-graph for the “Town has to cut spending” discussion from D-BAS [Dba]

Chapter 3

The Educational Research Perspective

This chapter provides an overview about current educational research for digital media and collaboration in schools. It begins with Digital Media in schools and explains what we understand of Digital Media, the different approaches to improve learning with technology and what benefits and difficulties exist.

Following, the chapter focuses on collaborative learning. Especially on how and when students can benefit from collaboration instead of individual learning.

The final section deals with the combination of the two previous sections and examines the CSCL scripts. It summarizes the research for this topic and explores its benefits and challenges.

3.1 Digital Media

We understand Digital Media as computer-based technology that presents content or allows interaction with or about the content [Ste+18]. It is essential to keep in mind that learning success is almost independent of the used medium. Digital media does not enhance learning *a priori*. An example of this would be a digital school book. If it were only an 1:1 transfer of the content to an electronic device, without using the potential of the new medium (e.g., comments, marks or 3D-pictures), we would completely give away the advantage of the electronic device [Bra+18]. Therefore, it is vital to use the possibilities of the new medium

to enable different learning approaches and lift barriers.

If we afterward note that there are differences in the learning results, we can assume that this is related to changes in the learning conditions like sufficient learning time, materials, or learning activity. Thus, if we use this medium to support high-quality learning activities, we can achieve enormous effects [Bra+18].

The main benefit of Digital Media is the possibility of the variety of learning methods. We can create different learning opportunities for different students, considering their various learning types. Studies have shown that Digital Media can promote learning through diverse and playful ways [Bel+17; Che+18].

[Ste+18] sees three perspectives on the use of Digital Media in teaching:

Technological This perspective focuses on the technical realization of digital learning. An example of this would be Mobile Learning, which allows the students to learn any time and everywhere they want.

Cognitive From the cognitive perspective, the learning materials are designed by using theories about human information processing. Specific learning activities are promoted, which use theories about knowledge and skill-building. E.g.:

- *drill-and-practice* The main idea of this practice is to automate diagnostic of learning process and choosing of exercises for the student.
- *Multimedia learning* This method uses a combination of different media, like text and pictures, to explain a particular topic. It is expected that different media enhance understanding and remembering.

Situated In contrast to the cognitive perspective, the situated perspective attaches great importance to learning environment. It criticizes that the cognitive perspective does not consider the context of knowledge and therefore leads to *dull* learning, which only applies for tests and not real-world problems. According to the situated perspective, a learning situation

should be full of diverse and complex interactions that engage the student much more in the learning situation. An essential aspect is the social interaction.

The situated learning consist of four different aspects:

- *Authenticity* uses real-world problems that can be solved by students. A possible learning activity for this would be simulation-based learning.
- *Multiple contexts and learning* should support knowledge transfer.
- *Social learning* focuses on cooperative learning and problem-solving.
- *Instruction based learning* structures the interaction for the learning group and supports the student in the learning process with this.

For many educators, learning success is the most important reason for using Digital Media. However, in an increasingly complex and digital world, schools need to broaden their view on the subject, if they want their students to stay competitive in the modern society. [Bra+18] explains that media education in schools needs a “systematical competence model” (Figure 3.1)

The model shows that students need a variety of different skills (e.g., communication and cooperation skills). Therefore, schools require Digital Media, which teaches students abilities that go beyond the learning of facts.

However, the benefit for students is not the only important aspect of using Digital Media. [Bra+18] mentions that a comparison between Germany and Iceland show that the political will is not enough for the success of Digital Media. One of the main factors for success is the personal motivation of the educator. If the teacher is not convinced of the new method, the new learning method will not succeed. This means, on the one hand, that the educator needs a solid education in the use of Digital Media, and on the other hand that the digital solution needs to support the teacher and does not cause more effort. To provide a solid education for teachers in Digital Media is out of the scope of this work, however we have to keep in mind that the application has to be supportive for the teacher.

One approach which seems promising to support the teacher is Learning Analytics. It allows the educator to collect information about the students and use this to improve the learning

environment.

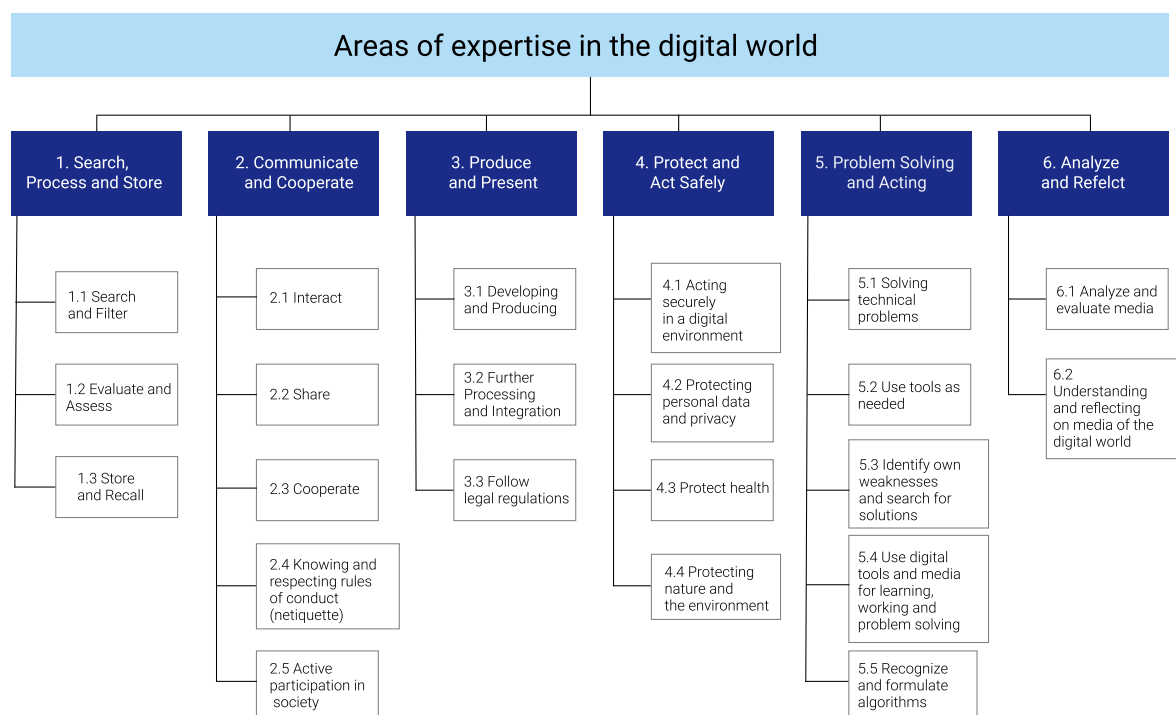


Figure 3.1: Competence model for students in schools for digital education [Bra+18]

To summarize this section

- Digital Media for itself is no guarantee for improvement. Only if we use it to support high-quality learning activities, we can achieve a positive effect.
- For an optimal use of the new medium, the digital solution has to offer a learning situation full of diverse and complex interactions.
- One of the main factors for success is the personal motivation of the teacher.

3.2 Cooperative Learning

The previous section has laid out that students in the 21st century need more than pure knowledge about a topic. As explained in Figure 3.1, students need a variety of skills, especially to

cooperate and interact with other people. This is, as mentioned before, the main focus of the situated perspective. Learning must be more than just the acquisition of knowledge.

According to [SR13], it is well established that working in small groups can enhance problem-solving and learning. In particular, if structure is added to support these productive interactions. One possible skill might be the transfer performance of students. “Transfer is the ability to apply or adapt prior knowledge to a novel situation” [BBC+00]. [PSM15] found that small-group learning has a superior effect on students’ transfer ability than individual learning.

The underlying process that promotes the success of cooperative learning is interaction and negotiation process, which leads to a deep understanding of the topic. On the one hand, students put more effort towards clarity of their ideas, when vocalizing to a peer. On the other hand, it enables the learners to share the cognitive load and therefore having more cognitive capacity left to comprehend the information at a deeper level [PSM15].

However, solely by letting students work in a group on a difficult task is hardly enough to improve their performance. A review of group performances showed a disadvantage of using groups for idea-generation tasks. However, if students worked alone and then combined their results, they created much more ideas [SR13].

Recognizing that collaboration can affect students performance positively or negatively, it is essential to identify characteristics that lead to these outcomes.

[SR13] studied why groups often fail to perform as the sum of the individuals and how to optimize the learning of students through group interaction. They use the terms:

Process Gain occurs when group interaction creates something beyond the pooled abilities of each group member.

Process Loss occurs when individuals in a group do not perform to their potential, limiting the groups effectiveness.

[Ste72] makes a distinction between what a group is capable of doing versus what a group is doing. [SR13] formulates this in the equation: actual productivity = potential productivity - losses due to fault processes.

Given that, they identified two sources for Process Loss:

Coordination Loss The group members cannot coordinate their effort to solve the problem or to combine their work to a solution.

Motivation Loss The group members are unwilling to perform to their potential and thereby limit the group's effectiveness.

Additional, they found characteristics that allow to minimize Process Loss by increasing the demonstrability of a problem.

[LE86] propose four conditions for demonstrability:

- **Group consensus** on a verbal or mathematical system.
- **Sufficient information** to solve the problem.
- **Sufficient knowledge by the members** of the group to recognize a correct solution.
- **Sufficient motivation, ability and time** of the group member with the correct solution to explain it.

These characteristics can be used to help educators to choose an appropriate group task. However, to increase the demonstrability of the problem does not always lead to a gain in group performance. One of the findings of [SR13] is that students who can solve the problem on their own, were more likely to be handicapped by the group. They explain that the results suggest that (a) demonstrability is not always enough that groups outperform individuals, and (b) task complexity in combination with demonstrability is a key factor in Process Gain versus Process Loss.

As already mentioned before, motivation loss is one of the primary sources for Process Loss. [PSM15] identified some features which are essential to motivate students. They found out, that, one of the defining features of group performance is the "individuals accountability". It can ensure that every group member is contributing and engaged in the activity. If students have the impression that they are not accountable for the result of the group or that other students do the work for them, they will fall for social loafing. In this case one or two students will do most of the work and the rest of the group benefits of their work [MFK97].

In contrast, if individual grades or feedback are given, and no group goal is applied, students might not engage in behaviors to help their teammates succeed [PSM15]. As a result, any group learning activity has to find a way to prevent social loafing while also induce a group goal, to motivate students to cooperate as a group.

To summarize this section

- The main factors for successful group learning is Process Loss and Process Gain.
- Two main sources for Process Loss:
 - Coordination Loss
 - Motivation Loss
- To minimize Process Loss we need to increase the demonstrability of the task.
- Demonstrability alone is not enough. The task needs to be complex enough so no student can solve it his or her own.

3.3 Computer-Supported-Collaborative Learning Scripts

This topic is a combination of the previous two. It summarizes the educational research for CSCL scripts and explains its benefits, downsides, and challenges. [Vog+17] defines a CSCL script as a kind of instructional support that uses computer technology to provide learners with guidance on how to interact with each other on a collaborative task, like a discussion.

CSCL scripts are seen to be useful for domain-specific and domain-general learning and also for the collaboration skill of students[Vog+17; RVF20].

[TS14] defines Domain-Specific Learning and Domain-General Learning as the learning of:

Domain-specific knowledge is memorized information that can lead to action permitting

specified task completion over an indefinite period of time. For example, we can solve many problems with Pythagoras' theorem. If a student wants to use the theorem, he or she must not only understand the theorem; the student must also learn to recognize the various problems to which the theorem can be applied [TS14].

Domain-general knowledge is knowledge that can be applied to any problem. Learning to solve problems by thinking of similar problems with known solutions is an example of domain-general knowledge [TS14].

As stated in Section 3.2, cooperative learning is beneficial for learning because it engages the students in activities that are expected to facilitate an in-depth elaboration of the learning materials. However, the effect of CSCL scripts should not be overestimated. Most of the meta-analysis found only a small effect for Domain-Specific Learning and Domain-General Learning [RVF20; Vog+17]. Nevertheless, one meta-analysis even found no positive effect for Domain-Specific Learning for CSCL script with argumentation. Although, the authors of this study emphasize that this is no final evidence that argumentation with CSCL scripts is not suited to support Domain-Specific Learning, they conclude that this result has two possible reasons. On the one hand, the theory that argumentation in combination with CSCL scripts is beneficial for Domain-Specific Learning might be wrong, and on the other hand, the studies which they examined did not use argumentation the right way to gain a benefit for the students. This shows that this is still an active research field.

The other benefit of CSCL scripts is the improvement of the cooperation skill of students. According to the "script theory of guidance" [Fis+13], it is an indicator of a lack of an Internal Collaboration Script, if students fail to engage in a high-level cooperative process. The Internal Collaboration Script is a flexible structure that consists of knowledge about how to interact in collaborative situations [RVF20]. If a student faces a new situation, he or she acts according to the internal script, which fits the novel situation best. [RVF20] states that to overcome an insufficient internal script, the student needs to be supported by the CSCL script's external structure. The CSCL scripts can be understood as the social interaction necessary for collaborative learning [KFH06]. By repeatedly engaging in collaboration with a CSCL script, learners will acquire a better internal script [Vog+17] over time.

In contrast to Domain-Specific Learning and Domain-General Learning the effect on the collaborative skill is much higher. [Vog+17; RVF20] both found a significant positive effect on the development of collaboration skills among students.

An important aspect of any learning activity is the motivation of the students'. According to [RVF20], it is a common hypothesis that CSCL scripts undermine students motivation due to the constraints by the structure of the script. This critique is related to the self-determination theory, which explains that basic psychological needs are a key to human behavior and that autonomy is one of them [DR08].

As a result of these two scenarios for the implications of this theory emerge [RVF20].

- 1.) The restrictive structure of the CSCL script undermines the learner's autonomy and therefore his or her motivation.
- 2.) The student gets a feeling of competence due to the early success through the combined learning effort of the students and because of the reduced negative effects of unequal participation (i.e. social loafing).

[RVF20] found a small, but non-significant positive effect on motivation. All studies either report non-significant or significant positive effect. The authors emphasize that this is in contrast to the hypothesis mentioned before. They assume that the variation in the results may come from a difference in the duration of the intervention or that different factors influence the learner's motivation. A possible explanation would be that the effects balance each other out. But the existing data do *not* allow any final conclusions on how motivation is affected by the CSCL scripts. But as an interesting additional founding, the author explains that most studies considering effects on motivation used scripts that distributed roles among participants.

To summarize this section

- CSCL scripts are a kind of instructional support to provide guidance for students.
- CSCL scripts have shown to be effective in fostering small positive effects on Domain-General Learning and Domain-Specific Learning.
- CSCL scripts have a significant large effect on collaborative skills of learners.
- An important aspect to consider is the motivation of students.

Chapter 4

Concept for the Time-Shifted Dialog in Schools

Designing a concept for the use of a time-shifted dialog to support the school environment is a very complex task. It is simply not enough to transfer existing approaches like *D-BAS* and *discuss* into school. The demands of the school environment differ from the demands of a typical online discussion. For example, in contrast to an open online discussion with dozens or hundreds of participants; we have a defined group of people who will argue with each other in multiple discussions over the course of a semester. Additionally, these discussions are graded by the moderator (the teacher). Furthermore, the participants of the discussion do not participate voluntarily; it is part of their homework. This leads to new demands in terms of motivation, coordination and infrastructure.

4.1 Requirements

This section deals with the requirements needed so that a time-shifted dialog can be beneficial for school. For this, we consider the vital demands for a successful digital educational application, mentioned in Chapter 3, and by the teachers. The aspects for teachers are the result of an interview with Gesamtschule Hardt in Mönchengladbach, Germany.

4.1.1 Educational Research Perspective

This section's requirements for a successful digital learning application are the summary of the examination of Chapter 3.

Digital Media One of the most important findings from Chapter 3 is that a digital learning application will bring no improvement if we just transfer an existing aspect of the school to the digital world. The application has to make use of the possibilities of the medium and support high-quality learning activities. Especially, the teacher has to consider the application an advantage, otherwise the use of this application will not be successful.

Cooperative Learning Whenever students work together to solve a task, some factors can affect student's performance, e.g. a confusing task description. A discussion is no exception to this. The two main sources that affect student's performance are Coordination Loss and Motivation Loss. Therefore, it is vital for every discussion application to consider these sources for Process Loss and finds ways to minimize them.

4.1.2 Teachers Perspective

The main concern of the teachers is how to create a lively discussion with the students. Especially, how to motivate the students to participate in an active manner. It is possible if not probable that many students will only contribute one or two arguments and most of them will do this shortly before class. If this is the case, it could result in a very shallow discussion.

Another concern for a teacher is, what if a student feels the need to add an argument, so he or she has participated in the assignment even if all reasonable arguments are already discussed. This could lead to students adding meaningless or redundant arguments. In turn, this could harm the discussion flow because students have to read the same argument over and over again, making the discussion more confusing.

For the teachers, it is also important how the discussion is managed. Therefore, if students misbehave, they need an easy way to notice it, so they can intervene.

At last, it is also vital for the teachers that one can easily export the results of the discussion for learning or to use in class.

4.2 Current Situation

Before we have a look on the actual concept it is important to consider the current situation and what can already be achieved with *D-BAS* and *discuss*.

4.2.1 D-BAS

Present Situation In its current form, a teacher can host a discussion about a topic from class, e.g. “Should vaccines be mandatory?”. He or she creates a private discussion for the topic.

Following, the teacher has two possibilities; add arguments that the students should discuss, or leave the discussion empty and the students add their own claims for the discussion.

The teacher then sends the invitation-link to all students by e-mail, and they can start the discussion by arguing about the existing positions or state their own.

After the discussion has ended, the teacher can integrate the results of the discussion in his or her teaching by discussing the resulting argumentgraph or certain contributions of students who made a compelling argument.

If the teacher requires additional features like teams, he or she has to group the students by hand and explain to them that, e.g., only one team is allowed to agree to positions, and the other team is forced to disagree.

Requirements Fulfilled Some requirements, explained in the previous section, are at least partially fulfilled by the current implementation of the time-shifted dialog with *D-BAS*. In Section 4.1.1, one crucial point is that every digital learning application has to make use of the medium’s possibilities and support high-quality learning activities. Section 3.2 explains

that learning and discussing with other people enables interaction and negotiation, promoting a deep understanding of the topic. Also, when vocalizing to a peer, students put more effort towards clarity. Therefore, we have a high-quality learning activity. Additionally, in Section 3.2, it is explained that if students have time to work out their idea, they produce more of them.

On the one hand, the time-shifted dialog enables a high-quality learning activity due to the discussion aspect of the dialog, and on the other hand, it gives the students time to elaborate their argument, resulting in more and better ideas due to the time-shifted aspect.

However, *D-BAS* does not make use of the possibilities of Digital Media like application that allow the students to embed YouTube videos and pictures in their post. Nevertheless, *D-BAS* gives structure to the discussion by using Digital Media to provide an argument graph. This allows the user to walk through the discussion and follow the argumentation he or she is interested in without having to read all arguments.

It is also explained in Section 4.1.1 that Coordination Loss is a possible source for Process Loss for cooperative learning. However, this is no problem in the case of a time-shifted dialog because the students do not communicate directly with each other, but exchange arguments over the system itself. It presents the student with arguments made by other students and allows him or her to argue for or against it. This given structure limits the sources for Coordination Loss because students do not communicate directly with one another, and therefore, they do not need to manage coordination.

Another requirement that is already fulfilled is the possibility to manage the discussion. If a student misbehaves, other students can flag the argument, and the system informs the teacher, so he or she can intervene by admonishing or punishing the student.

Open Problems Some requirements, mentioned in Section 4.1.1, are still open.

One of the most critical problems for the educational research perspective and the teachers is the student's motivation to create a lively discussion, which is also an open problem for *D-BAS* in a usual online discussion. Additionally, students do not participate in a discussion for class voluntarily. Therefore, they are possibly even less motivated to argue as a user in an ordinary online discussion.

Another issue of the teachers, still open, is that students add empty or duplicate arguments because they feel the need to participate even if they cannot contribute something meaningful. After all, the discussion is homework, and this creates the impression that the student has to add own posts to the discussion.

Also, it is important for the teachers that students can export the discussion results to learn with them. Currently, they can only start the discussion over and comprehend what argument the system presents for each position.

4.2.2 *Discuss*

Discuss allows students to argue directly about the content of the text. For example, the teacher hands out a poem or text passage. The student highlights the part he or she wants to argue about and then creates a new argument based on the highlighted text passage.

Requirements Fulfilled The argumentation core is the same as used by D-BAS. Therefore, all requirements which are already fulfilled by D-BAS are also fulfilled for *discuss*.

Open Problems *discuss* also has the same open problems as D-BAS. However, it has one significant additional problem. In the current version, there is no easy to use infrastructure which allows the teacher to upload any texts so the students can have a discussion about it. Therefore, in its current form, *discuss* can not be used in schools.

4.3 Concept

This section explains the concept of the use of a time-shifted dialog to support the educational environment.

The first subsection describes how a time-shifted dialog could be used in general as a learning tool for discussions. The second subsection considers the differences between a regular online discussion and the discussions held in schools; how these differences would affect the

discussions and how to deal with them. In the third subsection, we outline the necessary and reasonable infrastructure for teachers and students. Furthermore, the following subsection is about how to motivate students to participate and create a lively discussion, so the learning results are maximized. In the last subsection, we take a look on how an example use in class might look like.

4.3.1 General Concept

First and foremost, the system will be used in schools to provide the teacher with a high-quality learning activity. Due to this, the application is primarily work for the students. We can hope that the motivational aspects and the usage are so intriguing that the students will discuss more extensively than expected. However, this not very likely. It would be illusionary to assume that the software will make every student to a model student who devotes all his time towards the school. It makes more sense to treat the discussion as homework, and not as an activity that the students practice on their own time. This way, it is more likely that the students have a satisfying discussion, and the learning goals are fulfilled.

Therefore, the teacher will give the assignment to argue about specific positions or a particular topic for the next class. We anticipate the worst case and expect that most students will not do their homework immediately after school, or even the same day. Most of them will do their homework close before the next lesson. This has the consequence that many students will not find arguments in abundance from other students when they do their homework. Most of them will presumably work primarily with the arguments the teacher added or add an own position. Due to this, the discussion will be shallow at first. The teacher can compensate this by picking up the results of the “first round” of the discussion and give the students a new perspective of the topic by discussing arguments of students or repeat some important information about the topic. Following the lesson, the teacher will give the assignment to continue the discussion and argue about the input other students contributed. This schema can be repeated until the learning goals are accomplished.

As time goes by, the students should get more comfortable with discussions and the software, so the teacher can let the students discuss more on their own. For example, the discussion is scheduled for two weeks, and the students have to conduct a complete discussion in this time. According to [Vog+17], if students engage repeatedly in a collaborative activity and

the strict guidance is gradually removed, the Internal Collaboration Script of students can be modified to behave better in similar situation (Section 3.3). This means that the students should over time become better in debating and more engaged in the discussion. However, this can only work if most of the students add more than one or two arguments. In return, this freedom can give the students more self-determination, which in turn can positively affect the intrinsic motivation of students. According to [RVF20], intrinsic motivation is determined by basic psychological needs *autonomy*, *competence* and *relatedness*. If the students can successfully conduct a discussion on their own, it strengthens their feeling of autonomy and competence.

As stated above, the system is first and foremost part of the classroom and homework. Therefore, the teachers are worried that the students might feel the need to add arguments, so they have participated even if these arguments do not contribute something meaningful to the discussion (Section 4.1.2). It is beneficial if students want to contribute own input. This creates a lively discussion. However, if the arguments are shallow they probably will do more harm to the discussion than they will contribute because they make the debate more complex.

In *D-BAS*, it is possible to agree with another argument by selecting, “In my opinion, this statement is correct and it convinced me.”. It is a valid input for a discussion if one acknowledges the argument of a peer. Otherwise, users might focus too much on their own argumentation, missing out input from others. Therefore, it is also a valid option for a contribution in this concept. However, this option creates the possibility for students to take the easy way and just acknowledge the arguments of others and not contribute any own arguments. This has two harmful consequences. On the one hand, students are not achieving their learning goals if they do not contribute own input at all. On the other hand, other students, who would like to debate, are harmed because there are not enough arguments for them to have a real discussion and therefore their motivation is negatively affected. A solution for this problem could be that students, who acknowledge the argument of fellow students, have to write a short justification why they think that this argument is convincing. Even if this is just a rephrasing of the argument, the student has recapitulated it, and this will help him or her to achieve the learning goal. Additionally, some student might be motivated to put more effort towards finding a new insight to the topic, so he or she can contribute an argument at last because if they have to write something anyway, they might write an own argument.

4.3.2 Course of the discussion

One of the key differences between a discussion in schools and a regular online discussion is that in school, we have a certain number of users who do not change for the next discussion. This gives us new opportunities in terms of motivation (Section 4.3.4), but also new challenges in terms of creating a lively debate. In a typical classroom are between 20-30 students. This creates the problem that if we have too many positions, the discussion could become very thin because too few students argue over each position. Hence, it would make sense to limit the number of positions students can add, so more students argue per positions.

Another solution would be that the students can not add any positions. Therefore, they could only discuss claims made by the teacher. He or she could use this form of discussion to put the focus of the students towards certain argumentations.

Still, this is a decision that is best made by the teacher depending on the learning goals and how experienced the students are with discussions.

4.3.3 Infrastructure

This subsection is divided into two paragraphs. The first paragraph describes the infrastructure which is necessary or at least reasonable for the needs of the teacher and the second paragraph for the needs of the students.

For the Teacher

As described in Section 4.1.1, one of the most important aspects of a successful learning application is the teacher's conviction. If the teacher is not convinced, then the application will most likely not be successful. As a consequence of this, the software must be easy to use, so that the teacher can administer the discussions for his or her different classes without too much effort.

Hence, it makes sense to have a digital classroom for each course, so the teacher can easily

manage all discussions for a course along the semester.

The teacher creates the classroom at the beginning of the semester and adds all students of the course. Every time he or she creates a new discussion all students of the course automatically become participants. This provides an overview of all previous and current discussions for the course (Figure 4.1). Especially, if the teacher wants to use *discuss*, he or she needs an easy-to-use interface that allows uploading and managing texts for different discussions and classes.

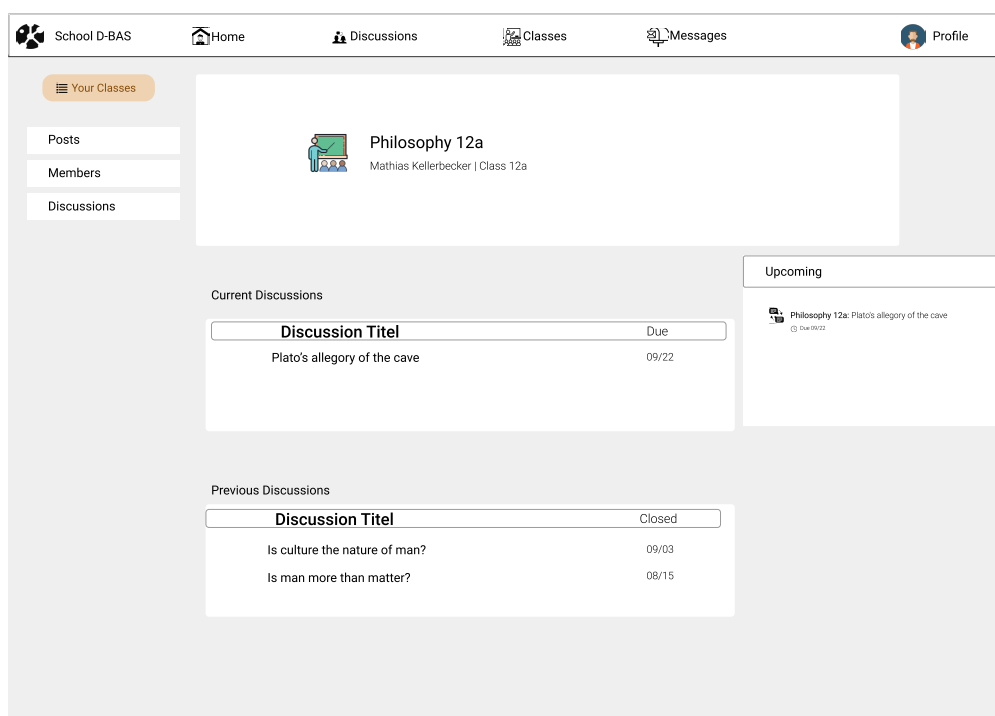


Figure 4.1: An overview page for the classroom with all current and previous discussions

A digital classroom is also optimal to collect all information the teacher needs. Hence, the discussion is part of the school; the teacher needs a possibility to get detailed information about the students. How do they participate? How many arguments have they contributed? Which arguments? In the real classroom, the teacher can easily observe the student's behavior and take notes. In a digital classroom with discussions, it is not that easy. The teacher would have to evaluate every argument for every student in the argumentation graph and take notes, which is incredibly time-consuming. Therefore, we need a dashboard with detailed statistics about the student for every discussion. A classroom would allow the teacher to get the information from the dashboard for every student for every discussion over the course of the semester. Figure 4.2 shows how a dashboard for a student might look like.

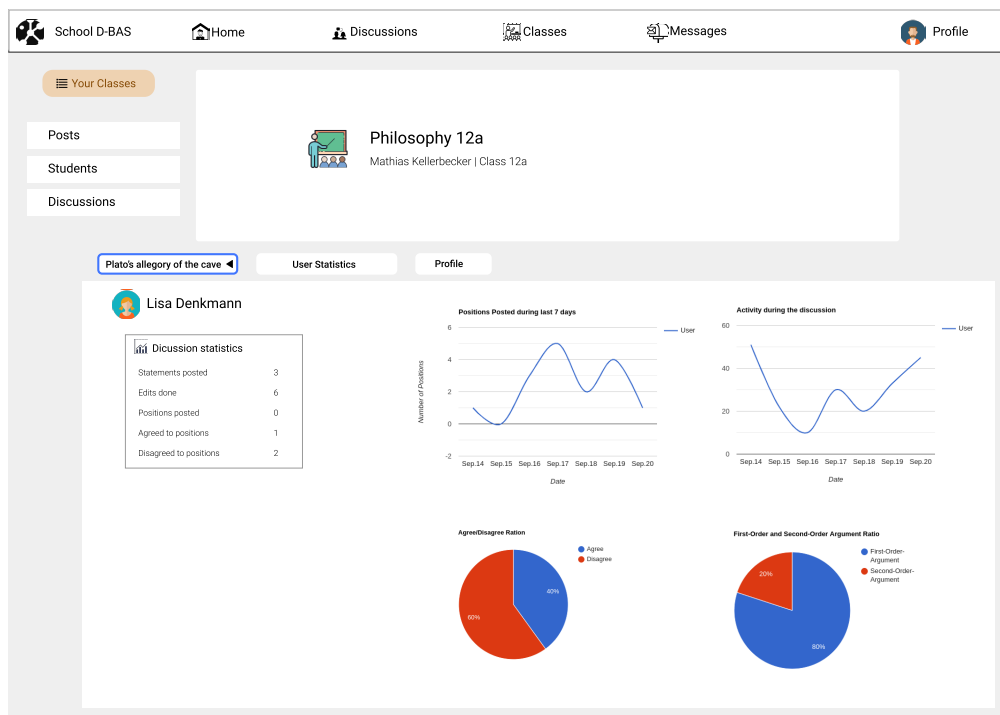


Figure 4.2: This page shows statistics for a student for a specific discussion or a general overview

Additionally, the teacher can use this information to see if a student misbehaves. Assuming the student adds a lot of statements in a short time and this is in contrast to his or her typical behavior, it is an indicator that the student tries to interfere with the discussion by spamming. Or, if a student receives much more counter-arguments than usual he or she might be bullied by other students. In such a situation, the teacher can intervene by sending a private message to the students and admonish them to behave. If this does not work he or she can make the student accounts to read-only user until their behavior changes, so they do not interrupt the debate anymore.

For the Student

The digital classroom can also be beneficial for the students. It helps him or her to organize the deadlines for the different discussions of various classes. Additionally, it allows him or her to monitor his or her progress in each class over the semester.

Still, the most important feature for students is accessibility. Mobile devices offer the pos-

sibility of portability and individuality, which a desktop based computer can not offer. Research has shown that mobile support can be beneficial for the student's learning achievements, learning attitude, and peer interactions [SYL17]. For this reason, an application for a regular use in class needs an app-based access.

As stated by the teachers (Section 4.1.2), the students also need an easy way to use the results of the discussion to learn for their exam. The application offers two possibilities for this. On the one hand, the student can access the discussion after it is finished and can follow the argumentation for different positions without adding new arguments. On the other hand, the student can export certain arguments that he or she thinks are important to learn. For this, we propose an interface where the student can select the argumentation he or she would like to export by selecting the statements in the argument-graph. These arguments are the presented in dialog form that can be downloaded.

4.3.4 Motivation

One of the most important issues for the success of a digital learning application explained in Section 4.1.1 is the motivation of the learners.

Due to the reason that there is no single solution for motivation, we present two possible approaches for it and explain their benefits and downsides.

However, one should keep in mind that every motivation strategy is no magical solution that all students are becoming model-student. If a student is not willing to participate in class at all, it is out of scope of this work to find a solution for this. This is a problem that only the teacher can solve.

Social Media Approach In this approach, we use ideas borrowed from the social media domain. [GL16] has shown that incorporating social media into teaching can have multiple benefits. On the one hand, teachers were able to monitor students performance more easily, and on the other hand, students who worked outside of schools on their own time, interacted and contributed with others, and became more autonomous.

In the approach the student will have a profile, and he or she can follow other students to get

updates about his or her friends and classmates (Figure 4.3). The updates are displayed in a newsfeed that shows all activities of the discussions and the other profiles.

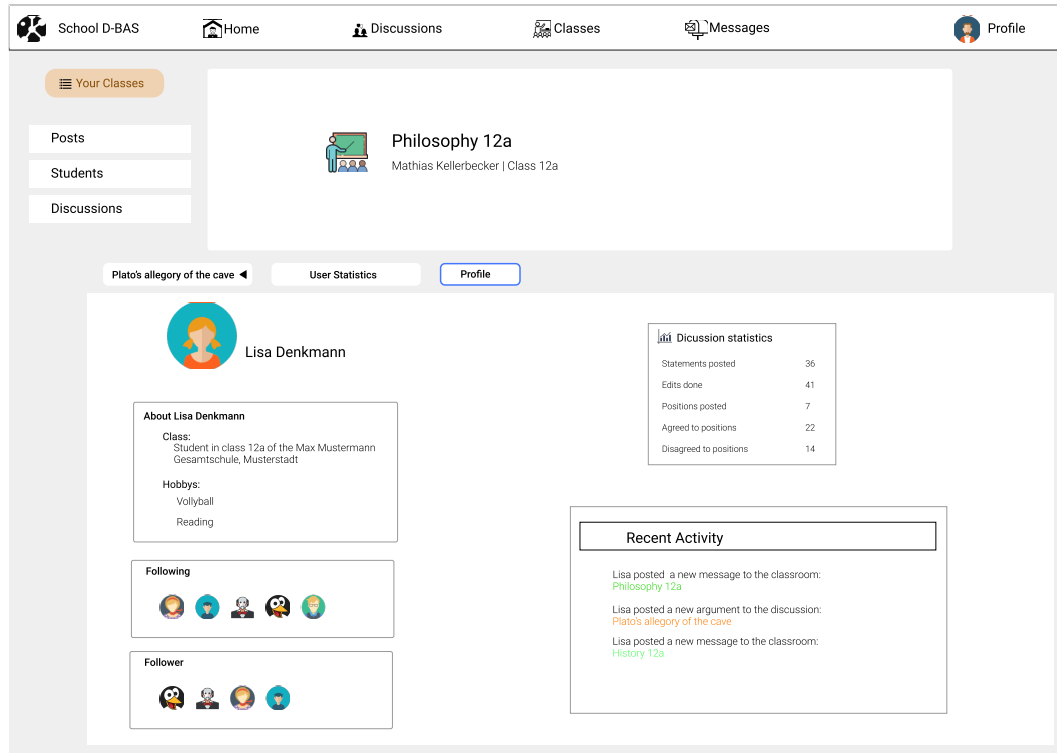


Figure 4.3: This page shows a student profile for the social media motivation strategy

One aspect of social media sites is that the user can personalize their site like the profile name, profile picture, and personal information. The profile can include information about the discussion behavior of the student, like the number of discussions he or she participated in or how many arguments the student has contributed. Students could compare these statistics and have a competition about who contributed more arguments which were discussed more frequently. This could lead some students to be more motivated similar to a gamification approach where the students would compete with each other. Of course, the profile should only show the information the students want to be public. Some students might not want to participate in a competition about their statistics, or they are afraid that some students might make fun of them. The personalization of the profile and the detailed statistics about the student can increase the affiliation between the students and his profile, and thereby increase the student's motivation to participate in the discussion.

One possibility to embrace the *social* aspect of social media more can be that the students could help each other to create more and better arguments. This way, they do not argue

against each other, but with each other. If a student reads an argument, and he remembers that one of his friends knows a lot about this topic, he or she can flag the argument for this student, so maybe he or she has another point of view to add (Figure 4.4). This cooperation can then be mentioned in the timeline of other students. Another way to collaborate would be if a student has an idea for an argument, but he or she is not sure if the argument holds. Therefore, he or she asks a friend for help, and the friend can give some input on the argument. With these features, the student might not feel isolated in the discussion, because they can ask their friends for help if they are stuck or just not sure about their argument(Figure 4.5).

This can help students who have problems to participate in a discussion to achieve a feeling of competence early by contributing an own argument, and that could increase learners motivation [RVF20]. On the one hand, this can lead to that more students contributing arguments, who would not have contributed any due to a lack of self-confidence. On the other hand, this can also lead to fewer arguments because it takes time for the friend to review the argument and maybe many weaker arguments will not be posted. Which one of them is correct, can only be shown in a study.

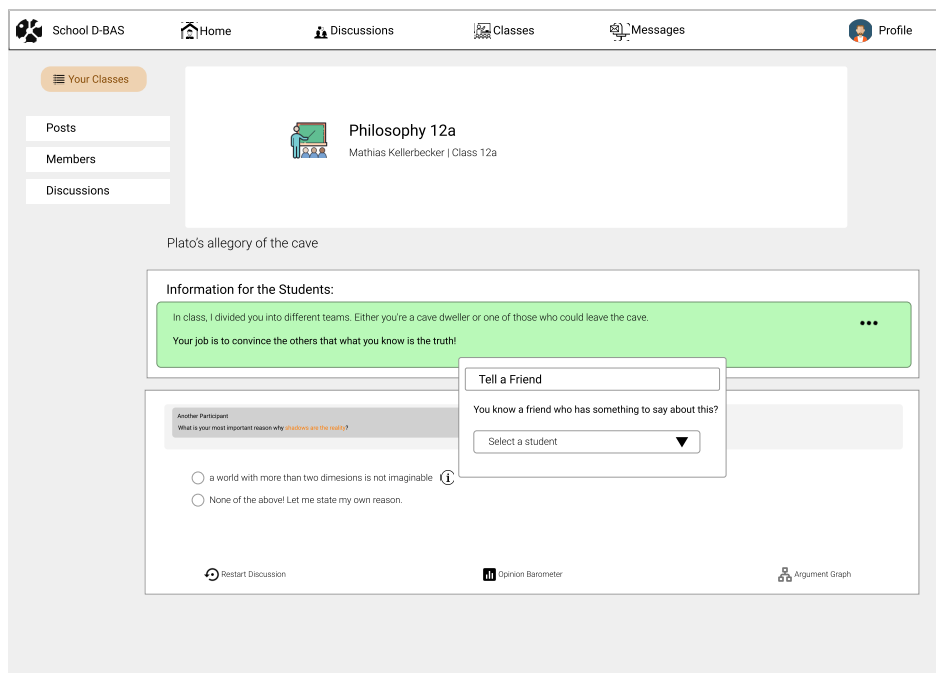


Figure 4.4: If a student knows that a friend of him or her knows something about this argument, he or she can send a notification to him or her.

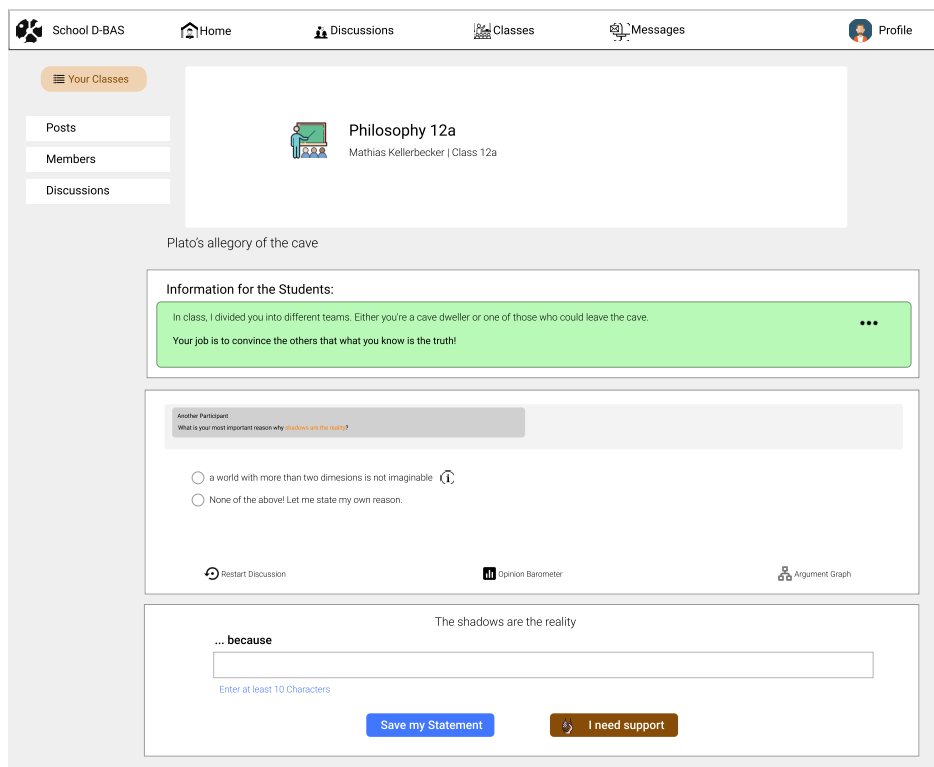


Figure 4.5: If a student is not sure about the quality of his or her argument. He or she can ask a friend for feedback.

Gamification Approach Studies have shown that gamification can shift “students attitude in a positive direction and subsequently increasing performance” [Smi17]. Thus, gamification can be “very effective if used wisely” [Dre19]. However, the approach should be carefully constructed because results have shown that an increasing number of gaming features can increase its complexity, and therefore, only a few selected features should be proposed to the learners [MLG17].

The main focus of this gamification approach would be the competition between students who can achieve more points. They can be positioned on a leaderboard for the course depending on their points (Figure 4.6), and after a certain amount of points, the students will reach a new level or gain a new achievement. Additionally, to the usual way of getting points by discussing, the teacher can grant bonus points and achievements for arguments that give a new sight on the discussion or are in another way compelling.

The usual way of gaining points would be that students argue with other students. Every time student *A* creates a new argument, he or she receives 10 points. However, student *A* should be

convinced to add a compelling argument. If most other arguments, argue against it, student *A* will lose 20 points for providing a poor argument. Therefore, he or she should put some effort into the argument instead of adding one that does not hold. Nevertheless, the points are not completely lost. If the teacher decides that the argument of student *A* does hold, he or she can return the points back.

If another student *B* then gets confronted with this argument, and it convinces him or her, student *A* will get another 30 points for a good argument, and student *B* gets 5 points for acknowledging the argument of a peer. This encourages students to not entirely focus on bringing in own arguments but also noticing others. Also, this approach allows students who have problems contributing own arguments to participate in the discussion by acknowledging arguments of others. Therefore, they can gain points themselves, so they have the feeling of progress. This is important, because if students fall behind too much it can lead to even less motivation and following less contribution. But if they want to reach a high positioning in the leaderboard, they have to contribute own arguments.

If student *B* thinks the argument of student *A* is good, but he or she wants to state an own reason, student *A* will get 20 Points for the compelling argument, and student *B* will receive 10 points for the new argument plus 5 points for acknowledging an argument of a peer.

However, what if students collaborate to trick the system to get a high placement in the leaderboard? For example, two students could easily work together by one student adding an argument, and the other student stating that it convinces him or her and then the other way around. Such an attempt is destined to fail because the students are not alone in the discussion and other students would argue against them because they add meaningless arguments. As a result to this, the students lose their points again. Also, the teacher notices their fraud attempt easily in the statistics because the students differ from their normal discussion behavior because they add much more content as usual.

Obviously, this approach benefits from the statistics dashboard, mentioned in Section 4.3.3. Additionally, if the student can see their progress they can monitor their development, and how many points are missing until the next achievement or a higher position on the leaderboard (Figure 4.7).

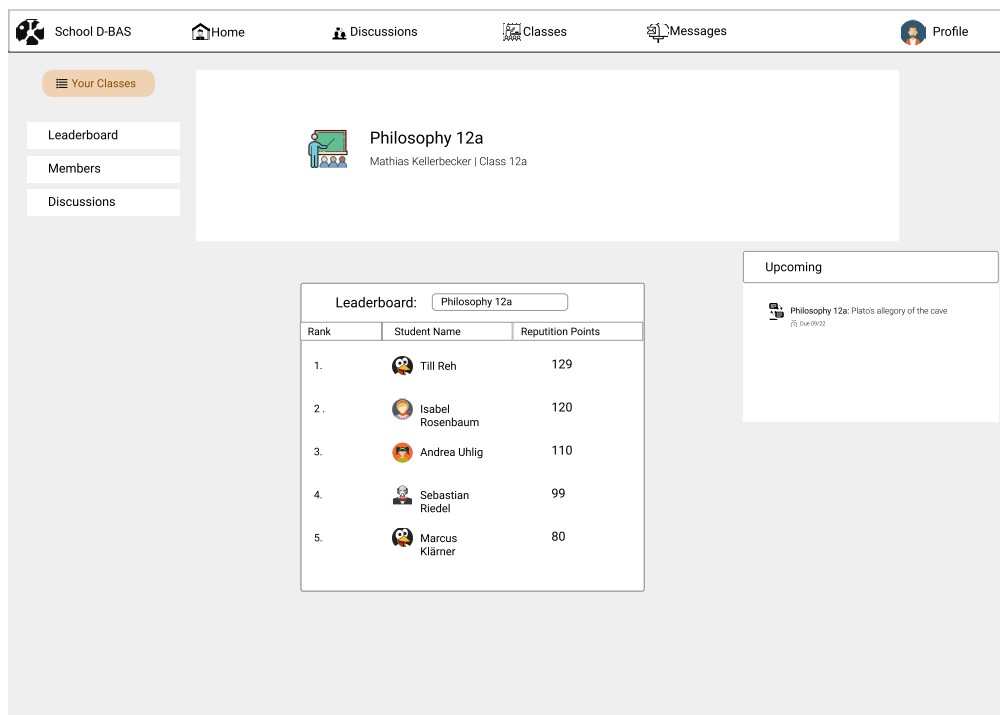


Figure 4.6: A leaderboard for the classroom showing the five best students

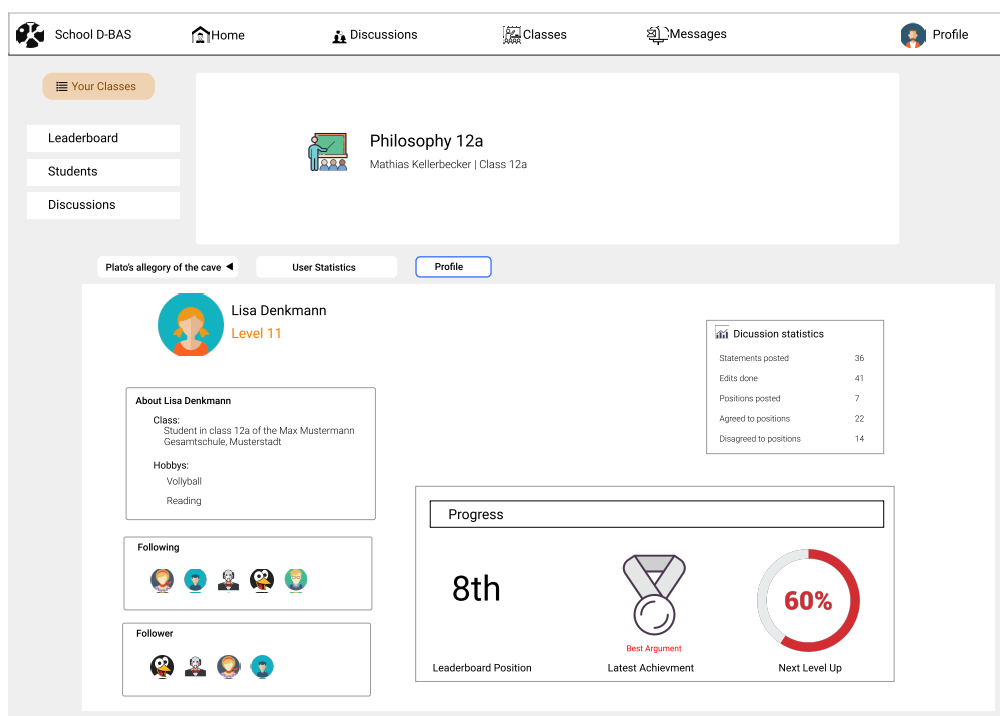


Figure 4.7: A student profile with gamification elements like achievements, Level Up etc.

4.3.5 Example Use in Class

This subsection describes how a typical use of the time-shifted dialog in class looks like.

The teacher wants the students to discuss a particular topic of class. The theme of the discussion should introduce a new topic to the students. For this purpose, the teacher prepares a discussion with some predefined arguments for the first lesson for the new topic. With these arguments, the teacher gives the students a starting point for the new topic.

In the first lesson, the teacher then introduces the topic and explains all necessary information, so that every student can formulate own arguments.

For the homework, the teacher sets the task to discuss given positions until the day before the second lesson so the teacher has enough time to process the results of the discussion for class. Most of the students will not do their homework until shortly before class. Therefore, these students do not find many positions by other students. In consequence of this, they most likely only discuss arguments added by the teacher.

The teacher then reviews the resulting argument-graph the day before the second lesson. How has the discussion evolved? On what positions do the students focus the most? Are there specific arguments that stand out the most? In the second lesson, the teacher integrates this information in his teaching to give the students another perspective on the topic. First, they talk about how argumentation has evolved. What argument was a reaction to another, and why? This way, the students learn about the course of discussions. The teacher can also show the students specific patterns in the discussion and discuss why that happened. E.g., many students focused on one position and not on the other. If the teacher discusses this with the class, the student can reflect upon one's actions why he or she has focused on this position and not the other. Notably, in classes with controversial topics, this is a valuable feature. Following, the teacher repeats certain aspects of the topic because some students used a few aspects wrong in their argumentation, and no other student argued against it. The teacher does not point out the argument, but he or she emphasizes the vital information so students can argue against it in the next round of the discussion.

For the third lesson, the teacher gives the task to continue the discussion. Now, the students have to include the arguments of their peers into their argumentation. In the following class, the teacher again includes the results of the discussion into the lesson and discusses the argu-

mentation graph in more detail. He or she picks out particular arguments that are interesting in some way. Some might bring a new perspective, and others are well formulated. They discuss why these arguments are compelling and how one might argue against them, so the students learn how to improve their debate skills.

Chapter 5

Discussions in Continuous Media

After we have dealt with the concept for the use of a time-shifted dialog in the previous chapter, we will now take a look at a possible further interface. The interfaces so far *D-BAS*, *discuss*, and a *pro- and contra list* do not use other media apart from texts. Yet, other approaches for discussions in schools (Chapter 6) show that Digital Media offer many more opportunities.

This is why we present a new usage for the time-shifted dialog, the discussion in continuous media like YouTube¹.

5.1 Interface

If we take a look at *Discuss* again, we see the advantages of such a system clearly. Instead of having a list of comments beneath the article, a structured discussion takes place in the text itself. This way, the debate is not artificially separated from the text. The user can interact with the text directly and uses the text passage for his argumentation.

We can transfer this idea from comments beneath an article to comments beneath a continuous medium like YouTube Videos or podcasts. Here too, users have a demand to talk about what they have seen or heard. This creates the same problem of an unstructured discussion like comments under newspaper articles have. Users can try to debate here by using a

¹<https://www.youtube.com/>

timestamp to refer to a scene in the video or type a quote, but this is rather unsatisfying. Additionally, it makes the debate more confusing because another user reads the comment and switch back to the video to understand what the author of the comment is talking about.

As an alternative, we present an interface for the time-shifted dialog in continuous media. Here, the user marks the sequence he or she would like to talk about and use it as a reference for the argument, like in *Discuss*. These sequences should be short, e.g. 10 seconds. Otherwise, it becomes unclear what the argument is referring to in the sequence exactly. A user who watches the video will note a mark on the timeline of the video, indicating a debate about this sequence. When the video reaches this mark, a tree appears. This tree shows the number of positions and how many pro and contra arguments users already contributed for the positions. By this, the user gets an impression on how controversial the sequence is (Figure 5.1).

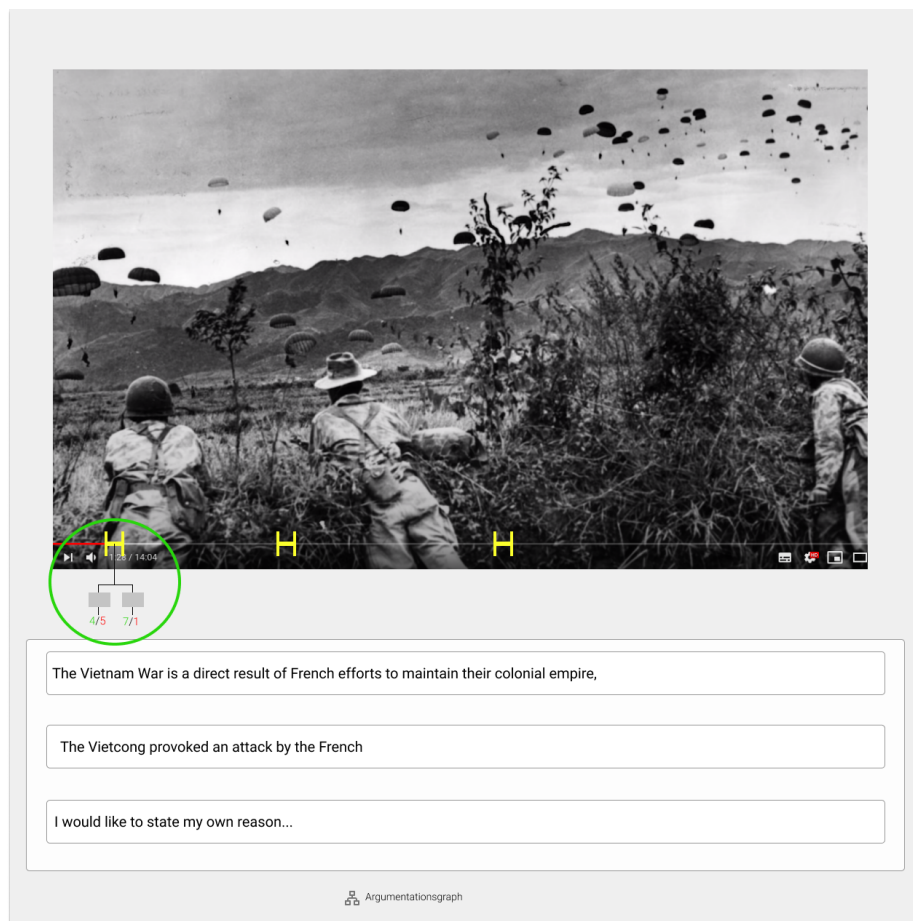


Figure 5.1: Interface for the use of a time-shifted dialog in continuous media with argument tree

Once, a user wants to contribute an own argument, a popup windows opens where the user can write his or her argument (Figure 5.2).

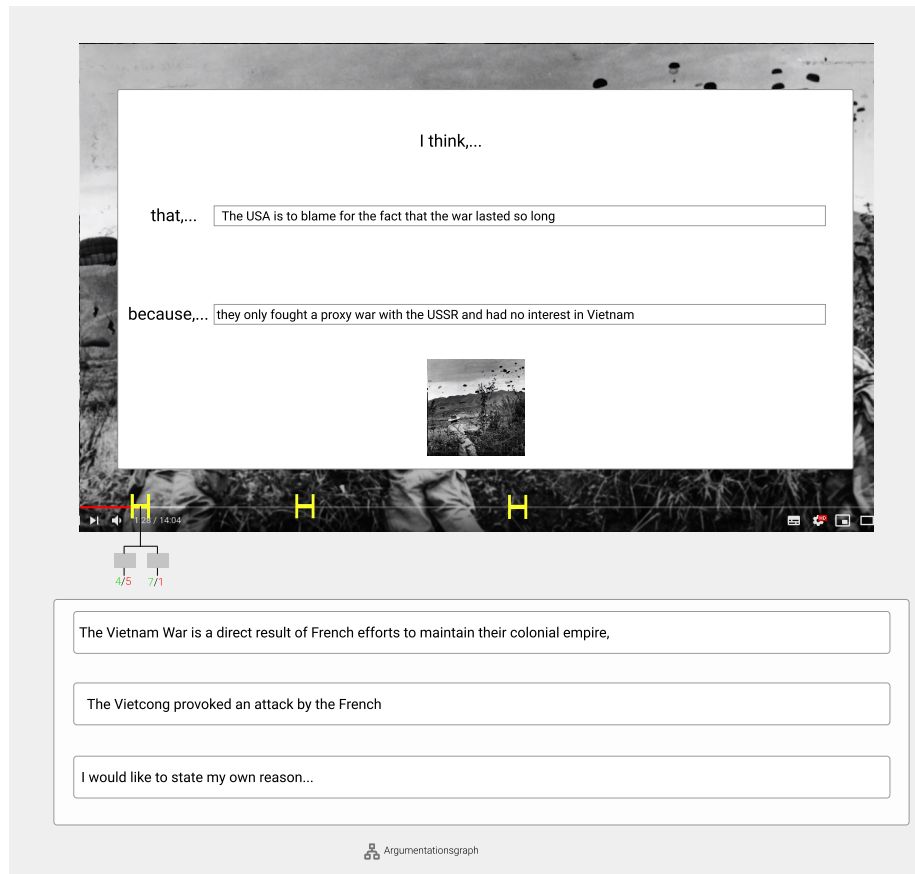


Figure 5.2: Contribute an own argument for the video

The discussion then takes place below the video. In contrast to a comment section, the user does not have to switch between the comments and the video. If the video is not in full screen mode, the user can keep both in view (Figure 5.3). Therefore, the time-shifted dialog allows the user to navigate the debate focused.

When the video continues and reaches the next marked sequence, the next tree for the debate will appear and show the discussion.

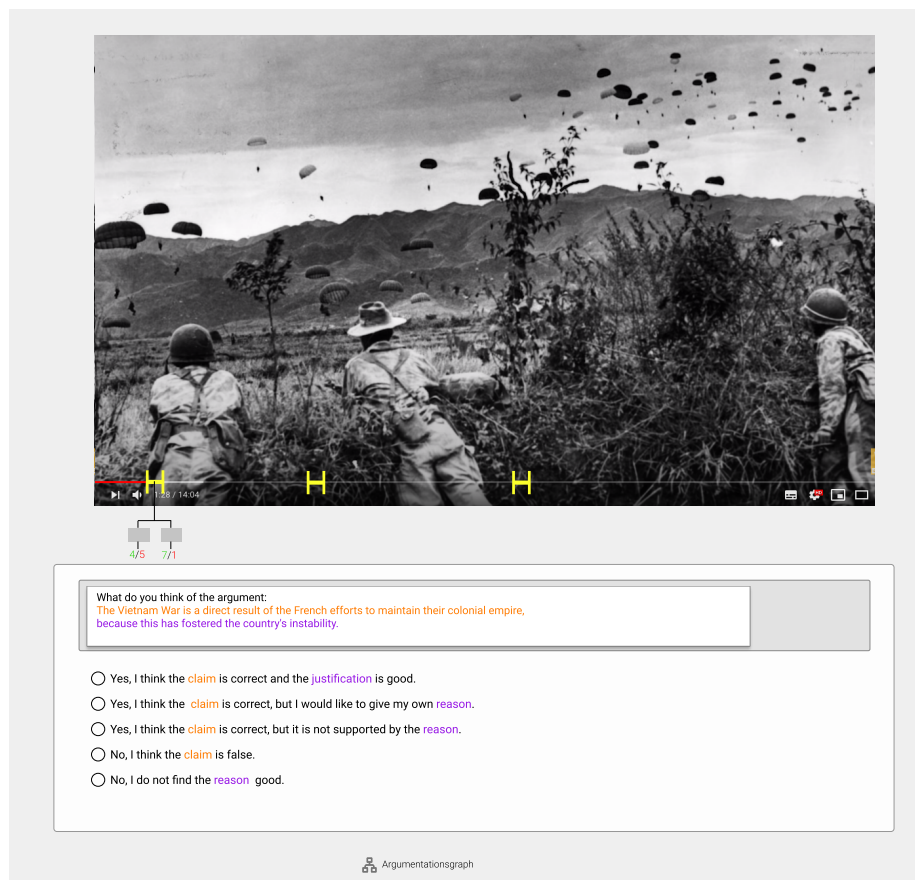


Figure 5.3: Discussion takes place below the video

5.2 Usage in Schools

The teacher can use such an interface to debate a variety of topics. On the one hand, he or she can use it to discuss documentations or blogs. Meanwhile, there is a multitude of content on YouTube, such as the Funk² network of public broadcasters ARD³ and ZDF⁴. An example for this would be the history blogs by Mr.Wissen2Go⁵. On the other hand, the interface gives teachers a tool to discuss more severe content with the student like propagandistic or conspiracy theory content. This way, student are able to take a critical look at it in class.

²<https://www.funk.net/> All links are Accessed on: 02.09.2020

³<https://www.ard.de/>

⁴<https://www.zdf.de/>

⁵<https://www.youtube.com/c/MrWissen2goGeschichte/>

Chapter 6

Comparison of Argumentationsystems

In this chapter, we take a look at different tools for discussions in the educational environment and compare them with the concept from Section 4.3.

The first six sections of this chapter describe different approaches for discussions in schools. For every approach, we have a description, a list of tools that are build upon this approach, and a section on how these tools fulfill the requirements from Section 4.1. Tools that are unique in some ways get their own section.

The last section draws a comparison between these tools and the concept from Section 4.3.

6.1 *Classical* Forum

A classical forum is in general hierarchically organized. On the top level are the most general topics, and with each descending level the topic is becoming more specific, e.g., a general topic is sport and on the deeper level are soccer, volleyball, and fencing. On the lowest level then are the discussions.

These discussions consist of a list of posts which are appended in a chronological order. Whenever a user wants to comment a post from another user, he or she can write a reply. With this, the user opens a new thread in which he or she can argue about the post (Figure 6.1).



The screenshot shows a forum thread with three posts. The first post is by Mary Cooch, asking if the Olympics and Paralympics should be combined. The second post is by David Beckham, responding that it would cause organizational problems. The third post is by Bradley Wiggins, replying that it should be done. Each post includes a profile picture, the title 'Combining the Games', the author's name, the date and time, and the text of the post. There are 'Reply' and 'Show parent | Reply' links between posts.

Combining the Games
by *Mary Cooch* - Thursday, 13 September 2012, 9:58 PM
Do you think the Olympics and Paralympics should be combined? If yes, why, and if no, why not?
[Reply](#)

Re: Combining the Games
by *David Beckham* - Thursday, 13 September 2012, 10:05 PM
I think in an ideal world they should be combined but in reality I think it would cause a lot of organisational problems and create so many more categories the games would be come unmanageable.
[Show parent | Reply](#)

Re: Combining the Games
by *Bradley Wiggins* - Thursday, 13 September 2012, 10:07 PM
Absolutely! Yes! Bring it on!

Figure 6.1: Example for a *classical* forum [Cla]

6.1.1 Tools

The following educational tools use a *classical* forum for discussion between students.

- Moodle ¹
- Ilias ²

6.1.2 Requirements

One of the most essential requirements made by Section 4.1.1 is that the application has to use the opportunities of the Digital Media to support high-quality learning activity.

On the one hand, the forum enables the students to have an online discussion and as stated in Section 3.2, discussing is a high-quality learning activity. Nevertheless, the forum does not use the possibilities of Digital Media to its full potential. Although many forums allow the user to use media like pictures in their post, the text clearly is the main medium for debate. However, if we compare this approach with more recent ideas for discussions, we see

¹<https://docs.moodle.org/39/de/Forum> Accessed on: 07.09.2020

²https://docu.ilias.de/goto_docu_pg_89967_6022.html Accessed on: 07.09.2020

that Digital Media offers significantly more possibilities by using other media or providing additional structure for the debate.

On the other hand, the forums missing structure fosters Process Loss due to its chronological order of posts. It is challenging for the user to separate different argumentations from one another and find the positions he or she would like to talk about. It is also complicated for the teacher to work through the discussion and use the results in class.

Therefore, the *classical* forum tries to use the possibilities of Digital Media to provide a high-quality learning activity. However, its missing structure and focus on text makes sure that it does not fulfill it completely.

Furthermore, this form of discussion does not offer a satisfying way to participate without contributing an argument. As stated in Section 4.3.1, it is important in a discussion to acknowledge the arguments of others if they are convincing. However, even if a student agrees to the argument of a peer; he or she has to write a post with justification. This will only add more content to the discussion, making it even more confusing.

Lastly, an advantage of this form of discussion is that it does not need much supervision. The teacher can be absent most of the time. Instead, he or she only has to intervene if students misbehave.

6.2 Posts

Using posts for discussions among students is not so different from the use of a *classical* forum. The posts of the user are appended in chronological order. The main difference to a forum is that discussion with posts start with a post or a question, and the students are writing short comments about this post or about the comment of another student to this post (Figure 6.2).

Applications like Google Classroom³ use a question as the starting point for the discussion. The teacher provides various materials like articles or videos, and task description for the

³<https://edu.google.com/products/classroom> Accessed on: 07.09.2020

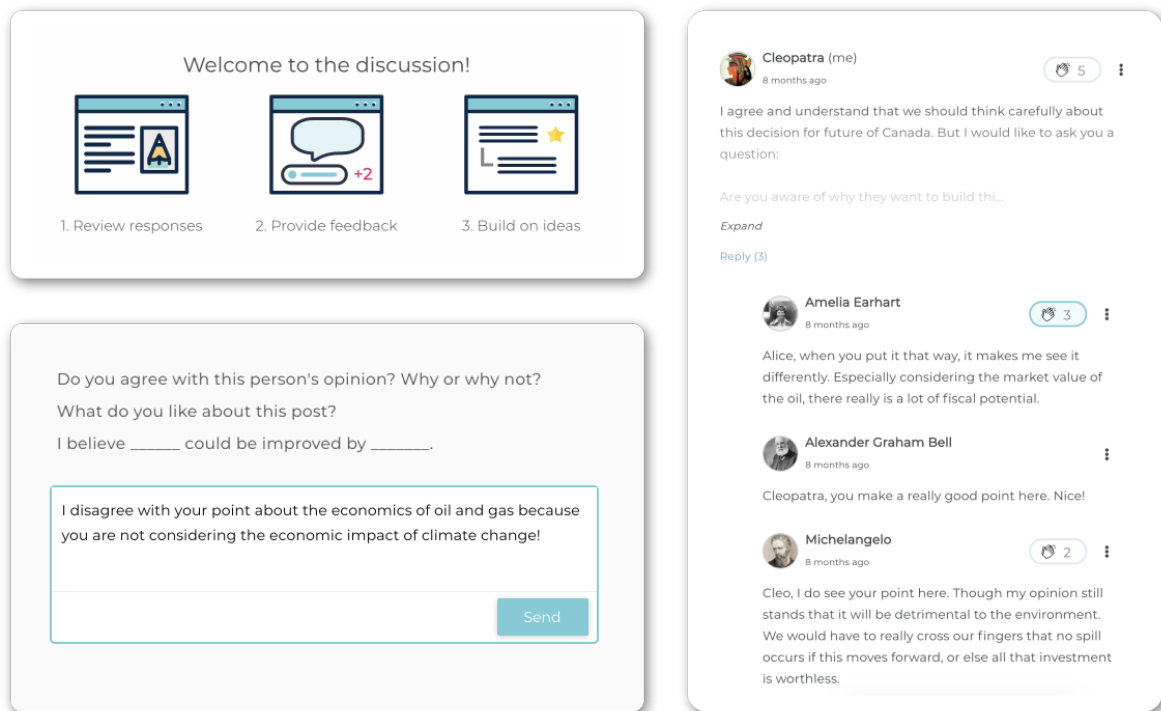


Figure 6.2: An example discussion with Parlay[Pos]

question. The students work with the materials and argue about the question and write comments on each others posts.

Some applications have additional features, like Parlay⁴. Here, the first step after the teacher's post is that the student has to write a comment to the post of the teacher. In this comment, he or she has to answer or refer to specific questions made by the teacher.

This part of the assignment is answered by every student separately and following, the students start a discussion by commenting the solutions of their fellow peers. To formulate their responses, the teacher gives the students *guided feedback questions*. By this, the response becomes more constructive and it provides more structure to the debate (Figure 6.2). A *guided feedback question* helps the student to formulate their response by providing a part of the formulation (Figure 6.2).

All these tools have the same approach to online discussions by using chronological posts.

⁴<https://parlayideas.com/how-it-works/> Accessed on: 07.09.2020

6.2.1 Tools

- Edmodo⁵
- Google Classroom³
- Parlay⁴

6.2.2 Requirements

Applications like Paraly or Google Classroom make excellent use of the possibilities of Digital Media by providing assignments with different media. For their response, students can use different media to support their response to the teacher's post and additional features like *guided feedback questions* help them improve their formulation.

However, in the discussion part students can only use text for their argumentation. They do not have the possibility to embed other media into their argument except posting a link to an external source.

Instead, students append their posts like in a *classical* forum. Therefore, the students have the same high-quality learning activity as the forum, the discussion. But, this form of discussion also faces the same problems regarding its structure and the use of Digital Media.

It also has the same advantage as the forum, the teacher does not have to be present all the time. He or she only has to intervene if students misbehave.

Lastly, a student can only participate in the discussion by adding new arguments. This has the same consequence as the forum. With every new post the discussion becomes more confusing and even harder to process.

⁵<https://support.edmodo.com/hc/en-us/sections/200909494-Manage-and-Edit-Posts>
Accessed on: 07.09.2020

6.3 Real-time Chats

In this form of discussion, students communicate directly with each other. All participants in the discussion take part at the same time and every argument a student makes is chronologically appended in real-time. There is no additional structure that helps to separate different argumentations or to organize the discussion.(Figure 6.3).

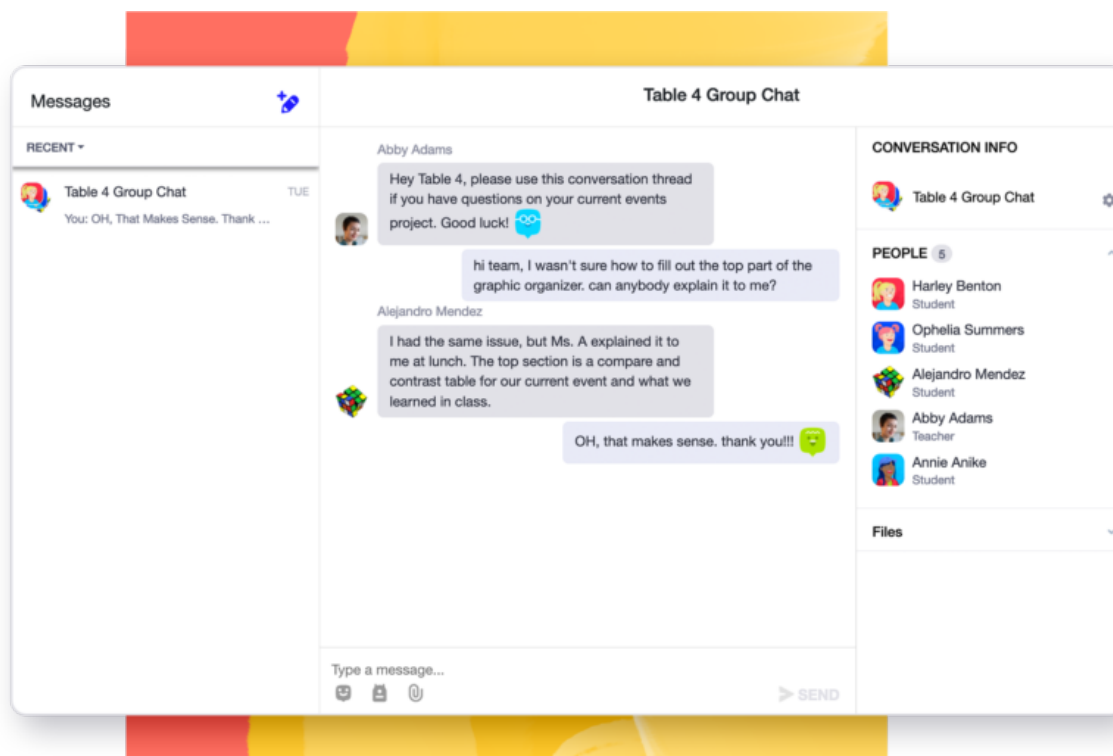


Figure 6.3: An example real-time chat from Edmodo[Rea]

6.3.1 Tools

- Edmodo⁶
- WhatsApp⁷

⁶<https://go.edmodo.com/students/> Accessed on: 07.09.2020

⁷<https://www.whatsapp.com/?lang=de> Accessed on: 07.09.2020

6.3.2 Requirements

One of the main benefits of this form of discussion is that it is close to a face-to-face discussion. The students communicate directly with each other and can quickly discuss ideas on a topic. Therefore, this form of discussion is suitable for an exchange of ideas.

Additionally, a dialog like this allows the student to support his or her argument with other media, e.g., a student can post pictures or a link to a video to back his position. However, like the post or the forum, this discussion form focuses on the text without using the possibilities of Digital Media to support the debate with additional structure.

Without this additional structure; it is complicated to separate different arguments from each other. If some students would like to debate different positions, this could make the discussion very confusing because all students write in the same chat. The participants would have to separate different argumentations from one another. Additionally, this form of communication needs constant supervision from the teacher. He or she has to monitor if students misbehave during the complete discussion. Otherwise, if students disrupt the discussion, the other students will not achieve a satisfying result.

Moreover, due to the missing structure, it is tough for the teacher and the students to reconstruct the discussion afterward and use the results for the class or to learn.

Like posts and forums, it is quite difficult for students to participate without adding more content to the discussion. If a student wants to participate, he or she would have to write a post acknowledging the contribution of another student and justify his reasons for this. This creates the same problem as in the previous discussion forms. The student adds more content to a discussion and therefore more complexity.

6.4 Kialo

Discussion software that uses a time-shifted dialog shifts the focus of the discussion from a direct exchange of arguments like the forum or posts to a more structured discussion where participants interact more with the system itself.

However, the systems that use a time-shifted dialog differ on the interface they present to the users.

One interesting approach is Kialo⁸. The systems present the user a position to discuss as the starting point for the discussion, e.g. “DC vs. Marcel: Which universe is better?”. The user then argues about this position by providing pro and contra arguments and other users continue the discussion by adding pro and contra arguments based on the previous arguments (Figure 6.4).

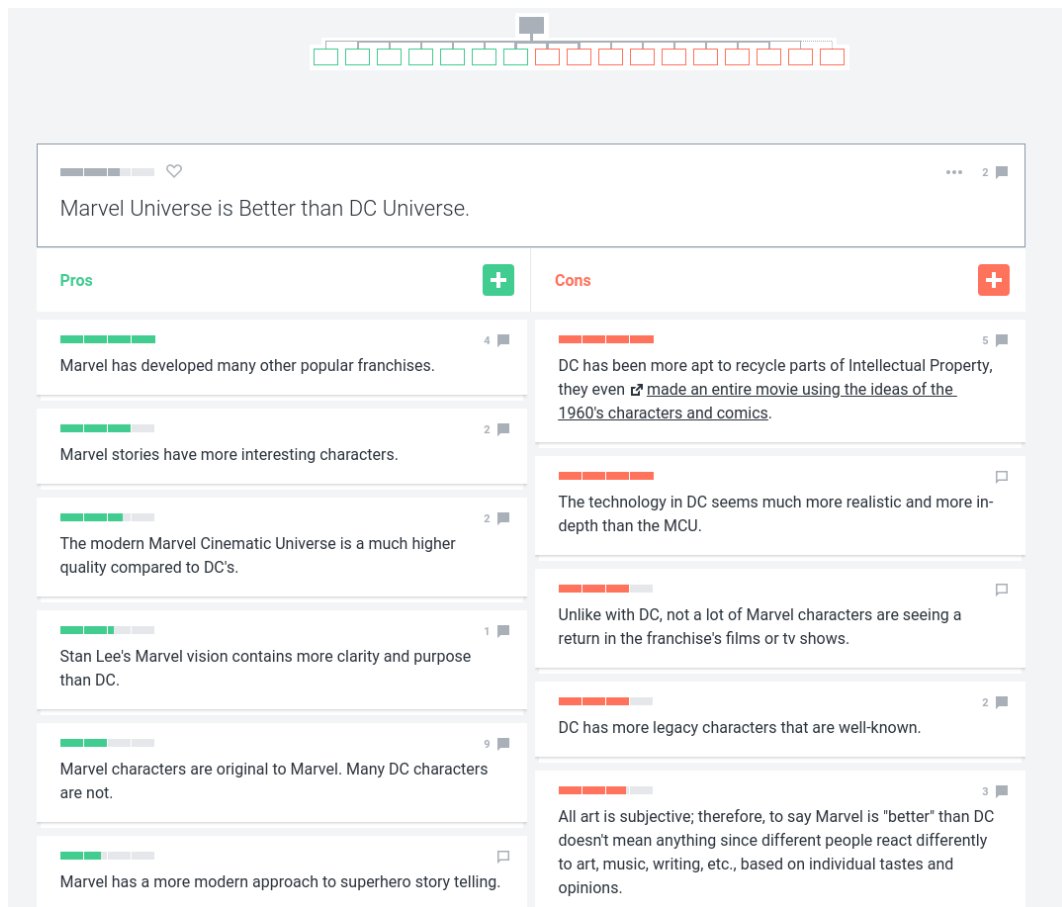


Figure 6.4: A discussion on Kialo about which comic universe is better DC or Marvel [Kia]

⁸<https://www.kialo.com/> Accessed on: 07.09.2020

6.4.1 Requirements

The application supports the educational environment with a high-quality learning activity by providing a structured discussion for the students. Additionally, educators can use the application in various learning scenarios to provide even more different learning activities. For example, every student has to write a complete discussion by himself. By this, he or she has to adopt different perspectives. Another possible use would be that the teacher writes the whole discussion, so the students get an introduction into the topic with different argumentations.

Due to the structure of the discussion, the students do not have the problem of coordination and therefore, no Process Loss due to Coordination Loss because the students do not interact with each other directly, but with the system. In turn, this could also influence the teacher's motivation positively because he or she does not have to coordinate the discussion or supervise the students as in a real-time chat.

Also, the structure of the discussion allows an intuitive understanding of the different argumentations. On every argument follows a list of pro- and contra-arguments. After it has ended, the students can go through the resulting discussion graph and understand which arguments follow each other.

However, the application does not allow students to participate without adding a new post. A student can only thank the author of the claim by giving him a heart. This is a useful feature to add a social component to the discussion, but it does not solve the problem that a user has to contribute a post to participate in the discussion.

6.5 NowComment

A different approach for discussions in schools is NowComment⁹. The students argue with one another about text passages. If a student wants to start a dialog about a passage, he or she has to mark it and write an argument. The student's posts are then appended in chronological order, and other students can reply to them, like in a forum. Because Students are able to

⁹<https://nowcomment.com/> Accessed on: 07.09.2020

discuss text passages directly within the text, they have more possibilities to express their arguments supported by the given text. However, if a student wants to reply with a text passage to an argument made in another passage, it seems that he or she has no easy way to connect those two conversations (Figure 6.5).

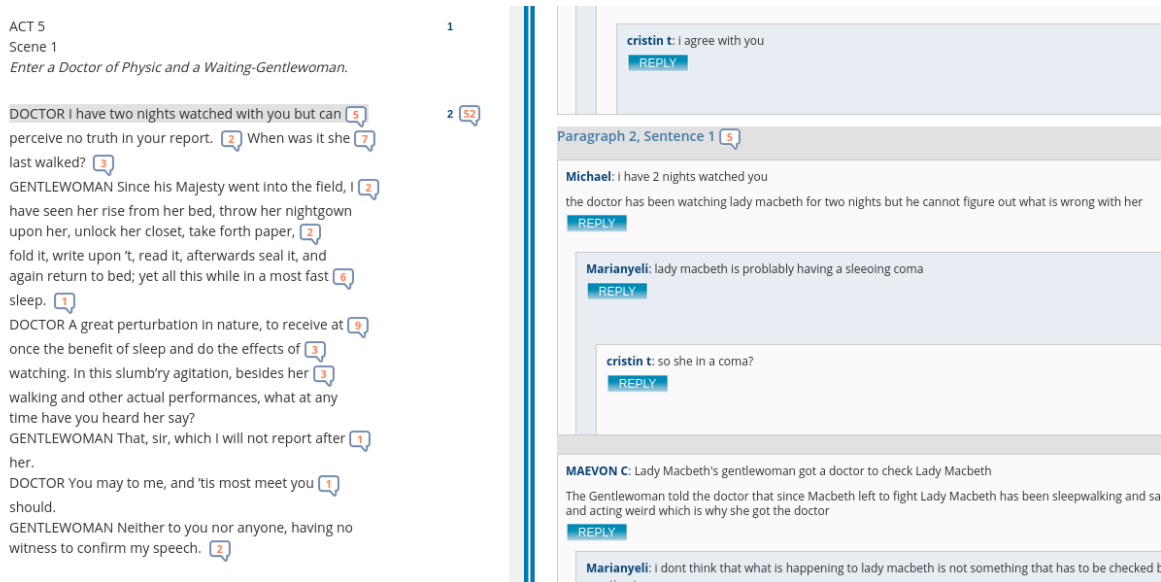


Figure 6.5: A discussion on NowComment about the play MacBeth by William Shakespeare [Now]

6.5.1 Requirements

The application gives student the possibility to directly argue in the text and support their argumentation with the text itself. Therefore, the application makes good use of the opportunities of Digital Media.

However, the application organizes the contributions of the students like a forum. Therefore, it has the same problems facing its structure. A discussion becomes more complicated with every new argument. Additionally, the discussions are bound to the text passage it refers to. We could not find a possibility to refer to another section in the discussion. This can lead to Coordination Loss because students have to circumstantial describe which other text passage they are referring to in their argument, which in turn can lead to Process Loss.

Also, like the forum, this form of discussion makes it difficult to process the discussion results for class or learning. One would have to work through every argument and try to separate the

different arguments for the same text passage.

Additionally, due to the reason that this form of online discussion uses the same structure for the dialog among students like the post or the forum; it does not offer a possibility for the students to participate without contributing own arguments, like the previous applications.

6.6 Flipgrid

Flipgrid¹⁰ is a tool for students to share their ideas and work by exchanging videos and comments for assignments.

An assignment is given by the teacher and provides the students with materials and instructions on how to approach the topic. Here, the teacher can use different media to support the understanding of the students.

Like Google Classroom and other learning applications, Flipgrid offers a classroom setting for the teacher to organize the different assignments for his class over the course of a semester.

Afterwards, the students can respond to the assignment by handing in videos of themselves explaining their solution to the assignment. Additionally, the students can use a whiteboard, video styles and emojis to enhance their video.

In response to the work of their peers, students can record own videos or write a comment, and start a discussion with the other students by posting these videos or comments. The dialog then consists of a timeline of videos.

6.6.1 Requirements

An application like Flipgrid makes excellent use of the possibilities of Digital Media. On the one hand, the teachers are able to use different media to help the students to understand the

¹⁰<https://info.flipgrid.com/> Accessed on: 07.09.2020



Figure 6.6: Response of a student for an assignment in Flipgrid [Fli](Section of the image)

topic, and on the other hand, the students have a variety of possibilities to create a response for their class by recording and editing videos.

This form of communication offers students not only an excellent way for exchanging arguments by using different media forms. It also gives them the possibility to enhance their contribution with facial expressions and gestures. A component that all other discussion software is missing. Some might use emojis to transport emotions, but these are a poor substitute.

However, even if students can make videos as a response to other contributions by students, it seems that there is no overall structure or coordination for the discussion. If one would like to argue about a specific position, he or she has to watch every video in case another student already talked about it. Additionally, we have to remember that 20-30 students are participating in the discussion and every student will record at least one video. Plus, if we want a complete discussion, the students have to record more than one video. This will result in a lot of material to process and it will be very time-consuming to gain discussion results from the videos for learning or class.

The teacher has the possibility to supervise the discussion by reviewing every video before it is posted. However, this would also be incredible time-consuming and therefore not many educators would do this for every discussion.

6.7 Comparison

Now, we compare the discussion systems from the previous sections with the concept for our own application (Section 4.3). We have to keep in mind that our system is not implemented yet and only exists as a theoretical concept. Additionally, some critique of other systems is only an assumption based on the material provided by the websites of the applications.

We will use checkmarks in Table 6.1 to visualize whether the system fulfills the following requirements from Section 4.1.

An application must use the possibilities of Digital Media and thereby support a high-quality learning activity. Additionally, the discussion should be structured by the tool to avoid Process Loss and should cause as little additional work for the teacher as possible. Therefore, the discussion should not require constant monitoring. Finally, it is important that the students have the opportunity to participate in the discussion without constantly contributing the same arguments in a new form.

✓: Applications fulfill the requirement **completely**.

(✓): Application fulfills the requirement **partially**.

✗: Application **does not** fulfill the requirement.

	<i>Classical Forum</i>	Posts	Real-Time Chat	Kialo	Now Comment	Flipgrid	Our Concept
High-quality Learning Activity	✓	✓	✓	✓	✓	✓	✓
Digital Media	(✓)	(✓)	(✓)	✓	✓	✓	✓
Structured Discussion	✗	✗	✗	✓	(✓)	(✓)	✓
Supervision	✓	✓	✗	✓	✓	✓	✓
Participating	✗	✗	✗	✗	✗	✗	✓

Table 6.1: Comparison between our concept and other discussion applications for schools

Due to the fact that all applications provide a form of discussion, it is obvious that they

support the classroom with a high-quality learning activity.

However, even if all applications use Digital Media to conduct the discussion, not all approaches use them to their full extent. Especially forums and posts highly focus on text without providing additional structure and rarely use other media to support the discussion. Even though, applications like our approach and Kialo also highly focus on text, they use the possibilities of Digital Media to give the discussion structure by providing an argumentation graph. Additionally, our new interface (Chapter 5) and *discuss* allow arguing in continuous media and texts. Therefore, we make good use of the possibilities of Digital Media with our concept by providing structure and access to different media for the discussion. Furthermore, discussion software like NowComment and Flipgrid also make good use of the opportunities of Digital Media by using the medium itself. NowComment allows the user to argue directly in the text, like *discuss*, and in Flipgrid students record videos with their argumentation.

If we take a look at how the different tools structure the discussion, we see that most of them focus on the accessibility rather the structure of the discussion. Some tools provide an interesting approach for accessing a discussion like Flipgrid or NowComment. However, these applications and other approaches like the forum, real-time chats and posts do not provide the structure needed for larger discussions. If too many students argue about the same passage in NowComment, the forum or posts, the discussion becomes confusing and if too many students argue in Flipgrid over a position, it becomes too time-consuming to process all videos and extract the argumentation. In all cases, students and teacher need too much time to separate the different argumentations from one another. Therefore, they will not use it regularly in class. In contrast, applications like our concept or Kialo provide the structure needed even for larger discussions.

Another point is how the applications manage the supervision of the participants of the discussions. Most of the applications do not need much supervision between its participants like the forum or our concept because the debate does not happen in real-time. If students misbehave, other students flag them and the teacher can intervene later. Nevertheless, there are applications like the real-time chat that need constant supervision because the exchange happens in real-time. In contrast to the forum, if users start to disrupt the discussion, it would take too long to flag the comment and wait for the teacher to intervene. As a consequence, most students would leave the discussion. Therefore, the teacher has to manage the discussion the whole time.

6.8 Summary

This section recapitulates the insights of Chapter 6.

Table 6.1 shows us that all applications provide a high-quality learning activity and make use of Digital Media, some better some worse.

However, if we take a look at the other requirements like structure, supervision, and participation, we see that especially older applications like post, forum, and real-time chats perform worse. They focus more on an exchange of messages via the digital medium than on the discussion itself. This shows that if an application is closer to the analog learning activity, the more requirements are not fulfilled. As stated in Section 3.1, a simple 1:1 transfer is barely enough.

Newer applications put more effort towards the use of Digital Media for structured discussions (Our Concept, Kialo) or the use of media (Flipgrid, NowComment). By this they provide the students with a more fulfilling learning experience.

Chapter 7

Conclusion

In this thesis, we developed a concept for the use of time-shifted dialog in the educational environment. To understand, what requirements and challenges are to expect for the use of an application in schools, we examined in Chapter 3 the existing scientific literature regarding the use of Digital Media in schools, cooperative learning, and CSCL scripts. Due to this, we were able to extract various requirements the literature deems necessary for the successful use of a learning application in schools.

Furthermore, we contacted a school to understand what requirements are necessary from the teacher's point of view. This is especially important because it allows us to get a practical point of view and consider their expertise early on in the concept.

Following, we examined in Chapter 4 to what extent *D-BAS* and *discuss* already fulfill these requirements. For this, we looked at how the existing applications could be used in schools and check which requirements are fulfilled and which were not. It turns out that the core of *D-BAS* and *discuss* do not need much adjustment, and first and foremost, school-specific problems are to be solved like how to motivate students and how to provide an easy-to-use infrastructure.

The most essential requirement left open was for the teacher to be sure that the learning goals are fulfilled. Therefore, the concept considers how the application has be used to ensure the learning goals are achieved even if the students only work minimalistic.

Another important aspect left open was the infrastructure. *D-BAS* and *discuss* already allow the user to have an online discussion. However, if the application wants to be successful, it

has to be no effort for the teacher to host the discussions. Therefore, we had to make sure that the application makes it easy to manage the various discussions for his or her different classes.

The last important aspect of the concept is the motivation of the students. They do not participate due to an inner need. They participate because it is part of their class. Therefore, we have to make sure that the learning experience is as motivational as possible. Otherwise, the potential of this learning activity might not be fully achieved.

For this, we developed two approaches to motivate students (Section 4.3.4). On the one hand, we have the social media approach. It borrows ideas from the social media domain to motivate the students by providing the ability to engage in social activity. Students can get updates about their friends' activity, or they can help each other by working together on an argument. On the other hand, we have the gamification approach. Here, students compete with each other. They can gain points by competing with other students and achieving high placement in the class leaderboard.

After we have developed a concept for the use of a time-shifted dialog, we took a look on a new interface to argue in continuous media. The idea is based on *discuss*, but instead of arguing in texts it allows users to argue in videos or audio files by marking sequences on the timeline. This gives the teacher an additional tool to deal with another kind of content like documentations or more severe like propagandistic content.

In the last section of this thesis (Chapter 6), we compare our approach with existing applications for discussions in schools. We have seen many interesting approaches on how to have discussions in schools. However, most of these approaches focus too much on direct interaction with the user and do not put much effort towards a structured online discussion. Here, our approaches clearly outperforms other applications if we compare them to how well they fulfill the requirements we extracted in Chapter 3.

Future Work The purpose of this thesis was to develop a concept for the use of a time-shifted dialog in schools. Therefore, the next logical step is to develop a prototype to see if the concept can be applied to the school.

In the first step of implementation, regular consultation with the teachers must be held so that

any features that have not proved promising in implementation can be replaced or improved. In the medium term, a field trial with students is also possible, if the prototype has been sufficiently tested with the teachers. Only then can it be clarified, which motivation strategy proves to be better.

Additionally, the concept needs to be further refined during the development of the prototype, as this concept has dealt with the general introduction of the time-shifted dialogue in schools and some aspects need further elaboration, such as:

- Possible use cases for the class.
- The formation of teams among the students.
- etc.

Glossary

Coordination Loss [SR13] define coordination loss as the failure of group members to coordinate their work or combine their output effectively. 14, 19, 21, 48, 49

CSCL script Computer-Supported-Collaborative-Learning script. ii, 3, 9, 15–17, 55

Digital Media We understand digital media as computer-based technology which present content or allows interaction with or about the content [Ste+18]. ii, 1, 3, 9–12, 21, 36, 41, 42, 44, 46, 49, 50, 52–55

Domain-General Learning [TS14] defines domain-general learning as the learning of domain-general knowledge which is knowledge to solve any problem in any area.. 15–17

Domain-Specific Learning [TS14] defines domain-specific learning as the learning of memorized information that can lead to action permitting specified task completion over indefinite period of time. 15–17

Internal Collaboration Script [RVF20] defines the Internal Collaboration Script as a flexible structure that consists of knowledge about how to interact in collaborative situations.. 16, 24

Learning Analytics [Lei+17] defines Learning Analytics as the measurement, collection, evaluation and transmission of data about students and their relations, to understand and improve the learning and the learning environment. 11

Mobile Learning In this form of digital media, learners are no longer bound to one place but are able to explore their environment, and they are supported by digital media [Ste+18].

10

Motivation Loss [SR13] define motivation loss as the failure of group members to contribute their maximum efforts to a group task. 14, 19

Process Gain According to [SR13] Process Gain occurs when a group interaction creates something that goes beyond the pooled abilities of each group member. 13–15

Process Loss According to [SR13] Process Loss occurs when individuals in a group do not perform to their potential and thereby limit the effectiveness of each group member. 13–15, 19, 21, 42, 48, 49, 52

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Ehrenwörtliche Erklärung

Hiermit versichere ich, die vorliegende Masterarbeit selbstständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt zu haben. Alle Stellen, die aus den Quellen entnommen wurden, sind als solche kenntlich gemacht worden. Diese Arbeit hat in gleicher oder ähnlicher Form noch keiner Prüfungsbehörde vorgelegen.

Düsseldorf, 28. September 2020

Jan Lukas Steimann