Providing guidance on Backstage, a novel digital backchannel for large class teaching

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Many articles in the last couple of years argued that it is necessary to promote the active participation of students in lectures with large audiences. One approach to make students actively participate in a lecture is to use a digital backchannel, i.e. a computer-mediated communication platform that allows students to exchange ideas and opinions, without disrupting the lecturer's discourse. Though, a digital backchannel, in order to be most helpful for learning, have to address the need for guidance of the users interacting. The article presents *Backstage*, a digital backchannel for large class lectures, and shows how it provides guidance for its users, i.e. the students but also the lecturer. Structural guidance is provided by aligning the usually incoherent backchannel discourse with the presentation slides that are integrated in the backchannel's user interface. The alignment is thereby asserted by carefully designed backchannel workflows. The article also discusses the guidance of a student's substantial involvement in both the frontchannel and the backchannel by means of scripts. Through the interactions of guided individuals a social guidance may emerge, leading to a collectively regulated backchannel.

Keywords Computer-Supported Collaborative Learning, Enhanced Classroom, Digital Backchannel, Social Software, Scripts

1. Introduction

Although direct instruction seems to be an old-fashioned way of teaching, it is quite an efficient way of information dissemination [1], especially in large classes. However, students in teacher-centered lectures usually take the passive roles of spectators, possibly leading to inert knowledge [2] and other adverse effects. Finding ways to overcome students' passivity has been a focal point of educational research and practical pedagogy [3-6]. In particular, enriching traditional teaching with activating and collaborative elements seems to be a promising approach. With the advent of computer-mediated communication software (CMC), and especially social media, much effort has thus been invested in the quest for computer-based collaborative learning technologies, e.g. [7,8]. When used in active and collaborative learning settings, these technologies can contribute to better learning results [9]. A well-known approach to promote active participation of an otherwise passive audience is to establish a so-called backchannel, allowing listeners to interchange simultaneously to, but without interfering with, the speaker's discourse. CMC software by which backchannels are established is thus referred to as digital backchannels. By using digital backchannels in higher education, students can give feedback to the lecturer without interrupting the frontchannel discourse [10], enquire individual opinions of classmates, and engage in virtual group discussions [11]. Recent backchannel literature reports on the use of microblogging platforms such as Twitter[1], both in academic conferences (e.g. [12,13]) and higher education (e.g., [8,14,15]). Providing short messages of typically less than 200 characters in size, microblogs allow for fast information exchange among listeners and thus seem to be very suitable for such kind of application. However, when using conventional backchannels, particularly in lectures with large audiences, the costs often overweigh the benefits. In those settings, backchannels tend to quickly degenerate to sources of mere distraction [14]. Also, feedback that is provided on the backchannel by classmates is often invaluable, and may perish in the clutter of the chat communication.

1.1 Conventional digital backchannels lack guidance

Conventional backchannel platforms barely provide means to guide the student's and the lecturer's interactions. This may not necessarily be considered as a defect, though. Conventional backchannels are based on generic CMC software and consequently do not address specific educational requirements. The provision of guidance to the required extent reaches beyond, and even may compete with, common principles of usability.

Most digital backchannels provide an unstructured chat discourse that is yet, by its nature, non-linear and incoherent. Participants usually engage in, and alternate between, multiple discussion threads [16]. Nevertheless, the chat is usually displayed as a single chronologically ordered thread of messages. Such a linearization causes the backchannel discourse to quickly get incomprehensible, and aggravates the re-orientation of both the lecturer and the student after some time

[1] http://www.twitter.com

of backchannel absence. As a consequence, both may become detached from the backchannel during the lecture. The missing structure also impedes using the backchannel discourse for subsequent learning tasks, e.g. reworking a lecture.

In a sense, conventional backchannels do not convey any educational rationale behind their uses. Hence, the communication on backchannels is mainly undirected and purposeless—without any mission statement, students get lost on the backchannel which might manifest itself in predominant off-topic communication and abuse. The lecturer can provide guidance only to a very limited extent. Since she easily gets detached from the backchannel while lecturing, she cannot monitor the students' interactions on the backchannel in a sufficient manner. Thus, a digital backchannel needs to provide means of guidance in how to make use of and how to reach the interactions sought after, viz. giving valuable feedback to both peers and the lecturer, reducing off-topic communication and abuse, and engage in exchange of ideas and opinions that is most helpful for learning.

1.2. Overcoming the lack of guidance on a digital backchannel

In [17] we presented *Backstage*, a novel kind of digital backchannel specifically tailored for the use in large class lectures by combining computer-mediated communication with elements of social media. It accounts for the demands of large class lectures, e.g. the potential necessity of private and anonymous communication, and the management of the backchannel discourse by social evaluation and collaborative filtering of messages. Akin to social media, the latter two can be seen as driving forces for an active participation of the audience. To fit the individual requirements of a lecture, *Backstage* is customizable by the lecturer to a great extent. Furthermore, in order to give performance-related feedback to the students, and to break up the lecture discourse into bearable sections, *Backstage* provides various kinds of quizzes reminiscent to audience response systems [18] that may be conducted by the lecturer during the lecture.

The chapter at hand discusses *Backstage*'s functionalities foremost in the light of guidance. The lack of structure of the backchannel discourse is overcome by aligning the communication with the presentation slides that are integrated in the backchannel. This makes the backchannel communication be navigated in a top-down fashion and therefore allows for fast re-orientation and a concise overview. The interactions on *Backstage* are laid out to fulfill educational purposes whenever reasonable, possibly deviating from pure usability principles. To support students in the substantial involvement in both the frontchannel and the backchannel, e.g. help students formulate high-quality questions, we discuss how the pedagogical concept of scripts [19,20] can be embedded in *Backstage*, and how they may positively influence the interplay between the frontchannel and the backchannel. *Backstage* provides the lecturer with various real-time data, e.g. a concise topic-related overview of the backchannel discourse, and thus serves as a decision support for the lecturer. For example, according to the data the lecturer is able to quickly recognize that there is a rush of questions on *Backstage* and react upon it in a timely fashion.

We also take the opportunity to introduce the pedagogical concept of scripts [20,21], and show how *Backstage* makes use, but also plays a role in, those scripts. We thereby highlight that the two concepts, claim-based user-interaction design and the notion of scripts, overlap and complement each other, building a bridge between the two disciplines of computer and educational sciences.

2. Introducing Backstage

Backstage is a digital backchannel for large class lectures that aims at increasing awareness and participation of both audience and lecturer. *Backstage* is customizable by the lecturer to a great extent to meet the individual requirements of the lecture at hand. Besides rich communication capabilities, *Backstage* provides comprehensive means for interactions among students for several purposes. In the following, a concise overview of the functionalities of *Backstage* is given. For a more detailed overview, the reader is referred to [17].

Backstage is built around a microblog by which students can communicate. As a key characteristic of microblogs, messages may comprise only a few ten characters. This brevity of messages allows for fast information exchange among the audience during a lecture. Besides public communication, messages can also be private or anonymous, as specified by predefined keywords at the beginning of the messages. Private messages, i.e. messages that are visible only to those users that are specified by the sender in the message, can for example be used to obtain social support by a selected group of users, prior to making the message public. Anonymous messages may help to start backchannel communication, e.g. at the beginning of a teaching term. Though, private and anonymous communication bears the risks of group dissociations and abuse. Thus, the lecturer can enable or disable these modes of communication.

Microblog messages may be rated by students receiving them using a simple rating scheme: A positive rating expresses approval and a negative rating expresses rejection. By aggregating these ratings a top-k rating of messages is determined that reflects the relevance of messages as considered by the audience, allowing the lecturer to get a concise

content-related overview of the backchannel discourse. Thus, rating provides feedback for both the lecturer and the students: The lecturer obtains an overview of what is considered by the lecture's audience relevant communication on the backchannel and a posting student gains feedback about the audience's appreciation of the value or relevance of her contribution.

Additional to the mere inter-personal communication among students, microblog messages may also be assigned to categories that are predefined by the lecturer when he configures *Backstage*. Assigning messages to categories makes it possible to retrieve and aggregate the messages of a category, thus providing the lecturer in real-time with a concise topic-related overview of the backchannel discourse. These categories may, among others, be content-related, e.g. "question", or process-related, e.g. "lecturing pace". By monitoring the aggregated topic-related overview the lecturer can quickly recognize, for example, if her audience indicates problems in following her lecture discourse, and enables her to promptly react upon it.

Besides the audience's active participation in the backchannel discourse, the lecturer may also call for active participation by means of quizzes which are reminiscent to Audience Response Systems or Classroom Response Systems [18,22,23]. These have been shown to be very helpful in promoting active participation of the audience [18]. The conduct of quizzes may not only assess the students' previous knowledge or opinions about the lecture's topic but also breaks up the lecturer's discourse into bearable chunks. Research indicates that students' attention and concentration drastically declines after 20 minutes of continuous lecturing [3]. Thus, quizzes may re-activate students and promote active participation, for example, by combining the answering of quizzes with a short interchange on the backchannel.

3. Providing Guidance on Backstage

At a relatively early stage of *Backstage*'s development we conducted a preliminary user study, providing the authors with first impressions about how students get along with *Backstage* [24]. Fourteen students interacted on *Backstage* during 30-minutes lasting presentations. Although the discussions were mostly fruitful and the students liked working with *Backstage*, quite unsurprisingly the important aspect of guidance has been identified as in need of improvements. For example, students confirmed that the single-threaded display of backchannel discourse quickly makes the discourse incomprehensible. Since presentation slides were not displayed at the user interfaces, students had to permanently switch between the backchannel and the frontchannel. Additionally, the analysis of the chat transcripts confirmed that students need support in formulating high-quality questions—just approximately 15 percent of the questions were of a high quality as defined in [19]. These insights led us to extend and rewire the functionalities of *Backstage* in order to account for guidance to a greater extent.

3.1 Guidance by scripts

According to contemporary research learners occasionally need to be provided with direct instructions (e.g. [25,26]), especially when they are equipped with insufficient previous knowledge or internal scripts [26]. The term "internal script" is rooted in cognition psychology [27] and describes already existent knowledge structures about courses of actions (i.e. procedural knowledge). Internal scripts make possible to behave adequately, and provide mental models about those courses of actions. In [27] one can find the often-cited restaurant script providing a detailed picture about how a restaurant visit in our culture takes place. However, internal scripts might be insufficiently advanced or flawed [26]. By instructions or so-called external scripts it is possible to unwind suboptimal scripts and support the learner in internalizing an improved, more efficient way to perform a learning task [28,29]. One possibility that proved to be helpful is the use of so-called collaboration scripts. "Collaboration scripts are instructional plans that specify and sequence collaborative learning activities", [27, p.18]. For example, collaboration scripts have been used to support the collaborative writing of texts. Therefore, O'Donnell and Dansereau developed the MURDER script that provides learners with two distinct roles and, accordingly, different activities [21]. While this script has been used in face-to-face settings, various recent scripts are used in computer-based learning arrangements (e.g. [9,31,32]). Script research has also been focusing on the improvement of argumentation (e.g. [33,34]) and on the construction of high-quality questions [19].

Based on [35] there are certain components (participants, activities, roles, resources and groups) and mechanisms (task distribution, group formation and sequencing) that facilitate cognitive and social processes. However, there are further two components to be considered that could influence the functioning of the other components as well as learning processes and results. Based on goals defined by the lecturer the learning activities and sequences are determined [36,37]. Furthermore, the representation of scripts should be taken into consideration. In most cases the above mentioned components lead to an improvement of learning results. Scripts can be separated into macro and micro

scripts [38]. While macro scripts specify activities from a higher level of perspective, i.e. an entire learning phase ([9,32]), micro scripts address single aspects and tasks of learners, e.g. argumentation (e.g. [39]).

In *Backstage* both forms, macro and micro scripts, can be employed. Likewise, macro scripts specify, i.e. sequence, the learning activities in and around the backchannel, and micro scripts provide support for single interactions of students on the platform. For example, if the lecturer recognizes that the quality of questions declines, she may activate some sort of script module on *Backstage* that supports students in constructing high-quality questions. Such a script module may in this case be based on [19]. Depending on the time available the lecturer can invest on such an issue, those scripts can support the individual, the collective, or both simultaneously.

While some functionalities of *Backstage* implicitly provide the user with support, and thus can be seen as scripts, the integration of explicit instructions that aims at supporting the user in her content-related involvement is still largely an open issue. Thus, the way of visualizing instructions on the user interfaces such that they are most helpful for learning, remains an open question. Furthermore, the management of scripts, e.g. activating a script, needs further consideration. While the lecturer can activate a script module, we have to carefully think about the basis (of data) the lecturer needs to be provided in order to recognize which scripts should be activated. Also, it is conceivable to tailor the scripts for each individual according to the profile data.

3.2 Guidance by interaction workflows on Backstage

As mentioned above, on *Backstage*, messages can be assigned to predefined categories, allowing the lecturer to gain a very concise topic-related overview of the backchannel's discussions. However, while in the previous version of *Backstage* assigning messages to categories has been an optional activity, in the new version of *Backstage* it is enforced. Indeed, providing the lecturer with an overview of how the backchannel communication is structured is crucial to keep her attached. By leaving the categorization of messages optional, the overview would in most cases be incomplete, though. Moreover, pre-defined categories implicitly convey to the students the communication that is sought after. In contrast, unrestricted communication leaves much space for off-topic messages. Hence, categorization can be a first step to counteract off-topic messages. To make users assign categories to all their messages in an intuitive way, it is reasonable to rewire the workflow as follows. The user always begins with writing a message. When she issues the send command, a pop-up menu occurs, from which she selects the category the message shall belong to (cf. Figure 1).

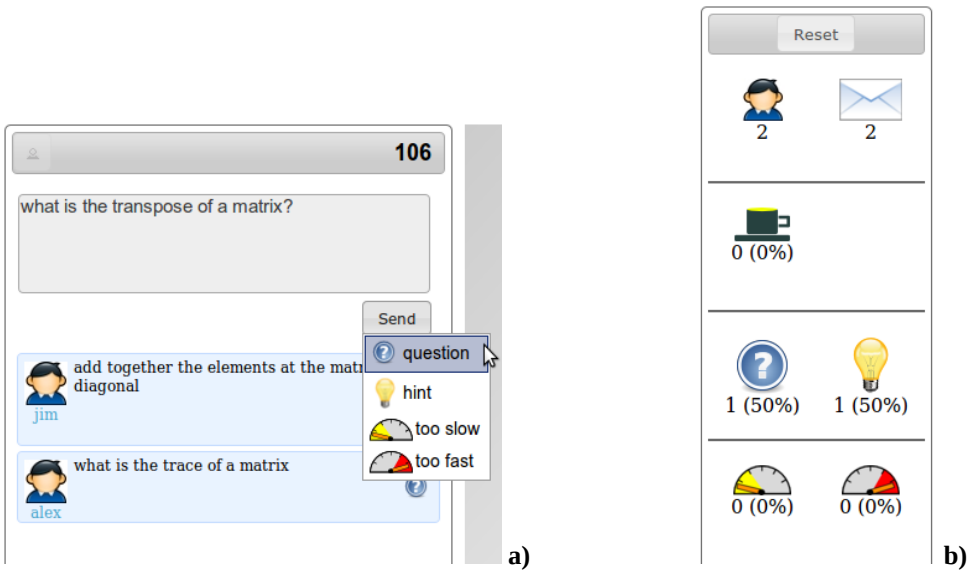

Figure 1 a) After entering the text message into the message editor the user issues the send command. Then, a popup menu occurs from which the user selects the category the post belongs to (in the picture the category question is selected). From top to bottom, the pop-up menu shows the two content-related categories question and hint, and the two process-related categories too fast and too slow. **b)** On the lecturer's dashboard the number of the users online and messages is displayed (top row). In the second row, the number of collectively classified off-topic messages is shown. The topic-related overview (last two rows) of the backchannel is displayed. The complete overview is updated in real-time.

This sequence in writing a message accounts for the assignment to categories in a reasonable way. Interestingly, such a workflow can be seen on the one hand as a sort of script that tacitly instructs the student to assign her messages to categories, and on the other hand as another script that specifies the sort of discourse sought after.

Apart from the aforementioned categorization, the backchannel discourse can be structured according to presentation slides displayed on the backchannel. Each message is always related to the slide currently displayed at the sender's dashboard. Accordingly, only those messages are shown that belong to the displayed slide while any other messages are not shown. That is, by navigating through the slides one also navigates through the backchannel past discourse. Additionally, the discourse for each slide can be structured at a finer level, by subdividing it into threads of discourses, thereby leaving explicit the incoherency and non-linearity of chat communication. The preservation of threads gives structure to the communication in a top-down fashion and allows for fast re-orientation of the users and for instantaneous reuse of the backchannel discourse for further learning tasks.

The creation of threads is merged with the workflow of posting messages. That is, messages either open up or extend a thread. To create a thread, the student writes a message as previously described. After selecting a category, however, the message is not yet sent. Rather, the student clicks onto the slide in order to specify a position for the thread to be created. The thread is of the same category as its opening message. Creating a thread is illustrated in the Figure 2. By placing on a slide, a thread can be related to some meaningful part of that slide. For example, a question can be placed in that region of a slide to which the question refers. Thus the placement of threads on slides allows for some sort of topic-based navigation in each slide. Slides can be structured so as to include pre-defined topics of relevance for the lecture. The user can quickly recognize whether a thread may be of interest to her alone by the location of a thread without the need to deal with the comprised discourse itself. In order to add a message to an existing thread, by clicking the thread icon at a slide, the student selects the thread her message shall belong to. As a result, only those messages are displayed at the student's dashboard belonging to that thread. According to the procedure described in the section above, the student adds a message. Since an existing thread is already selected, the positioning of an icon in order to send the message is omitted. The user leaves the thread either by selecting, i.e. entering, another thread or by clicking onto the slide. Latter leads to showing the discourse for the entire slide at the microblog window.

Apart from guidance by structure, students' interactions at a learning platform such as *Backstage* should be related to some shared artefacts [40], like presentation slides. Showing the chat log together with, and in the context of, slides on a single screen is considered to be conducive for learning [40]. Also, placing threads on slides, i.e. relating communication to shared content, has been shown to be valuable for collaborative learning and for the improvement of learning success, since it fosters building of common ground among students and encourages students to also respond to older messages [33]. It should be noted that, in order to benefit from this sort of functionality, it might not necessarily be the case that full-blown presentation slides are provided. Rather, it would be sufficient to provide the backchannel with slides just containing a more or less detailed outline of the lecture. Such outlines can certainly be easily given, no matter what lecture is to be supported by *Backstage*. After all, a lecturer should be conscious of her lecture's outline.

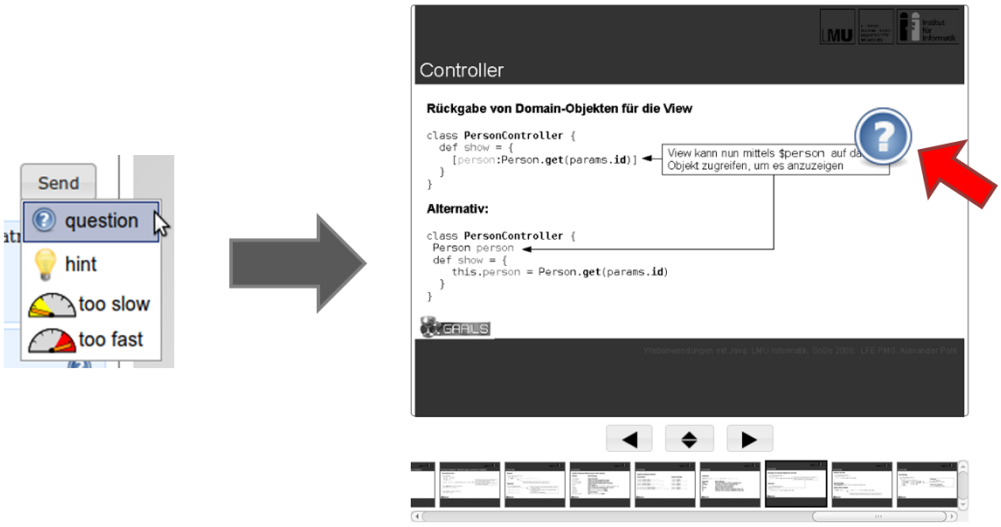

Figure 2 After writing the message the student selects a category (e.g. question, as shown at the left). To create a new thread by the message the student clicks on the region of the slide near to where the thread is related to (shown at the right). A corresponding icon is shown at the specified position—the red arrow at the right (not part of the slide) points to the icon that is placed by the student.

3.3 Collective guidance on Backstage

In addition to the guidance of individual interactions by interaction workflows "with a purpose" and the use of scripts to support students content-related involvement, *Backstage* allows for a kind of collective guidance of individuals by the audience that may support both the student and the lecturer. By means of rating and further collective categorization of posts, such as off-topic, the group may tacitly exert, using the backchannel, a review of the individual's behaviour. For example, an ill-located thread may be rated negatively, or may merely gain poor attention. Rating and activity indicators, besides being instruments for the increase of partaking, serve as a means to collective quality or relevance management. Well-located threads with relevant messages may gain much attention and may be rated highly positively. This provides the user with insights about what the community considers profound and considerable. Going a further step ahead, rating itself could be subject to quality management. This could be achieved by enforcing that the rating itself results in a message containing the explanation for the rate given. Ratings are then expressed by mere messages that in turn can be rated. Thus, rating and collective categorization can be seen as forms of peer learning.

Since on a digital backchannel dedicated to large classes a vast amount of data accrues, it is necessary to provide some sort of information management, e.g. filtering out irrelevant information. For this task, rating and categorization come in handy. As mentioned above, assigning messages to categories, that may not only be related to lecturing style but also to content, allows for a concise aggregated overview about the kinds of messages currently exchanged on the backchannel (cf. Figure 1b). This provides a kind of decision support that guides her steering of the frontchannel. The overview can be enriched by a top-k ranking of messages that is determined by the rating scores of each post. Both keep the lecturer attached to the backchannel and enable her to react upon the backchannel discourse, and thus include the audience in her lecturing to an extent that would otherwise only be possible in small learning groups.

Especially in combination with the guidance of each individual, by collective guidance a regulation of the backchannel by the audience may emerge. We consider such a regulation of the backchannel that relies on the audience to be highly desired, since it unburdens the lecturer from permanently monitoring the backchannel, a task that she can barely carry out by herself during lecturing. It may also reduce the need for further faculty staff, thus allowing the backchannel to be used in classes with nearly arbitrary large-sized audiences. More importantly, the group behavior can be processed and examined by the lecturer giving her insight about the overall-behavior of her audience. It also allows the lecturer to relate, and compare, individual backchannel activities to that of the group. Certainly, finding ways to foster self-regulation of the backchannel is an involved task and needs further research.

4. Conclusion

The article discusses the functionalities of the digital backchannel *Backstage* foremost in the light of guidance. The article assumes that guidance of learners on collaboration platforms such as *Backstage* is essential in order to be conducive for learning. Therefore, the functionalities of *Backstage* are extended and rewired in order to provide for guidance in four different ways: by structure, by user interactions "with a purpose", by scripts, and by the collective. Guidance by structure is provided by aligning the backchannel communication with presentation slides that are integrated in the backchannel, and by preserving the incoherency and non-linearity of the chat with the concept of threads. In order to trigger reflective thinking of students and to establish the kind of communication sought after the user interactions are carefully designed accordingly, thereby possibly deviating from mere usability principles. Furthermore, recent research (e.g. [41-44]) suggests to provide the user with various instructions and predefined sequences of activities. By proper guidance of individuals a collective guidance on the backchannel may emerge and thus lead to a social self-regulation of the backchannel by the audience.

It should be noticed that especially with the provision of guidance in an unobtrusive way—for example, when placing icons the user is not aware of being scripted—learners could be activated and guided, without much loss of self-regulation and motivation [45]. Yet, how far this may be the case, and how it might actually influence motivation [45] and reactance [46], among others, needs to be investigated in future studies.

As another challenge, *Backstage* might demand much attention, and thus time, from both the lecturer and the students during lectures. This might impinge on the efficacy of *Backstage* for learning, especially when used in traditional teacher-centered lectures. Thus, it could be necessary to structure the lecture itself by means of a macro script that specifies, and thus accounts for, distinct times when to interact on the backchannel, and specifies how to make use of *Backstage* during a lecture.

In this context it is also possible to validate the usefulness and accuracy of the data displayed on the lecturer's dashboard. This may be supported by *Backstage* itself. According to the data scripts may be employed that may guide the lecturer during her discourse which might be interesting especially for yet marginally experienced lecturers.

We plan to conduct both laboratory and field studies to a most detailed picture about the efficacies of *Backstage*'s functionalities and the applicability of the backchannel in real lecture settings. This combination enables us to carefully develop, and adapt, novel scripts, since the development can be based on existent data. According to [38], scripts need to be carefully designed in order to be successful.

References

[1] R.E. Slavin, Research on Cooperative Learning and Achievement: What We Know, What We Need to Know., Contemporary Educational Psychology. 21 (1996) 43-69.

[2] A. Renkl, Träges Wissen: Wenn Erlerntes nicht genutzt wird [Inert Knowledge: When what is learned is not used], Psychologische Rundschau. 47 (1996) 78-92.

[3] J. Cuseo, The Empirical Case against Large Class Size: Adverse Effects on the Teaching, Learning, and Retention of First-Year Students, Journal of Faculty Development. 21 (2007) 5-21.

[4] L. Deslauriers, E. Schelew, C. Wieman, Improved Learning in a Large-Enrollment Physics Class, Science. 332 (2011) 862 -864.

[5] E. Mazur, Farewell, Lecture?, Science. 323 (2009) 50 -51.

[6] A.W. Chickering, Z.F. Gamson, Seven Principles for Good Practice in Undergraduate Education, AAHE Bulletin. (1987) 3-7.

[7] G. Stahl, T. Koschmann, D. Suthers, Computer-supported Collaborative Learning: An Historical Perspective, in: Cambridge Handbook of the Learning Sciences, Cambridge University Press, 2006: pp. 409-426.

[8] M. Ebner, M. Schiefner, Microblogging - More than Fun?, in: S. Immaculada Arnedillo, P. Isaias (Eds.), Proceeding of IADIS Mobile Learning Conference 2008, 2008: pp. 155-159.

[9] A. Weinberger, B. Ertl, F. Fischer, H. Mandl, Epistemic and Social Scripts in Computer-Supported Collaborative Learning, Instructional Science. 33 (2005) 1-30.

[10] W.A. Kellogg, T. Erickson, T.V. Wolf, S. Levy, J. Christensen, J. Sussman, et al., Leveraging Digital Backchannels to Enhance User Experience in Electronically Mediated Communication, in: Proceedings of the 20th Anniversary Conference on Computer-Supported Cooperative Work, ACM, New York, NY, USA, 2006: pp. 451–454.

[11] G. Grosseck, To use or not to use Web 2.0 in Higher Education?, Procedia - Social and Behavioral Sciences. 1 (2009) 478-482.

[12] N. Saunders, P. Beltrao, L. Jensen, D. Jurczak, R. Krause, M. Kuhn, et al., Microblogging the ISMB: A New Approach to Conference Reporting, PLoS Computational Biology. 5 (2009).

[13] C. Ross, M. Terras, C. Warwick, A. Welsh, Enabled Backchannel: Conference Twitter use by Digital Humanists, Journal of Documentation. 67 (2011) 214-237.

[14] S. Yardi, Whispers in the Classroom, Digital Youth, Innovation, and the Unexpected. Edited by Tara McPherson. The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge, MA: The MIT Press. (2008) 143-164.

[15] C. Costa, G. Beham, W. Reinhardt, M. Sillaots, Microblogging In Technology Enhanced Learning: A Use-Case Inspection of PPE Summer School 2008, in: Workshop at the European Conference on Technology Enhanced Learning (ECTEL) 2008, Maastricht, The Netherlands, 2008.

[16] T. Holmer, Discourse Structure Analysis of Chat Communication, Language@Internet. 5 (2008).

[17] F. Bry, V. Gehlen-Baum, A. Pohl, Promoting Awareness and Participation in Large Class Lectures: The Digital Backchannel Backstage, in: Proceedings of the IADIS International Conference E-society, Spain, Avila, 2011: pp. 27–34.

[18] R.H. Kay, A. LeSage, Examining the Benefits and Challenges of using Audience Response Systems: A Review of the Literature, Computers & Education. 53 (2009) 819 - 827.

[19] A. King, Guiding Knowledge Construction in the Classroom: Effects of Teaching Children How To Question and How To Explain., American Educational Research Journal. 31 (1994) 358-68.

[20] A. King, Scripting Collaborative Learning Processes: A Cognitive Perspective, in: F. Fischer, I. Kollar, H. Mandl, J.M. Haake (Eds.), Scripting Computer-Supported Collaborative Learning, Springer US, Boston, MA, 2007: pp. 13-37.

[21] D. Dansereau, A. O'Donnell, Scripted Cooperation in Student Dyads: A Method for Analyzing and Enhancing Academic Learning and Performance., in: Interactions in Cooperative Groups. The Theoretical Anatomy of Group Learning, Cambridge University Press, New York, 1992: pp. 120-141.

[22] C. Fies, J. Marshall, Classroom Response Systems: A Review of the Literature, Journal of Science Education and Technology. 15 (2006) 101-109.

[23] R.W. Preszler, A. Dawe, C.B. Shuster, M. Shuster, Assessment of the Effects of Student Response Systems on Student Learning and Attitudes over a Broad Range of Biology Courses, CBE Life Science Education. 6 (2007) 29-41.

[24] V. Gehlen-Baum, A. Pohl, F. Bry, Assessing Backstage, a Backchannel for Collaborative Learning in Large Classes, in: Proceedings of the International Conference ICL 2011, Slovakia, accepted for publication.
[25] A. King, Structuring Peer Interaction to Promote High-Level Cognitive Processing, Theory Into Practice. 41 (2002) 33-39.
[26] I. Kollar, F. Fischer, J.D. Slotta, Internal and External Scripts in Computer-Supported Collaborative Inquiry Learning, Learning and Instruction. 17 (2007) 708-721.
[27] R.C. Schank, R.P. Abelson, Scripts, Plans, Goals, and Understanding: An Inquiry into Human Knowledge Structures, Hillsdale, NJ: Lawrence Erlbaum Associates, 1977.
[28] M. Baker, K. Lund, Promoting Reflective Interactions in a CSCL Environment, Journal of Computer Assisted Learning. 13 (1997) 175-193.
[29] V. Gehlen-Baum, Gibt es Overscripting? Auf der Suche nach Interaktionseffekten zwischen internalen und externalen Kooperationsskripts bei der argumentativen Wissenskonstruktion [Does Overscripting Exist? In Search of Interaction Effects between Internal and External Collaboration Scripts for Argumentative Knowledge Construction], Master's Thesis, Ludwig-Maximilians-University Munich, 2010.
[30] K. Stegmann, Argumentative Knowledge Construction. Analysing and Facilitating Discursive Processes, Cognitive Processes, and Knowledge Acquisition during Collaborative Argumentation in Online Discussions, Dissertation, Ludwig-Maximilians-University Munich, 2008.
[31] C. Wecker, F. Fischer, Fading Scripts in Computer-Supported Learning: The Role of Distributed Monitoring, (2006).
[32] P. Dillenbourg, P. Jermann, Designing Integrative Scripts, in: F. Fischer, I. Kollar, H. Mandl, J.M. Haake (Eds.), Scripting Computer-Supported Collaborative Learning, Springer US, Boston, MA, 2007: pp. 275-301.
[33] M. Mühlpfordt, M. Wessner, Explicit Referencing in Chat Supports Collaborative Learning, in: Proceedings of the Conference on Computer Support for Collaborative Learning: Learning 2005: The Next 10 Years!, International Society of the Learning Sciences, 2005: pp. 460–469.
[34] I. Kollar, Webbasiertes Forschendes Lernen in der Biologie: Effekte internaler und externaler Kooperationsskripts auf Prozesse und Ergebnisse des gemeinsamen Argumentierens [Web-based Inquiry Learning in Biology: Effects of Internal and External Cooperation Scripts on Processes and Outcomes of Collaborative Argumentation], Logos, Berlin, 2007.
[35] L. Kobbe, A. Weinberger, P. Dillenbourg, A. Harrer, R. Hämäläinen, P. Häkkinen, et al., Specifying Computer-Supported Collaboration Scripts, International Journal of Computer-Supported Collaborative Learning. 2 (2007) 211-224.
[36] F. Oser, F. Baeriswyl, Choreographies of Teaching: Bridging Instruction to Learning, in: Handbook of Research on Teaching, American Educational Research Association, 2002: pp. 1031-1065.
[37] C. Wecker, Vom Sollen zum Können - oder: Wie man Instruktion wieder los wird [From Ought to Can--Or, how we Fade Instruction], Dissertation, Ludwig-Maximilians-University Munich, 2008.
[38] F. Fischer, I. Kollar, A. Weinberger, K. Stegmann, C. Wecker, J. Zottmann, Collaboration Scripts in Computer - Supported Collaborative Learning, in: C. Hmelo-Silver, A. O'Donnell, C. Chan & C. Chinn (Eds.). International Handbook of Collaborative Learning, Taylor & Francis, Ner York, NY, in press.
[39] K. Stegmann, A. Weinberger, F. Fischer, Facilitating Argumentative Knowledge Construction with Computer-Supported Collaboration Scripts, International Journal of Computer-Supported Collaborative Learning. 2 (2007) 421-447.
[40] D. Suthers, J. Xu, Kükäkükä: An Online Environment for Artifact-Centered Discourse, in: Proceedings of the 11th World Wide Web Conference, 2002.
[41] C.E. Hmelo-Silver, R.G. Duncan, C.A. Chinn, Scaffolding and Achievement in Problem-Based and Inquiry Learning: A Response to Kirschner, Sweller, and Clark (2006), Educational Psychologist. 42 (2007) 99.
[42] A. Weinberger, K. Stegmann, F. Fischer, Learning to Argue Online: Scripted Groups Surpass Individuals (Unscripted Goups do not), Computers in Human Behavior. 26 (2010) 506-515.
[43] J. Sweller, R.E. Clark, P.A. Kirschner, Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching, Educational Psychologist. 41 (2006) 75-86.
[44] A. Weinberger, F. Fischer, K. Stegmann, Computer-Supported Collaborative Learning in Higher Education: Scripts for Argumentative Knowledge Construction in Distributed Groups, in: Proceedings of the Conference on Computer Support for Collaborative Learning: Learning 2005: The Next 10 Years!, International Society of the Learning Sciences, Taipei, Taiwan, 2005: pp. 717–726.
[45] E. Deci, R. Ryan, Die Selbstbestimmungstheorie der Motivation und ihre Bedeutung für die Pädagogik [Self Theories on Motivation and their Implications for Pedagogy], Zeitschrift Für Pädagogik. 2 (1993).
[46] J.W. Brehm, Theory of Psychological Reactance, Academic Press, 1966.