Scripting Small Group Processes within a Learning Community

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Abstract: Building on research concerned with scripting and learning communities, this study explored how to script small group processes within a larger community-wide script. Small group scripts, Peer Instruction (PI), Community Supported Worksheets (CSW), and Community Knowledge Construction (CKC), were designed and implemented in an online preparatory mathematics course for 181 freshmen. The completion rate and completion quality of group activities were analyzed. Except for CKC activities, PI and CSW had a satisfactory completion quality. We analyzed the impact of group activities on students' epistemological beliefs about learning communities, and also performed content analyses of students' ideas and artifacts, to show the reciprocal influence between the community and small groups. Results show students had a significant agreement that the whole community is an important source for learning. Meanwhile, after taking this course, they had a more profound conceptual understanding of the context, purpose, means, and challenges of the learning community.

Introduction

In recent years, there has been an increasing interest in scripting for instructional design. As new technologies enter the wider practices of teaching and learning, we are seeing a surge of interest in phenomena like "flipped classrooms" (Akçayır & Akçayır, 2018) and "active learning" (Beichner, 2012), in which students are engaged in dynamic interactions with peers, leveraging collaboration and Computer-Supported Collaborative Learning (CSCL) techniques and technologies (Slotta, Tissenbaum, & Lui, 2013). There has also been some research in the learning sciences about the structure and discourse patterns that occur within such learning designs, which includes ideas about collaborative groups (Dillenbourg & Jermann, 2007; Weinberger, Kollar, Dimitriadis, Mäkitalo-Siegl, & Fischer, 2009), design teams (Kozlowski, 2018), and learning communities (Bielaczyc & Collins, 2009; Slotta, Quintana, & Moher, 2018).

The present study builds on a body of research concerned with scripting (Dillenbourg & Jermain, 2007; Kollar, Fischer, & Slotta, 2005; Weinberger et al., 2009), with a particular interest in prior studies of the role of external collaboration scripts in relation to participants' internal scripts or knowledge (Kollar, Fischer & Hesse, 2006; Kollar et al., 2005). This research also builds on prior work concerned with learning communities or collective inquiry (Slotta et al., 2018), which argues for the importance of scripted interactions that allow community knowledge to take from and serve as a resource for subsequent (also scripted) inquiry within the community. In particular, we examine whether small group scripts can gain structure and definition, as well as valuable inputs, from being situated within a larger community-wide script. Jigsaw designs (Aronson, 1978) are a common example of such, where the specific scripts that guide several small specialist groups are designed to fit within a larger script to recombine those groups such that knowledge and products developed by various small group specialists become available across the community. The current paper builds on specific principles of learning communities (e.g. *Sharing Principle and Structural-Dependence Principle*) articulated by Bielaczyc and Collins (2009), to interconnect small group scripts within a broader community, in a math course for freshmen, focusing on logic and mathematical proofs. We examine the impact of such connections on students' epistemological beliefs about the value of community in learning and also perform content analyses of student ideas and artifacts, to show the reciprocal influence between the community and small groups. We close with a discussion of considerations that are important to the CSCL research community.

Literature Review

Learning community and group process

The term *learning community* refers to advancing the collective knowledge to support the growth of individual knowledge (Scardamalia & Bereiter, 1994), where everyone is involved in a collective effort of understanding (Bielaczyc & Collins, 2009). In a learning community environment, individuals benefit from: (1) learning in a social constructivist environment to construct knowledge (Palincsar, 1998); (2) multi-cultural communication, where diverse cultural backgrounds are valued (Cifuentes & Murphy, 2000); and (3) extending individuals' Zone of Proximal Development with the collective knowledge of learning community (Hung & Chen, 2001). However, learning communities have complex social, cultural, and cognitive situations (Hung & Chen, 2001), which make it difficult to build a learning process with a vibrant and sustaining sense of community. Guiding a large number of students through a CSCL environment including facilitation of specific activities and providing feedback is a challenging task (Weinberger et al., 2009). The distribution of a global whole community process over different individuals or groups is a mechanism commonly exploited in CSCL scripts (Dillenbourg & Jermann, 2007). Small groups are like microelements, which interact and consist of the whole community. The interconnections of small group processes create opportunities for knowledge building and leveraging the collective resources of the community (Slotta & Peters, 2008). By focusing on small group processes, we aim to make learning communities more feasible and effective. A related area of work from the practitioner community is concerned with active learning (Beichner, 2012), where many different forms of interaction have been explored. Especially these three small group scripts: (1) Peer Instruction script (Fagen, Crouch, & Mazur, 2002; Mazur, 1997): students are engaged individually, in small groups, and as a whole class in reflecting on patterns of responses to carefully crafted multiple-choice items; (2) Community Supported Worksheet script (Li, Dai, Wang, & Slotta, 2020): students work on a difficult problem in a small group to find a correct solution. Groups are asked to provide solution hints to help other groups who have difficulties; (3) Community Knowledge Construction script (Slotta & Peters, 2008): students contribute to a shared knowledge base collectively to reflect and consolidate their understanding.

Personal epistemological development and epistemological beliefs have attracted researchers' interest since the late 1980s. Epistemological beliefs refer to learners' beliefs about the nature of knowledge and the process of its acquisition (Magolda, 1992). They can shape students' engagement in learning communities by influencing their cognitive thinking and reasoning (Peer & Lourdusamy, 2005) and active involvement in the learning process (Magolda, 1992). Previous research has found that a change of epistemological beliefs could help students understand the meaning and effects of learning science and learning communities (Slotta & Peters, 2008). However, epistemological beliefs are not easy to change (Peer & Lourdusamy, 2005). To some extent, a person's epistemological belief is a context of how knowledge is accessed, which comes from an accumulation of previous learning experience. As we know, learning communities are a culture to seek a collective effort of understanding (Bielaczyc & Collins, 2009). An effective learning community approach will influence students' epistemological beliefs in a productive way (Acosta et al., 2014). Thus, the change of student epistemological beliefs can be evidence for having a good learning community approach (Li et al., 2020).

Collaboration scripts

CSCL allows a wealth of new affordances for learning within the groups. However, learners find it hard to engage in productive collaboration processes without guidance (Weinberger et al., 2009). Kollar et al. (2005) introduced the construct of collaboration scripts as one means of providing such guidance. They used carefully constructed scaffolds to support pairs of students who created structured arguments concerning scientific debates. This study found that a highly structured external collaboration script supported the acquisition of *domain-general knowledge* of all learners regardless of their internal scripts. Ensuing work, conducted by Vogel, Kollar, Ufer, Reiss, and Fischer (2016), examined scripting in the context of a higher education mathematics course. It found that a highly structured domain-general collaboration script for argumentation was more effective than a less structured one to acquire disposition to use argumentation skills.

While collaboration scripts offer an interesting form of scaffolding for small group processes, there remains a wider question concerning the scripting of an entire class community, as it progresses through topics, activities, and assessments. Whole class scripts have been described by Dillenbourg, Nussbaum, Dimitriadis, and Roschelle (2013) as a way of offering higher-level guidance and structure to support the classroom community. For example, in the Concept Grid script (Dillenbourg & Jermann, 2007), the class is presented with a two-dimensional grid of concepts that must be addressed collectively, such that students must choose open squares to ultimately complete the grid. Such scripts are often described in close conjunction with the notion of orchestration (Dillenbourg et al., 2013; Slotta et al., 2013), such that the interaction of individuals, small groups, and the class as a whole is scaffolded jointly by the instructor and supportive CSCL technologies. Slotta and his colleagues (e.g., Slotta & Peters, 2008; Slotta et al., 2018) have advanced a model of scripting for learning communities called Knowledge Community and Inquiry (KCI). Dillenbourg et al. (2015) introduced the notion of an orchestration graph, to describe the shifting patterns of discourse and activity across social planes (e.g., individual, small group, whole class) that support smooth orchestration of activities within such designs.

However, while CSCL researchers have made advances in the forms of scripting and orchestration for whole-class inquiry, there remains a gap between the fine-grained studies of scaffolded collaboration (e.g., Kollar et al., 2007; Vogel et al., 2016), and the community level scripts such as those of Dillenbourg and Jermann (2007) or Slotta et al. (2018). Given the emphasis placed by CSCL on the importance of social practices within a community of learners (Kollar et al., 2006), well-designed collaboration scripts should serve to support group processes, enhance individual learning, but also reinforce exchanges amongst the wider community of learners (i.e., between a group and other groups or with the community as a whole). Scripts addressing both small groups and the community level are also supposed to support knowledge construction within the community, and the use of that knowledge as a resource for inquiry (Slotta et al., 2018). An important question for further research is concerned with how to define collaboration scripts such that they promote effective individual (and small group) learning as well as productive exchange amongst peers within a classroom community (Dillenbourg et al., 2013; Kollar et al., 2007).

There has been some research about how small group scripts help the learning communities. For example, "jigsaw" designs establish small groups that specialize in one aspect of the topic, then recombine into new small groups (each of which include at least one member who specialized in each of the previous topics) which serves to support the wider learning community (Dillenbourg & Jermann, 2007). Slotta et al. (2013) report on the use of scripted small groups within a KCI curriculum, where small groups were responsible for different parts of the inquiry, contributing to the progress of the community as a whole. Because small group activities were situated within the context of the broader community inquiry, this allowed new affordances for epistemic and pedagogical designs (Slotta et al., 2018). However, these studies did not explicitly address the specific guidance and scripting of small groups within the context of the broader scripts for the learning community. While there were small groups present within the designs, and these were instrumental to the collective progress, the specific nature of the scripting for these groups was not a formal matter of study.

Research Questions

The present study seeks to define specific small group interactions in the context of a broader community of inquiry. The prior findings of this scripting research were helpful to guide our designs for small groups but neglected to include the interface with a learning community. This work will build on previous studies of Kollar et al. (2007) and Vogel et al. (2016), engaging students in the same higher education mathematics context, but with an additional level of scripting across the group and whole class contexts. The group processes were designed to explicitly engage the community context, making beneficial knowledge contributions, and gaining important community inputs. In order to explore what group processes may bring to a learning community and how small group collaboration scripts facilitate learning interaction and collective knowledge sharing, two research questions are addressed: **RQ1:** In what ways can we design scripts for small group processes to support and benefit from a learning community? **RQ2:** What changes in students' learning behavior and epistemological beliefs of a learning community's role in individual learning can be identified over a course using such scripts?

Methods

Context and Participants. The study was conducted within a two-week preparatory course for prospective mathematics university students in Germany. The course was offered before the beginning of their first semester to support them in the transition from secondary school mathematics to university mathematics. The class was held in German and contained twelve asynchronous online lectures and ten tutorial exercises on elementary number theory and other mathematical topics (e.g., basic propositional and predicate logic, proof techniques, induction, and recursion). Participation in the course was voluntary. Overall, 181 students registered on the learning platform, who were distributed in seven different tutors' classes. Finally, 129 (71.27%) students were included in the analyses, because they (1) agreed to participate in this study, (2) completed the course, and (3) took part in all learning activities and test sessions. As shown in Table 1, the gender distribution is nearly equal with 65 females and 64 males. The mean of their ages is 19.11, which ranges from 17 to 24.

Table 1. Number, gender, and age of participants

	Tutor 1	Tutor 2	Tutor 3	Tutor 4	Tutor 5	Tutor 6	Tutor 7	All
Registered students	31	27	26	25	25	26	21	181
Participants	27	26	6	14	18	21	17	**129 (71.27%)**
Female	10	19	3	6	7	9	11	65 (50.39%)
Male	17	7	3	8	11	12	6	64 (49.61%)
Age	19.00 [17, 24]	18.63 [17, 21]	19.33 [18, 24]	19.09 [17, 21]	19.47 [17, 24]	19.35 [17, 24]	19.33 [18, 23]	19.11 [17, 24]

Material and activity design. The course had two parts: (1) Watch lecture videos asynchronously and autonomously; (2) Participate in synchronous Zoom tutorial meetings (90 mins per one), which were conducted by seven mathematics tutors. Eight mathematical topics, such as logic, quantifiers, and divisibility, were addressed within the course. For each topic, three or four small group activities were designed for the tutorials. Materials used in the activities were designed by one mathematical lecturer, an experienced instructor for the subject matter. Meanwhile, both lecturers of this course improved and confirmed the use of these materials. Thus, the activity materials used were suitable for study purposes. All students were assigned to these seven tutors randomly and equally. A learning platform named SCORE (SCripting and ORchestration Environment) was used to implement the learning activities. The student epistemology belief survey (Acosta et al., 2014; Madhok et al., 2010) was adapted for pre-post tests, which had two multiple-choice questions (*1. What are your main learning methods?* and *2. What will you do when you have a learning problem?*), two five-point-Likert questions (*1. Discussing with my classmates helps me learn better; 2. The class community (all students in the class, considered together) is an important resource for my learning*) and one open question (*What do you think is a "learning community"?*). The Likert scale was from 1 (*strongly disagree*) to 5 (*strongly agree*).

Small group scripts. Based on the principles for the design of effective learning communities (Bielaczyc & Collins, 2009), we designed activities that help students expand the community's knowledge (*Community-Growth Principle*), and advance the overall quality of knowledge (*Quality-of-Products Principle*). In order to connect small group participants with the whole class community, three scripting patterns were designed and implemented (*Multiple-Ways-to Participant Principle*): Peer Instruction (PI; Mazur, 1997), Community Supported Worksheet (CSW; Li et al., 2020), and Community Knowledge Construction (CKC; Slotta & Peters, 2008). These scripts have been used in the authors' previous studies and applied in this study, for purposes of addressing the research of small groups within a learning community.

PI (*Sharing Principle*): Ten multiple-choice question tasks were implemented. The first two tutorials had two PI tasks each time, the other six tutorials had one per time. All tutors used the same tasks. The PI scripts had three stages: (1) Individual students submitted their answer; (2) Students were shown the combined answers from all members of their tutorial group, as well as the wider classroom community; The answer distribution charts changed when more students submitted their answers, allowing students to see dynamic community responses; (3) Students were asked to reflect: "*What is the difference of the answer distribution between your group and the whole class? What do you think is the correct answer? Is there anything that surprises you?*". Their answers were recorded in the learning systems as the discussion data.

CSW (*Structural-Dependence Principle*): Nineteen CSW activities were designed and implemented as well. Each tutorial had 2-3 activities and all tutors implemented the same activities. Each CSW included four steps: (1) Students were assigned to collaborate in small groups with 3-4 students in the Zoom breakout rooms; (2) A math worksheet was given to them to solve together; (3) If the group had completed the worksheet, they created a hint and provided it to other groups; If the group had difficulties, they could go see the hints made by others; (4) Students were asked to give feedback about the usefulness of hints.

CKC (*Quality-of-Products Principle*): Knowledge base templates for the course were created to invite students to contribute their understanding. There were eight lecture topics in all. Students were given the knowledge base document link after finishing the corresponding tutorial. CKC had two steps: (1) Knowledge base templates were created, which had the modules "*Key ideas we learned*", "*Why this topic is important in math*", "*Help request*", and "*Suggestions*"; (2) After finishing the learning of each topic, students were invited to co-write in a shared document to reflect on their learning.

The above scripts are seen to interact with the whole community on different levels. In integrating the PI script, individuals are engaged in thinking about the problems independently, then have opportunities to identify one's own position within the group and the group's situation within the whole community regarding the tasks. This is a micro script to help individuals benefit from the collective knowledge of the whole community. Unlike PI script, CSW aims to improve communication among small groups. This script engages individuals in "face-to-face" small group activities within Zoom breakout rooms. Connections to the community are of the form seeking help (*benefit from the community*) and giving help (*contribute to the community*). Moreover, "hints" (not "answers") can push small groups who provide help to think deeper because they need to diagnose possible difficulties. CKC is a critical script to connect the whole community. It has three roles: (1) collecting the inputs from PI and CSW; (2) collective knowledge contribution for summarizing and organizing what they have learned; (3) shared space for communication to sense the presence and benefits of the whole community. In all, PI, CSW, and CKC were designed to elaborate as small group process scripts to support the whole community.

Data sources and analyses. Data in this study came from (1) pre- and post- questionnaires, (2) data from learning platforms (i.e. SCORE and shared knowledge document). Data analyses were conducted based on the following steps: (1) Data preparation: data were put together from the sources mentioned above, anonymized, and prepared for analysis. (2) The qualities of each small group activity enactment were mainly evaluated by the research assistant and first author from 1 (*very bad*) to 5 (*very good*). The score was given for each student in each activity. More specifically, PI quality was determined by students' reflection (step 3 for PI) on answer distribution charts. CSW quality was decided by solution hint posts and help-request replies, CKC quality was the number of entries entered by students. (3) Qualitative content (e.g. open-ended survey questions, participants' responses to math problems, and knowledge base data) analysis was conducted by the research assistant and first author; (4) All results were translated from German into English by the research assistant (native German speaker) who was good at English.

Results

Here we begin by reviewing the outcomes of our small group activities, followed by an analysis of the impact on students' perception of the wider community's role, and finally an evaluation of the impact of the community on students' epistemic beliefs (i.e., about the importance of learning from peers and the learning community).

Participation in small group activities

Because the individual tutors varied in their priorities and approaches, they adopted the designed activities to a different extent. As shown in Table 2, PI activities had the highest completion (70%, varying from 20% to 100%). CSW had the least completion (51.9%, varying from 20.1% to 79.0%). Regarding the quality of the activity completion, PI scored the highest (3.53) and CKC the worst (2.39). As we can see, higher activity completion tended to have better quality. Overall, more than half of the activities were implemented by students from these 7 tutors, although some tutors' participants (e.g., # 3 and 4) completed less and with lower quality. A post-test question was designed to ask students which was their most favorite script. One hundred and four (80.62%) participants submitted their answers: 39.42% of them chose PI, 10.58% chose CSW, 6.70% chose CKC. The other 43.27% of participants had no strong preference. This might imply students would not engage in the learning community just because of a strong preference for only a specific script.

Table 2. Completion rate and quality of small group activities

Tutor #	Peer Instruction		Community Support Worksheet		Community Knowledge Construction	
	Completion	$M_{quality}$(SD)	Completion	$M_{quality}$(SD)	Completion	$M_{quality}$(SD)
1	100%	4.0 (1.03)	73.7%	3.2 (1.21)	100%	3.6 (1.32)
2	100%	4.2 (1.23)	79.0%	3.6 (1.01)	87.5%	3.3 (1.04)
3	20%	2.4 (0.93)	20.1%	2.3 (0.73)	0	0
4	30%	2.7 (0.88)	26.3%	2.5 (0.84)	12.5%	1.4 (0.83)
5	70%	3.5 (1.32)	52.5%	3.1 (1.03)	62.5%	2.7 (0.94)
6	90%	3.8 (0.96)	63.2%	3.2 (0.83)	75.0%	2.9 (1.21)
7	80%	4.1 (1.21)	47.4%	2.8 (1.12)	62.5%	2.8 (0.94)
All	**70%**	**3.53 (1.08)**	**51.90%**	**3.00 (0.97)**	**57.10%**	**2.39 (1.05)**

Influences of learning community approach

Three findings of influences of learning community approach (i.e. after the practical experience of the small group processes script activities in this study) were obtained: First, participants were asked about "what was your main learning method before" in the pre-test. The response to "attend the class" was 43.4%, "study alone" was 47.3%, and "learning with friends" was 9.3%. As we can see, more than 90% of participants didn't have a "learning community" approach as their main learning method before. Second, pre-post tests on students' preference for help-seeking showed participants had an increased preference at the end of the class to "ask peers" for help when they have a problem, which rose from 32.8% answers to 63.3%. In correspondence, the response to "I prefer to search the answer by myself" had decreased obviously from 38.0% to 12.4%. The choice "I prefer to ask the course teacher or tutor" had a minor decrease from 29.5% to 24.8%. Overall, students had an increased preference for the "peer learning" method. Finally, as shown in Table 3, there is a significant improvement in students' perception of the whole class community as an important source. Their perception of peers' help did not change significantly with means of 3.91 and 3.82 respectively.

Table 3. Paired *t*-test analysis of student perception of the learning community

Questions	Test	Mean	*SD*	*t*
Discussing with my peers helps me learn better	Pre-test	3.91	0.96	0.89
	Post-test	3.82	0.91	
The whole class community is an important source for my learning	Pre-test	3.40	1.06	-1.93*
	Post-test	3.61	0.92	

Note: $*p < .05$

Student responses to the pre- and post- survey about the nature of communities revealed (in an open coding) four key dimensions, along which their ideas were seen to shift. The first is *Context,* which refers to the setting of the learning community. The second is *Purpose,* which has to do with why we need a learning community. The third dimension is *Means,* which is concerned with how to learn within a learning community. Finally, *Challenge* refers to the difficulties of working in a learning community. Table 4 provides some examples of how students' ideas shifted across these dimensions. As we can see, these were subtle conceptual understanding changes but implied students had a substantial epistemological change. For example, the same student in the pre-test mentioned the "Purpose" of the learning community was to "benefit from the strengths of others". This answer pointed out the advantage of learning community pedagogy. However, it didn't show an understanding of the "strengths" meant, which became clearer in the post-test response as "different perspectives".

Table 4. Examples of students' understanding difference of learning community

Themes	Pre-test	Post-test
Context	"spend time outside of the university"	"do something in a friendly atmosphere"
	"meet at agreed times to deal with a topic together"	"Giving and taking knowledge"
Purpose	"benefit from the strengths of others"	"better understand them through different perspectives"
	"have a higher chance of success"	"more effectively and, above all, more pleasantly in a group"
Means	"learn efficiently and support and help one another"	"talk to each other about the different solutions and thus find the best solution together"
	"collaboration and gathering of students in the same subject area in order to enable more successful and efficient learning"	"coming together and working together on the same topic (mathematics for us) in order to gain the greatest success from learning"
	"come together to learn and help one another"	"work together on tasks, develop possible solutions, help each other and fill in gaps in knowledge"
Challenge	"a group of students who try to work on topics together and support each other to better understand learning content"	"On the whole, I was able to work very well with the other participants in the tutorial, but it was sometimes difficult because one or the other was sometimes very quiet and you didn't really work together."

Discussion and Conclusion

This study demonstrated that small group processes scripts could help individuals become better connected to the wider class community, where individuals contribute knowledge and resources to the community and gain helpful hints and information. According to principles for the design of effective learning communities, three small group scripts were designed and implemented. Three main findings can be highlighted in this study: First, simple small group scripts, such as PI, have a higher activity completion rate and completion quality than more complex scripts (i.e. CSW and CKC). At the same time, PI is the most favorite script for participants, which was adapted from Mazur's (1997) original F2F script. The advantage of an online PI script is to make students have more opportunities to do a deep self-reflection of the solution of problems because writing down thoughts needs more mental engagement, especially for mathematics (Peer & Lourdusamy, 2005). Second, student engagement in the learning community depends on many factors. From the data analysis of the most favorite scripts, most students didn't show a strong preference for a specific small group script. We can interpret this result from two perspectives: (1) small group scripts are better to be designed more diverse (i.e. *Multiple-Ways-to Participant Principle*; Bielaczyc & Collins, 2009); (2) in order to form a productive learning community, group processes should be considered from a more flexible and dynamic perspective. Third, students' learning preferences and epistemological beliefs can be changed by participating in small group script activities. The analysis results showed students had an improved preference for the "peer learning" method and a more profound conceptual understanding about context, purpose, means, and challenges of learning community pedagogy. As we mentioned, the participants were freshmen. It is easy to think the above changes might result from the transition of a more lecture-based high school teaching methods to a rather new, open and collaborative university lecture environment. However, it seems that this is not common for university mathematics students to have a good collaborative learning experience.

In addition, from our findings, we see two main issues. The first issue is the limited group activity time. To address this problem, we see the need to design more elaborate scripts, especially for supporting CSW and CKC. Basically, these two scripts are suitable for activities that have enough time or performed asynchronously. However, if external collaboration scripts are designed properly, students might work more effectively or benefit from the support from learning communities within a limited time. In other words, the scripts should provide clear instructions on how to work on the activities and how to interact with each other in different situations. This will be our next step to iterate this study. The second issue is how to connect support levels of individuals, small groups, and the community successfully. In this study, interactions from different perspectives were designed to make the three small group process scripts more interconnected. The interconnective design is very helpful because it provides broader opportunities for students to access the whole community. It means group processes should be understood from a more global perspective, where the community is in the center but with flexible and various interactions between groups. In the future study, we plan to make the small group processes more connected with the whole community and think about how to measure this interconnection. In this study, the evidence of interaction among the group process scripts is not sufficient, but this is a critical problem related to the effectiveness of small group processes script design.

With the group process scripts, we aimed to help individuals benefit from a broader community. Indeed, students reported a higher agreement that the whole class community was an important source for their studies. It means that they realized the value of the learning community. However, they didn't show an improved perception that discussing with their peers helped them learn better. This also reflects their low preference for CSW script. When analyzing students' answers on "what is a learning community", the question arises whether students truly understand the concept of the learning community and whether the group process scripts adequately change their comprehension. The results show that from the perspectives of learning communities' context, purpose, means, and challenges, students show an improved conceptual understanding of learning community pedagogy. Epistemological beliefs are a foundation for learners' engagement in the communities. In all, this study delivers first ideas and insights from a specific context on how to design small group process scripts to construct a productive learning community. The results showed that the scripts received satisfied feedback from participants. Meanwhile, there are some good recommendations for future studies: First, the small group process scripts in this study need to be more elaborate. It describes how to scaffold the activity flow and interaction (i.e. external collaboration scripts) but also needs to consider how internal group interactions occur. Second, we could look at the small group interactions and adjust the scripts to encourage all (or more) participants to be more active. Finally, in order to increase the value of the community knowledge, it needs better integration or dependency of small group process scripts with the community.

Acknowledgments

This study is funded by the Elite Network of Bavaria (K-GS-2012-209). Special thanks to Xinli Wang at the University of Manitoba and Joel Weber at the University of Toronto, they have worked on this study as well.

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