How Can Current Approaches to the Transfer of Technology-Based Collaboration Scripts for Research and Practice Be Integrated?

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Abstract: Research on technology-based collaboration scripts has been very successful in terms of the development of a broad range of scripts that effectively foster processes and outcomes of computer-supported collaborative learning. However, neither the transfer to other experimental platforms nor the transfer into practice has been managed systematically so far. To foster both replications of script effects across domains and sites and the use of scripts of proven effectiveness in practice, tools that allow for the exchange of scripts are necessary. This symposium offers an overview of the most influential tools to develop, implement, investigate and transfer computer-supported collaboration scripts. Furthermore, the future direction of the development of tools for script implementation and transfer is discussed.

Why We Need More General Tools for Script Development and Implementation

Research on technology-based collaboration scripts has been very successful in terms of the development of a broad range of scripts that effectively foster processes and outcomes of computer-supported collaborative learning (e. g. Baker & Lund, 1997; Weinberger et al., 2005; Kollar et al., 2007). One goal of this research is to reveal the mechanisms or types of successful scripts and to formulate guidelines for the development of effective computer-supported collaboration scripts. However, the accumulation of findings about general script mechanisms or types is quite difficult due to the fact that all these scripts were developed for a variety of instructional scenarios, learning environments and educational institutions. Technology-based collaboration scripts are usually tested exclusively within one of these environments. Neither the transfer to other experimental platforms nor the transfer into practice has been managed systematically so far.

Why is it a problem that specific technology-based collaboration scripts hardly are used across different (experimental) platforms? We need evidence to what extend script effects can be replicated across instructional scenarios, learning environments and educational institutions. Evidence is needed whether scripts effects be specific to the instructional scenarios, learning environments and educational institutions in which they were tested or whether they have rather general effects across different integrations. However, it is common practice to generalize over different instructional scenarios, learning environments and educational institutions despite the fact that the script was only tested in one environment. To overcome this problem, the effectiveness of particular scripts needs to be established across a broader array of different instructional scenarios, learning environments and educational institutions. To transfer a computer-supported collaboration script to another learning platform, usually a re-engineering is necessary, and the effort required for this purpose typically cannot be expended.

The same holds for the transfer of collaboration scripts of proven effectiveness into practice: If the scripts have been implemented as an integral part of a particular, often purely experimental, learning platform that is not open to and supported for the public, practitioners cannot simply use them and again, re-implementation on the platforms used in educational institutions typically is not feasible. To foster both replications of script effects across domains and environments and the use of scripts of proven effectiveness in practice, ways to exchange scripts are necessary.

Approaches to the Development and Implementation of Re-usable Scripts

To provide solutions for the replications of script effects across instructional scenarios, learning environments and educational institutions and the use of scripts of proven effectiveness in practice, several suggestions have been made. At least four aspects of sustainable script development can be distinguished (see Figure 1): (1) Frameworks enable script developers to specify their collaboration script using a collaboration-specific description language. Thereby, not only the description is standardized, but also dimensions for research are defined. (2) Authoring tools offer script designers more easily to create collaboration scripts. These tools usually provide a graphical interface. (3) An interface (including exchange formats/standards) is needed to run a script authored with an authoring tool in a specific (4) runtime environment. The runtime environment "plays" the scripts. It provides the human-computer-interface.

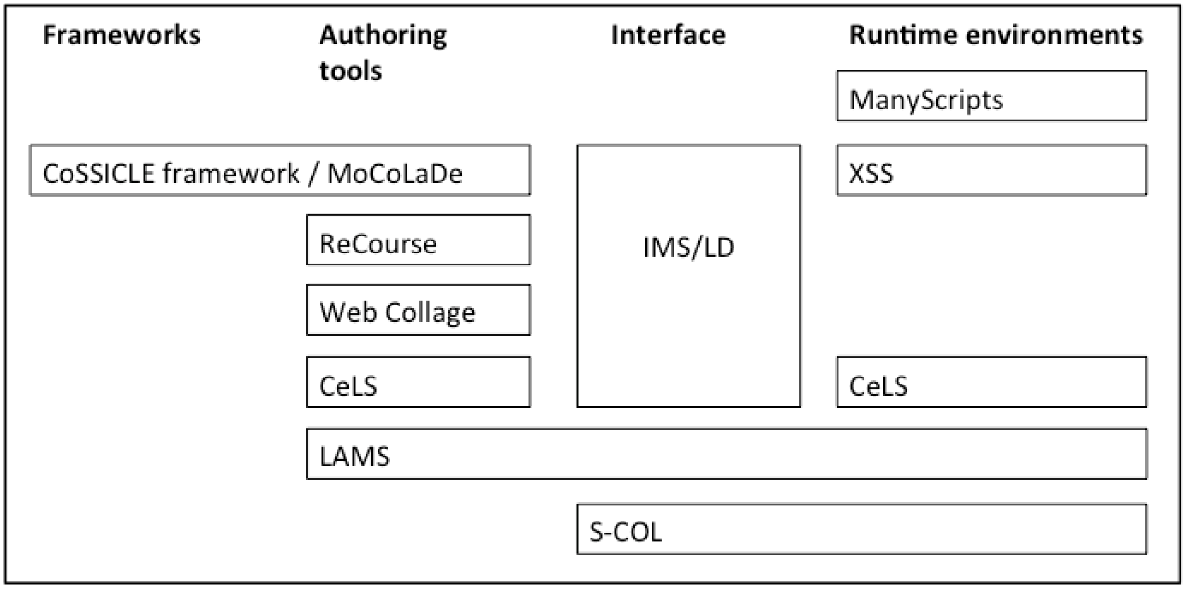

Figure 1. Aspects of the Sustainable Script Development and an Overview, Which Tool Focuses Which Aspects.

A prominent approach is the development of a common scripting language or a unified framework for the description of scripts such as the one developed by the European Research Team "CoSSICLE" consisting of educational scientists, psychologists and computer scientists (Weinberger et al., 2007): This framework (Kobbe et al., 2007) defines a small but still comprehensive number of components and mechanisms of computer-supported collaboration scripts. The components are participants, activities, roles, resources, and groups; the mechanisms comprise task distribution, group formation, and sequencing. The idea behind this approach is that each single collaboration script from a broad variety of script types can be described as a specific configuration of these components.

On the basis of this descriptive framework the graphical modelling tool MoCoLaDe for designing collaboration scripts has been developed (Harrer & Malzahn, 2006). This modelling tool produces an IMS/LD file as an output, i. e. a file that can be read by all learning platforms that support the IMS Global Learning Consortium Standards. An example of a runtime environment and functional framework that simplifies the implementation of scripts on devices such as tabletop displays or mobile phones by using a representation in IMS/LD such as the ones produced by MoCoLaDe is XSS (Stegmann, et al., 2009). The server component of the XSS framework is a runtime environment, while the functional framework offers a bundle of functions and classes to develop own GUIs for the clients. Other tool that create a computer readable script description in IMS/LD are Web Collage (Villasclaras-Fernández, 2010) or ReCourse (Griffiths et al., 2009). However, instead of an implementation on the basis of a script formalization, Web Collage offers specific script patterns (e.g. a jig saw pattern) and assessment capabilities to the user. ReCourse is quite similar to MoCoLaDe, but uses an adapted IMS-LD framework to describe collaboration scripts. Finally, CeLS has to be mentioned as tool that comprises capabilities for designing as well as enacting collaboration scripts on the basis of IMS/LD.

Graphical modelling tools do not necessarily produce a machine-readable output. LAMS (Ellaway, Dalziel, & Dalziel, 2008) allows to create learning designs with a pre-defined set of activities (incl. online discussions, questionaires, etc.) that can be either "played" directly in LAMS or used for controlling other learning platforms. The interface to other platforms is not implemented by means of an exchange format, but through a direct integration of LAMS and other learning platforms (e.g., moodle, Blackboard, Microsoft Sharepoint).

A different approach to the transfer of collaboration scripts to other settings has been offered in the "ManyScripts" project (Dillenbourg & Hong, 2008): Manyscripts offered teachers a web-based environment to adapt a set of specific scripts to satisfy their own needs, in particular their own learning material. "ManyScripts" did not offer the opportunity to develop new computer-supported collaboration scripts, but to change the learning material. Thereby, we regard "ManyScripts" not as a script authoring tool. Currently, the Concept Grid, Argue Graph (Dillenbourg & Jermann, 2007), and Ice (Dillenbourg & Hong, 2008) scripts are still available on the project website (Manyscripts, 2009). For example, the Argue Graph script composes groups with divergent opinions with respect to a specific domain (e.g., drug use in sports). To adapt the Argue Graph script, teachers can easily define their own questions that will be used to form these divergent groups. The ManyScripts environment is a standalone learning platform. A native integration into other learning platforms has not been a goal and is not supported.

In some sense, the S-COL approach follows an idea similar to the one behind ManyScripts, i. e. developing ready to use instances of collaboration scripts and making them available in other contexts. The difficulty in this approach is how to integrate these ready-made instances of collaboration scripts in the technological platforms used in other learning settings. S-COL solved this problem by means of a general interface to any kind of web pages (cf. Wecker et al., 2010). Thereby, collaboration scripts created once can easily be used on different learning platforms.

These different approaches all have their respective strengths and weaknesses. Often the current shortcomings of one approach match with particular strengths of another one, and there are chances for progress by combining them. Therefore, this symposium explores ways to advance development of methods for the seamless transfer of collaboration scripts to other platforms. It offers an overview of the most influential approaches and implemented tools to develop, investigate and transfer computer-supported collaboration scripts. On this basis, the future direction of the development and integration of a set of interconnected tools for script implementation and transfer will be discussed.

In the following, the individual approaches are presented in more detail. We clustered the approaches into authoring tools (MoCoLaDe, Web Collage) and runtime environments (CeLS, S-COL). We're aware that CeLS and S-COL are hybrids (combining authoring tool or interface with runtime environment). However, their focus lies in both cases more on the runtime environment than on authoring or the interface.

Authoring Tools

MoCoLADe: Model for Collaborative Learning Activity Design

MocoLADe was developed as a graphical modelling approach based on the conjointly developed COSSICLE framework on collaboration scripts. Thus, it was built to allow the definition of collaboration scripts on a general level that is not tied explicitly to specific learning platforms and scripting engines. It provides an explict mapping of COSSICLE's components and mechanisms to respective graphical representations that allows visual specification of collaboration scripts without the need to be knowledgeable about specific educational modelling languages, as the XML binding of IMS/LD, or being restrained by specific tool(sets) within concrete learning environments, as in the case of the LAMS system (Dalziel, 2006). Among the features of the MoCoLADe language are different group formation strategies, role rotation, and distribution/collection of resources.

How Does MoCoLaDe Work?

MoCoLADe is an editor implemented as a Plugin to the collaborative whiteboard application FreeStyler. It is used as a stand-alone editor, i.e. independent of a specific learning system, with which the script designer creates graphical scripting models in formats that can be applied to different learning platforms. The main target platforms are IMS/LD compliant Learning Management Systems, but a proof-of-concept export to the learning platform CeLS and its proprietary format for learning processes was conducted as well.

How Does MoCoLaDe Advance Research on Computer-supported Collaboration Scripts?

MoCoLADe with its platform-independent modelling approach supports comparison of different scripting platforms as well as re-usability of script templates across different domains. In the first case, the same model / script could be exported to several platforms and practically tested with their specific functionality and realizations of learning activities. Thus it supports a comparative research on learning / scripting platforms. For the second case, a modelled MoCoLADe script can be re-used in different learning contexts and scenarios just by exchanging the material and resources provided to the students (e.g. a set of case descriptions from

Chemistry instead of Psychology). Thus, the transferrability of the same script in different domains can be explored and evaluated systematically.

How Does MoCoLaDe Advance the Implementation of Scripts into Educational Practice?

MoCoLADe supports the implementation of scripts into practice in a twofold way. First, a designed script can be tested practically by the designer by means of interactive simulation. By stepping through a modelled script and checking the settings, such as current groups, role and resource assigments, a script can be checked for validity and potential pitfalls before putting it into practice. Second, the transformation mechanism of a script or a simulation run of a script to the de facto standard IMS/LD provides the seamless transition from convenient graphical modelling to enactment in IMS/LD supporting environments, without a designer having to be an expert in IMS/LD coding. Using application specific profiles (Harrer et al., 2009) the export of a model can also be tied to a specific learning platform and the tools available in that platform. Preliminary tests with an application profile for the CeLS learning platform have been performed and presented in (Harrer et al., 2009).

Web Collage

Web Collage (Villasclaras-Fernández, 2010), an extension to the previous tool *Collage* (Hernández-Leo, et al., 2006a), was developed to aid non-expert designers, such as teachers interested in applying collaborative learning with computer support, in the creation of computer-interpretable collaboration scripts (Weinberger et al., 2009). Similar to MoCoLADe, by relying in the *de-facto* standard IMS/LD specification, *Web Collage* aims at creating interoperable scripts that can be enacted in any IMS/LD compliant player. More interestingly, *Web Collage* extends Collage in providing pedagogical support for configuring not only learning activities of the script, but also the related assessment support (Villasclaras-Fernández, et al., 2009a).

How Does Web Collage Work?

Web Collage promotes a design process in which designers reuse design patterns in order to create the different components that compose a CSCL script. Currently, *Web Collage* lets the user apply two types of patterns: Collaborative Learning Flow Patterns (CLFPs), which codify well-known collaborative learning techniques (such as the *Jigsaw*, *Pyramid*, or *Think pair share*) (Hernández-Leo, et al., 2006b), and assessment patterns that correspond to common assessment techniques (Villasclaras-Fernández, et al., 2009b). The tool encourages the user to read the documentation of each pattern, in order to select the most adequate techniques for each case. Once a pattern has been selected, *Web Collage* automatically handles the creation of the components necessary to represent the chosen learning/assessment technique. In this way, non-expert designers can easily create scripts composed of complex collaborative learning structures. Moreover, *Web Collage* generates an interactive graphical representation of CSCL scripts depicting the learning and assessment techniques used, with the objective of facilitating the understanding of the expected collaborative learning processes (Villasclaras-Fernández, et al., 2009a). In addition, *Web Collage* implements an advisor system, which indicates potentially necessary actions to be carried out in order to complete the script, together with a brief explanation of the pedagogical rationale for each recommendation.

How Does Web Collage Advance Research on Computer-supported Collaboration Scripts?

The generation of a CSCL script is a complex task, and many aspects need to be taken into account in the design task. *Web Collage* recognizes the relevance of assessment embedded in collaboration scripts and encourages a design process in which alignment between learning and assessment is a key design goal (Villasclaras-Fernández, et al., 2009a). On the other hand, more aspects of the design process need to be tackled as well, such as aid for the configuration of the distribution of documents among participants in a script, the integration of flexibility, support to create or reuse learning/assessment existing resources, etc. These new elements may be eventually included in a complete design process (Villasclaras-Fernández, et al., 2009c). With respect to this, the development and evaluation of both *Collage* (Hernandez-Leo et al., 2010) and *Web Collage* (Villasclaras-Fernández, 2010) represent relevant milestones towards this objective. On the other hand, the ability to easily produce scripts suitable for specific learning situations facilitates the involvement of teachers in research case studies in which technologies, such as Virtual Learning Environments, are tested in authentic scenarios. In this way, *Web Collage* may be (and has been) used as a resource in TEL research.

How Does Web Collage Advance the Implementation of Scripts into Educational Practice?

The objective behind the development of Web Collage is to enable any type of designer to create pedagogical sound computer-interpretable CSCL scripts. Considering that the access to the technological resources necessary to enact CSCL scripts is becoming wider and wider, the possibility of easily creating CSCL scripts is very attractive in the case of teachers without extensive experience of CL or technology. Coupled with IMS/LD players, any teacher could potentially create a CSCL script for their specific needs (Villasclaras-Fernández, et al., 2009c). The usage of design patterns and the graphical representation, on the other hand, are expected to increase reusability of CSCL scripts by facilitating the understanding of scripts created by others.

Runtime Environments

CeLS: Collaborative e-learning Structures

CeLS is a web-based environment aimed to provide a flexible tool for designing, creating, enacting, sharing and reusing online collaboration scripts and incorporating them in existing instructional settings. CeLS special feature is the controllable data flow: the ability to selectively reuse learners' artifacts from previous stages according to various Social Settings and to support the design and enactment of rich multi-stage pedagogical scenarios (Ronen et al., 2006; Ronen & Kohen-Vacs, 2010).

How Does CeLS Work?

A script designed in CeLS may include any number of stages. A stage comprises a combination of basic building blocks, while each building block generates a certain type of interface in the student's environment. The special feature in the CeLS approach is its ability to control the data flow in order to *reuse* learners' inputs and products from previous stages and to relate *actions* on these products to different social requirements. In the CeLS approach the social aspects are the key for controlling the data flow within a script. Each building block can be assigned particular Social Settings that determine what information would be presented or which artifacts would be offered for interaction to each participant. The Social Settings may use pre-defined Social Structures that represent the characteristics of students' grouping. Since the functionality of a script is determined by attributing social properties to the script's building blocks, different participants may encounter different information, perform actions on different data items, or perform different actions, during the same activity stage. This approach allows for the design and implementation of adaptation patterns (Ronen & Kohen, 2009). During enactment with students the teacher has full control and can introduce necessary 'on the fly' changes of the script. CeLS is an independent environment though it could be interfaced with other systems that support aspects of scripting, such as MoCoLaDe to expand the potential offered for modeling and enacting pedagogical scenarios (Harrer et al., 2009).

How Does CeLS Advance Research on Computer-supported Collaboration Scripts?

CeLS flexible architecture supports the design and enactment of a large variety of scripts, thus offering a tool for conducting empirical research on the pedagogical efficacy of different types and versions of activities (Kali & Ronen, 2008; Hammer et al., 2010) and for exploring how teachers adopt the use of scripts in real settings (Ronen & Kohen-Vacs, 2010).

How Does CeLS Advance the Implementation of Scripts into Educational Practice?

CeLS is designed to encourage and support teachers to incorporate online collaborative activities into their daily practice by providing them with a flexible tool and examples that they can explore, adopt and adapt. Teachers can also express their pedagogical creativity and design new scripts from basic building blocks. CeLS is used by teachers at all levels (elementary school to higher education) in variety of subject domains: education, psychology, science, technology, medical professions and arts (Abrahamov & Ronen, 2008; Kali & Ronen, 2008). The early adopters are teachers, at all levels and subjects, who are already trying to use the available technology for conducting collaborative activities in their courses. CeLS has enabled them to design and implement pedagogical activities that were very difficult or impossible to handle before.

S-COL: Scripting for Collaborative Online Learning

S-COL was developed to solve the problem of how to use collaboration scripts in combination with multiple learning platforms. The suggested solution implements collaboration scripts and scaffolds as part of a web-browser and thereby allows for the sustainable development of scripts and scaffolds that can be used with a broad variety of content and platforms.

How Does S-COL Work?

The S-COL (Scripting for Collaborative Online Learning; see Wecker et al., 2010) approach to support research on collaboration scripts and their transfer into practice is to implement support measures as part of the browser and trigger them based on the recognition of types of functionally equivalent pages on the Internet. With respect to online discussions, for example, these important types of pages are the form for composing a new message and the list of all posted messages. If the browser plug-in recognizes a specific type of page, it triggers specific kinds of support embedded in the browser. Furthermore, S-COL establishes a communication channel between all connected Web browsers to allow synchronization of activities within groups (e.g., synchronized switching of roles etc.). Administrative functions allow teachers to manage groups and select adequate support measures from a scaffold library. For the developers of new collaboration scripts, S-COL offers a library with functions that allow fast implementations of new kinds of support. The features of S-COL that allow for an easy implementation of scripts allow also several additional functions such as logging the navigation behaviour or the transfer of identification data from pre-test to post-test in field studies.

How Does S-COL Advance Research on Computer-supported Collaboration Scripts?

Computer-supported collaboration scripts developed by different researchers differ regarding more aspects than just the specific process that they aim to facilitate. The collaboration scripts are often an integral part of the experimental learning environments (e.g., Stegmann et al., 2007). Replications of effects of specific scripts using other learning platforms than the origin are usually not done. Using S-COL may help to tear down these invisible walls between research labs. The effects of the very same script can be examined using different learning platforms and also across different cultures. This is the only way to investigate interaction effects between the script, the learning platform at hand, and the cultural background of the learners.

How Does S-COL Advance the Implementation of Scripts into Educational Practice?

Once a script is developed and successfully evaluated, S-COL allows for easy distribution of the script. Regardless of the learning platform in use, the script can be used to support collaborative learning. Because the scripts are implemented as a ready-made part of the browser, their adaptation to any collaborative learning platform requires nothing more than the adaptation of the template file for the recognition of the page types within the learning platform actually used. For example, by inserting unique features of the message composition form of the online learning environment (e. g., URL, control elements such as text boxes or buttons) into the template file, S-COL is enabled to recognize the types of functionally equivalent pages.

Discussion

And the winner is? Of course, it would be more dramatic to elect one approach as the best. The truth is that all approaches have their strengths and weaknesses. None fits all needs of research *and* transfer in to practice sufficiently. One conclusion could be to have different tools for different purposes. However, the main problem seems to be the gap between research and transfer into practice. Most tools presented are either focusing on one or the other aspect. To close the gap, an approach is needed that integrates different approaches. A combination of concrete learning environments that support scripting (e.g., CeLS) including script libraries (e.g., ManyScripts), languages, frameworks and according editors to develop new scripts and describe them in a machine-readable format (e.g., MoCoLaDe, Collage), and tools that allow the transfer of scripts between different learning platforms (e.g., S-COL).

The conclusion should rather be that we need the "CeLS-ManyScripts-MoCoLaDe-Collage-S-COL" approach. To support research and transfer into practice at the same time it would be preferable to have a tool that allows an easy development of scripts and the transfer of scripts between learning platforms. The platform needs to understand patterns and/or IMS/LD and should offer a script library with effective scripts that can be easily adapted and further developed by educators. Furthermore, learning platforms are needed that offer an interface to realize specific aspects of collaboration scripts, like group formation on the base of meta-data of users.

Symposium Activities

The goal of the symposium is to bring together educational researchers, computer scientists and practioners to discuss an agenda for the next steps to facilitate the sustainable development of collaboration scripts. Therefore, we start the symposium with an overview of four exemplarily tools. Each approach will be shortly introduced in a firehose presentation with examples of current research and a short demonstration. Then, strengths, limitations and future directions for each tool will be discussed . Next, a discussant will provide anchors for the discussion with the audience about the pros and cons regarding research on and transfer of the different approaches. The discussant will be Armin Weinberger, who was the leader of the European Research Team CoSSICLE (Computer Supported Scripting of Interaction in Collaborative Learning Environments). This research team developed the aforementioned specification of computer-supported collaboration scripts (cf. Kobbe et al., 2007) that strongly influenced all the approaches presented in the symposium. The final phase is reserved for an open discussion and idea generation about the agenda to integrate the approaches.

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