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Orchestrating 21st Century Learning in Higher Education: A Perspective on Student Voice

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Orchestrating 21st-Century Learning in Higher Education: A Perspective on Student Voice

Abstract: For universities to meet the 21st-century learning needs of today's students, it is important they allow students to take an active role in developing pedagogy and sharing their perspective. This paper introduces design-based research aiming to develop a pedagogic approach to support technology-enhanced learning practices at the university level with the focus on teacher orchestration of learning activities and student voice. Drawing from the perspectives of teachers and students who participated in a course focused on learning and 21st-century competencies, four main elements indicating student voice and technology-enhanced pedagogy are presented: increased interaction among university communities, teacher orchestration, technology and collaborative learning. Enabling and hindering factors related to student voice are presented for each element.

Keywords: Student voice, teacher orchestration, technology-enhanced learning (TEL), 21st century skills, instructional design

Introduction

The future knowledge society challenges universities to develop their educational practices, particularly regarding the role of new technology in supporting teaching and learning. Research focused on the educational use of technology typically begins with interventions to examine its impact on learning by testing whether students learn better with or without a particular technology. The current research-based pedagogic development trends largely acknowledge technology's diverse role in the development of teaching and learning. First, a goal of research in this field is to understand what the increasingly technological society means for learning in various contexts (i.e. how literacies are changing along with new technologies (Leu, Kinzer, Coiro, Castek, & Henry, 2013). The second goal is to provide insights into how technology can be harnessed to enhance the learning of various new skills and competences needed in the knowledge society (Rutten, van Joolingen & van der Veen, 2012). A third line of research, though less prominent, focuses on clarifying possibilities that

technology offers for school improvement by considering student voice as a vehicle for developing pedagogies (Bahou, 2011; Cook-Sather, 2002).

In this article, we approach technology-enhanced learning (TEL) (see Balacheff et al., 2009) from the latter perspective. We introduce a pedagogic approach to support technology-enhanced learning practices at the university level with the focus on teachers' orchestration of learning activities and student voice. We are interested in understanding how teachers' orchestration of learning activities may open space for students' multiple perspectives when engaging and developing TEL practices. We also aim to understand students' perspectives on whether their voice was actually heard during a course offered at one Finnish university implementing TEL practices.

Orchestrating learning activities

Our research-based perspective for designing 21st-century learning builds on the idea of the teacher as an orchestrator of beneficial learning processes (Dillenbourg & Jermann, 2010), with particular attention on student voice (Gentile, 2014; Quinn & Owen, 2016). In TEL contexts, the orchestration of learning originally referred to teachers' pre-design and real-time classroom activities to facilitate students' high-quality learning processes. This might include scaffolding the ways students work independently, in small groups, and/or at the classroom level (Prieto, Asensio-Pérez, Muñoz-Cristóbal, Jorrín-Abellán, Dimitriadis, & Gómez-Sánchez, 2014).

Recent research demonstrates how teacher orchestration in the classroom provides new possibilities for TEL and improves the quality of learning processes (Prieto et al., 2014; Tchounikine, 2013). However, when involving technology, it would be problematic to limit teacher orchestration only to in-class activities. For TEL in university settings in particular, only a small part of the learning typically takes place in the classroom under the teacher's

presence. For the most part, TEL takes place outside actual face-to-face lessons through independent, small-group, or whole-class activities taking advantage of various learning platforms and social media. In the present study, teacher orchestration refers to both designing different types of learning activities that differ in teachers' role, learning objects, students' choices related to technology, as well as managing various learning processes in and outside of the classroom. As our approach is grounded in Vygotsky's (1978) theoretical framework emphasising the fundamental role of social interaction in learning, the orchestration of learning activities also offers opportunities for interaction within and outside the learning community.

Student voice

This article focuses on student voice mainly from a participatory teacher-student interaction perspective aiming to meaningfully transform teaching activities (Levin & Pekrul, 2007). The approach has been argued to have the potential to both authorise students and give teachers opportunities to respond to student voice (Seale, 2009). TEL opens up new possibilities for transformation, participation, and empowerment so that student voice can be taken into account better when developing university studies (Cook-Sather, 2002). Although possibilities for improvement and innovations in higher education are increasing, in reality student voice is not manifested strongly enough in developing instructional practices (Grion, 2014; Smyth & Mc Inerney, 2012). Typically, teaching and related development efforts are based mainly on teachers' own pre-design, and in practice students have little influence on the development of instructional/teaching practices. One problem is that while students' experiences are solicited quite often through course feedback questionnaires at the end of a term, their experiences rarely inform new pedagogical innovations.

As technology is inevitably changing the prevailing culture of teaching and learning, students can play an instrumental role in the development of university pedagogy. For instance, they may be more skilled than their teachers in using various different digital tools and social media applications; thus, such learning resources could be leveraged in the pedagogical design. However, this requires an equalising of power relations to shape what counts as education (Cook-Sather, 2002). In this sense, pedagogic leadership is more of a dialectical process than a fixed process. Particularly in university contexts, the development of organisational practices, norms, and structures calls for a dialogue between teachers and students (Angus, 2006).

Ideally, the interaction among students and teachers serves as a resource for developing teaching and learning practices. In this case, learning and teaching practices develop in an interactive process, where individuals shape their initial understandings on the basis of ideas coming from other participants. This then leads to the construction of new knowledge based on this dialogic collaboration process (Hämäläinen & Vähäsantanen, 2011). This way collective discourse develops and extends one's own thinking. In such cases, learning and pedagogic development can be seen as a by-product of participating in a series of linked dialogues and monologues (Enedy & Hoadley, 2006).

Aims of the study

This study aimed at developing a pedagogical approach to support TEL practices at the university level. In particular, we designed a course that promoted student voice as a vehicle for TEL development. We organised a course on 21st-century skills with three interconnected modules (see Table 1). The course provided students with theoretical aspects on 21st-century skills with a special focus on technologies and hands-on experiences in digital literacies. Students then arranged a seminar for university teachers on digital tools and their

pedagogical use. Further, the study aimed at understanding how student voice as a strategy can impact the adoption of technologies and technology-related practices. The specific study questions were:

- 1) What are the main elements of student voice that higher education students described relating to technology-enhanced pedagogies?
- 2) What factors enabled and hindered student voice?
- 3) How useful did teachers find ideas related to digital tools and related pedagogical practices presented by students in the seminar?

Method

Design-based research (DBR) was used to test and refine educational design based on theoretical principles (Collins, Joseph, & Bielaczyc, 2004). The empirical part followed the idea of articulating the role of technology as a mediating tool for social development, instead of seeing technology as an organizational means to deliver traditional learning (Ravenscroft, Sagar, Baur & Oriogun, 2008). This study followed DBR as follows: (a) we designed a new pedagogical approach that emphasised students' voice as a vehicle for TEL; (b) the focus was on authentic learning and teaching practices over three months (cf. the process in focus); (c) we designed and modified existing teaching practices — a teacher used novel ways of teaching regarding technological applications and student voice (cf. the interventionist process); (d) the study occurred in a naturalistic context and relied on collaboration within a learning community and across a university community. This all aimed at improving university teaching with the theory-driven student-voice approach.

Participants

This study took place in a course focused on 21st-century competencies at a Finnish university, incorporating both student and teacher perspectives. First, five students were chosen for theme interviews (Edwards & Holland, 2013) among students representing 16 participants in the course. Three of the students were Finnish and two were international students. Their ages ranged from 27 to 49 (one male, four females), and they represented three different collaborative teams around which some of the course activities were organized. The teachers participating in the seminar worked within the field of education at the time of the study, and they represented over 40 participants in the seminar organised by the students. Second, 23 teachers completed a web-based post survey to capture their views concerning the seminar on pedagogical digital tools.

Course design

The course, Learning and 21st Century Competencies, consisted of six 135-minute face-to-face lessons and a seminar organized by the students. An additional 114 hours of coursework was then allocated for independent work in small groups or individual task assignments outside of the classroom. Students were given flexibility in how they organised their group work.

The course was designed around three learning modules that concentrated on different aspects of 21st-century skills both in theory and in practice (Table 1). In the first module, students working in small groups were asked to make a mind map on one of the 21st-century skills and compose a one-minute digital video building on their conceptual understanding. The first two lessons provided theoretical perspectives on 21st-century skills and multimodality digital video composition. In the third lesson, all students' videos were watched and discussed.

--TABLE 1 HERE--

The second module consisted of two lessons focused on innovativeness in teaching with technologies and the two-hour seminar, *Cool Tools for Innovative Teaching*, organised by the students for university teachers. The small groups formed in the first module were responsible for giving a five-minute Cool Tool presentation in the seminar and introducing the potential pedagogical uses of their tool in an exhibition following the presentations. The small groups were free to choose one technological tool to share with the staff that would be pedagogically suitable and helpful for university teachers. Students also worked in three teams with different responsibilities for the seminar organisation. The promotion team was responsible for the visual appearance of the seminar and for advertising it. The management team was in charge of the overall planning of the seminar and practical arrangements. Finally, the communication team was responsible for informing the university community and wider audience of the seminar with the help of a person from the university communications.

The third module concentrated on digital literacies with one lesson and a task assignment that asked students to individually compose an expert statement concerning the role of digital literacies in curriculum reform. The task assignment was given through a letter from an imaginary ministry of education representing a state that was preparing a new curriculum.

Data collection and analysis

The participating students and teachers constituted two units of analysis: the students' experiences and the teachers' experiences and interpretation. Students' experiences were collected by interviewing five students. We chose interviews because this approach makes it

possible to explore a complex issue and to draw relevant theoretical and practical implications with a limited sample size (Mabry, 2008). Students' interviews were conducted in 2016 immediately following the course. The interviews covered the following themes: students' reflections of themselves as learners in the course and beyond; the role of technology in their own learning and in the course; collaboration and teacher-student interaction on the course; experiences with the seminar and its effectiveness. The interviews varied from 38 to 65 minutes, and each was recorded and transcribed.

Teachers' (n = 23) views on how useful they found students' ideas on TEL presented in the seminar for developing their pedagogical practices were collected via a web-based survey including seven multiple-choice questions and one open-ended question. Two multiple-choice questions concerned the frequency of technology and social media use in teaching, and five dealt with teachers' perceptions on the seminar's usefulness. Teachers were asked to evaluate the seminar in relation to the following aspects: receiving new pedagogical ideas for applying technology, learning new digital tools, and the likelihood of utilizing new ideas or tools in their teaching. They were also asked whether they had already applied acquired pedagogical ideas or tools in their teaching. Finally, teachers were asked to rate the seminar (excellent, good, satisfactory, poor). The open-ended question focused on teachers' new ideas and how they intend to make use of students' ideas in their future teaching.

The analysis of the interviews focused on uncovering the main elements of student voice described by higher education students themselves. To track the main elements, the data analysis involved qualitative content analysis (Cohen, Manion & Morrison 2007; Saldaña, 2013). First, we read the interview data word for word to capture their precise meanings. Concerning the first research question, we identified the key expressions related to student voice. That is, we designed the initial coding scheme in accordance with our reading

of the transcripts. The names of the codes were based on their meanings. Then, codes with similar contextual meanings (i.e. expressions of similar experiences) were grouped and sorted into the same category. Two independent researchers (authors of the studies) identified the key expressions indicating an aspect of student voice and coded them. All disagreements were discussed and resolved.

To develop the rigor and overall quality of the study’s design and findings, we triangulated different perspectives and data sources (Erlandson, Harris, Skipper, & Allen, 1993). Students’ viewpoints were reflected to what teachers expressed about their technology integration. In addition, we looked for disconfirming cases and included any divergent viewpoints.

Overall, four main categories were found to illustrate student voice. These categories address students’ experiences on how they perceived their voices being heard when developing university pedagogies, which can assist in the future application of student voice in developing TEL practices.

Findings

We found four main elements indicating student voice related to technology-enhanced pedagogies (see Table 2): (a) increased interaction among the university community; (b) teacher orchestration; (c) technology; and (d) collaborative learning. In the following sub-sections, we will describe hindering and enabling factors related to these four elements. These elements emerged at four different levels; individual, learning community (including class, team, and small group levels), university community and broader community (Table 3).

----TABLE 2 HERE-----

----TABLE 3 HERE-----

Student voice mediated through increased interaction among the university community

All interviewed students viewed their presentations of digital tools as an opportunity to be heard within the university community. Participating teachers' active engagement in the seminar and the feeling that they could utilise students' ideas in their future teaching was found to be empowering. One student described her experience as follows: 'I think that the teachers accomplished a lot. Everybody was listening our presentations and there were lots of smiling faces in the audience. They also asked a lot about the tools' (Student 1). Another student also felt that students' perspective was quite apparent at the seminar.

Students also believed that the seminar made it possible to engage in equal interactions with the teachers aimed at developing TEL practices together at the university. Although the low hierarchy in Finnish universities enabled dialogue with teachers, the lack of possibilities for informal interaction was still identified as a barrier, as discussed by one student:

Finnish universities in general are a lot less hierarchical than many universities. Teachers are very approachable. I've been amazed by how willing they are to give you time and to meet and discuss things. But let's see — I guess the only thing I can think of is maybe some more informal opportunities to talk to them and get to know them a little bit more as people (Student 5, international student).

Teachers' orchestration of learning processes

Teachers' orchestration of learning processes seemed to play a meaningful role enabling student voice in the present course. Four out of five students mentioned that they had ownership of their learning; one student described it as follows:

The way it was done was that she let us make a lot of the decisions on our own. We felt, quite a few times, that we weren't sure what to do. Do we ask her [the teacher]? And then she wouldn't tell us what we needed to do; she had us figure it out so we would own the project a lot more, and the sense that we actually might fail gave us a much stronger sense of ownership. Alternatively, if she had arranged everything ...if she had ownership, we knew it would work out and we wouldn't care as much and we wouldn't have learned as much (Student 3).

As shown in this quote, the feeling of ownership was closely related to students' sense of freedom to navigate the seminar quite independently.

An open and collegial learning environment that allowed students to express even incomplete ideas also opened space for student voice. All interviewed students felt that the atmosphere in the course was safe. Two students reported that they felt their teacher was listening to their views. However, another student felt that a lack of communication prevented them from being heard.

An additional aspect of the orchestration of learning processes is how teachers scaffolded the learning community. Students worked individually, in small groups and in teams with a shared goal. Two students responded positively to combining individual and collaborative work, and two other students found working in interconnected groups effective. Working in different collaborative combinations may provide different students room to share their ideas. When some students maybe more willing to share their ideas after first having the possibility to think through the issues themselves, others may be immediately willing to share their ideas in a bigger group. Although it appeared that the orchestration of learning activities mainly enabled student voice, finding the balance between freedom and structure is often challenging. This was also true in the observed course. One student

experienced teacher orchestration in a conflicting way: in some instances, she felt there was too much control and other instances, too much freedom.

Student voice mediated through technology

All five students described technology as one possibility for enabling their voice to be heard. In this regard, technologies were more often associated with enabling than hindering factors. At the individual level, the learner's technological skills seemed to affect the extent to which technology enables student voice. One student who reported a lack of technological skills suggested the smallest range of possibilities for using technology as a means to support student voice. The more experienced the learners were as users of technology, the more optimistic they were in describing how technology might enable and enhance student voice.

At the learning community level, the biggest challenge arose from the freedom of choice with respect to the technologies used. Students' relation to technology as an enabler of their activities was partly ambivalent. On one hand, students pointed out that it was good that they had a say in the choice of technologies (it enabled student voice); however, some reflected that they chose too many applications, which caused confusion and hindered the effectiveness of their work.

[W]e were [operating] in many different [technological environments]: someone was in Optima, another one was in Google Drive and others in email. I...was totally in the dark for two weeks and didn't know anything whatsoever. I was wondering what on Earth the people were rambling about, as there has been no discussion about it. And then there was also Facebook. We had four different channels. There should have been just one where everything was done so everybody could see where we were going. For example, Optima would have been just excellent for this, but people didn't want Optima then. They wanted

[to operate] in Facebook (and I hate Facebook). Then, we had to go to Google Drive, and some of us didn't know how to use it. (Student 4)

Students pointed out that they either should have been able to regulate the activities better as a group or the teacher ought to have orchestrated their learning activities more strictly.

As for major hindering factors for student voice at the university in general, students said traditional lectures do not allow sufficient interaction. However, technology was mostly seen as an enabling factor at the university level. As illustrated by the following example, a special advantage of technology was associated with its capacity to disrupt hierarchical barriers:

Well, sometimes you may notice that teachers are not necessarily so skilled with the technologies. Then, you can show your own competence with technologies. This shows that the teachers are also human and makes it easier to approach them. I mean that the status gap decreases a bit, which, in my opinion, is not necessarily a bad thing either. (Student 1)

In relation to technology at the broader community level, students only mentioned enabling factors. As a special advantage, students acknowledged opportunities to share their perspectives with the 'real world' through different technologies.

Collaborative learning

Collaborative learning emerged in interviews in conjunction with student voice as both enabling and hindering factors. At the individual level, collaborative work was viewed as an opportunity for personal reflection based on group activities, increasing possibilities to express student voice more effectively. On the other hand, the different voices of students in

collaborative settings increased pressures as to how the collective student voice should actually sound (conflicting voices of different students).

At the learning community level, students found at best that they were contributing to the collaborative activities on an equal basis. A challenge identified by the students had to do with the negotiation and reconciliation of different points of view. However, most factors related to collaboration were regarded as promoting their perspectives. Student voice was enabled especially when learning activities allowed a variety of viewpoints, equal contributions, mutual familiarisation, and complementary expertise. One student also explained how she pursued her studies while living in another town and consequentially was not able to regularly meet with other group members face-to-face between lessons. This hindered her ability to bond with the university community.

Usefulness of student voice related to digital tools and pedagogical practices

The use of technology for one's own work was quite familiar to the teachers, and 52% of them reported that they applied educational technology actively in their work. Alternatively, the use of social media in university teaching was considerably rarer, as 45% of the teachers revealed that they hardly utilised social media in their teaching. On the contrary, about one third reported to use it regularly. Teachers believed that at the seminar students presented useful ideas related to digital tools or pedagogical practices. Altogether 86% said that they had received new ideas or technological tools to develop their own work in the university context, and 91% planned to take advantage of them in their work, including gathering information about students' prior knowledge or beliefs before a course, designing new forms of teaching, and developing a culture of experimentation. A few weeks after the seminar, 36% of the teachers reported that they had already applied the received ideas or tools in their work.

Concluding remarks

Traditional university practices do not often allow much space for student voice. However, to meet the needs of 21st-century education, students should increasingly play an active role in the development of university pedagogies (Cook, Holley & Andrew, 2007) especially when targeting lasting educational improvement (Levin & Pekrul, 2007). To address these challenges, this study aimed at designing pedagogical practices that promote student voice to develop TEL in higher education.

This study illustrated that student voice in TEL settings can be channelled in multiple ways within the university community. Student perspectives can be heard by orchestrating special occasions, e.g. seminars, targeted to lower the communicative barriers between students and teachers (cf. Angus, 2006). In this case, teachers speak with students rather than for students (Fielding, 2004). This is in line with the recent research findings indicating that technology may shape the interaction between teachers and students (Hämäläinen & De Wever, 2013). Hence, from the perspective of future learning, a particularly interesting aspect relates to the evocative dimension of learning, that is, how student voice actually influences the development of education. As addressed in this study, evocativeness can be increased by orchestrating student voice in TEL within the university community.

On the other hand, we found that the opportunities to be heard may be experienced very differently among students. This appeared when one student found a learning activity or situation as an enabler for student voice and another student experienced it as a hindering factor (see Table 3). In spite of some contradictory experiences among students, it seems that a safe learning atmosphere, student ownership of learning activities, and the resulting meaningful learning products may be the most important factors enabling student voice. These results are in line with previous research findings on factors like enabling creativity in learning (Davies, et al, 2013). In the university course described, the learning activities that

were arranged to communicate students' perspective on TEL in the university community were particularly empowering.

Finally, the study illustrated that student voice can serve as a strategy to enhance the adoption of technologies and technology-related practices. The results of the survey for university teachers verified the students' experience of the successfulness of the seminar to be true. Namely, the results of the survey provided encouraging evidence that students have much to offer in the development of pedagogic and other university practices. Survey respondents found student voice to be a useful instrument for the development of their pedagogies; most of them had planned to take or had already taken student voice into account in their work-related development efforts. As this study was only limited to explore teachers' perspective through questionnaires, there is a need for understanding how student ideas transfer to practice and how students' voice advances teachers' current TEL-practices, such as the integration of social media and tools for promoting higher-order thinking skills (Postareff, Lindblom-Ylänne, & Parpala, 2014).

Another limitation of this study is that we primarily relied on student and teachers' perspectives after the course to understand how technology fostered their voices being heard. Future research should also closely examine instances during collaboration when student and teachers' voices are expressed through different technological and face-to-face mediums, and how others respond to their voices. This type of data would provide a more nuanced and complete picture of how student voice can be expressed or stifled through technology. The strength of this study is that it identified factors enabling and hindering student voice. These factors offer the foundation for larger-scale studies on understanding how student voice can be utilized in developing TEL-practices in higher education. This line of research is worth of investigating, as it appears that both teachers' and students' experiences support the notion that student voice can change the scenario of pedagogical practices (Quinn & Owen, 2016).

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Table 1

Learning Modules on the Course

Learning modules in the course			
	<i>I Digital video composition</i>	<i>II Organising a seminar</i>	<i>III Composition of an expert statement</i>
Task	Composing a digital video on one of the 21 st -century skills and preparing a mind map to inform the video production	Organising a seminar being responsible for both the content and arrangements	Composing an expert statement on the role of digital literacies in the new curriculum
Audience	Learning community	Department staff	Imaginary audience
Technology used	MovieMaker/iMovie A mind map tool* Adobe Connect Pro	Optima learning environment Online Inquiry Tool for controversial issues Facebook ** Google Drive** Survey Monkey**	Optima learning environment
Outside resources	Visiting lecturer from overseas	Communications officer	----
Collaboration	Working with a small group	Working with a small-group and with an organising team	Individual work

* Student chose the tool freely or from the list of suggested tools

** Students' self-selected tools for working

Table 2

Description and examples of main elements indicating student voice related to technology-enhanced pedagogies

Main element	Description	Example
Increased interaction	Descriptions on offered possibilities to teacher-student interaction.	I felt that we were able to explain and share ideas to them (teacher audience) how to use the tool whilst we were probably able to lower the threshold to try. (Student 2)
Teacher orchestration	Descriptions on how the teacher orchestrated the learning processes during the course.	Especially during the second module of the seminar, which was the Cool Tool seminar, she (teacher) was more one of us and she was the final say on a lot of stuff but she left almost all of it up to us. We designed everything ourselves, she did the classroom booking, only because we weren't actually able to. So there was the dynamic there where she was very hands off "You guys get together" ... But mostly she left it up to us and she gave us direction and just kind of said go and we went, even in other parts of it the third module it was a very traditional professor lecture which was kind of nice after have that everyone works together, now it was I could do this by myself (Student 3).
Technology	Descriptions on the use, role and skills related to technology.	When we were preparing the seminar, we were allowed to get to know the programs by ourselves. We were also allowed to decide what kinds of programs we use for presenting the tools. I bet that the student-perspective was apparent in other groups as well (Student 1).
Collaborative learning	Descriptions on group and team work.	I was in the X team for the first part, the video and it was a very equal group. So, we all contributed different parts..... And we just often talked about things and it would be who would write it up. But, it was a lot of discussion about the ideas and a lot of I guess, decision-making but it was done very equally. It wasn't necessarily that any of us had particular roles (Student 5).

Table 3 *Enabling and hindering factors of student voice. A number in the parenthesis refers to a specific student.*

		Collaborative learning	Technology	Teacher orchestration	Increased interaction
Broader community	Enabling factors		Transferring new technological ideas to work life (1) Transferring new technological ideas to personal life (4)	International collaboration with other university (1)	
University community	Enabling factors		Technology lowering hierarchical barriers (1)		Collaborative practices (2, 4, 5) Low hierarchy (2, 5) Student perspective (1) Teachers utilizing students' ideas (1, 3, 4, 5) Teachers active engagement in the seminar (1, 2, 4) Possibility to equal interaction between teachers and students (1, 2, 4) "Feedback week" (1)
	Hindering factors	Lack of "own group" (2)	Traditional forms of learning (2, 3) New forms of teacher-student interaction (4)	Lecturing (1, 2, 3) Lack of resources (1) Hierarchical organization (2, 4) Learner's unwillingness to give student voice (4)	Language barriers (5) No student influence for choosing texts (5) Not enough possibilities for informal interaction (5)
Learning Community (class, team & small-group level)	Enabling factors	Variety of perspectives allowed (1, 2, 3, 5) Abilities to compromise (2, 3) Equal contributions (1, 5) Getting familiar with each other (1, 2) Complimentary expertise (1)	Expression through multiple modes (1, 3) Technology as a mediator to take leadership (2, 3) Own choices of technology (1, 4)	Student ownership (1, 2, 3, 5) Freedom of designing seminar (1, 2, 3, 5) Shared engaging goal (5) Responsibility (1) Listening students' views (3, 4) Safe atmosphere (1,2,3,4,5) Teacher as a facilitator (3, 4) Combining individual and collaborative work (1, 4) Interconnected groups (2, 5) Experimental learning (3) Self-directed (3) Flexibility (1) Teacher's professionalism (4)	
	Hindering factors	Negotiating different views (3, 4)	Too many technologies selected by the students (1, 2, 4) Garbled technological environments (2)	Teacher's low orchestration (4) Teacher's too high orchestration (4) Lack of communication (3)	
Individual	Enabling factors	Personal reflection stimulated by group work (3)	Good technological skills (1,3,5)		
	Hindering factors	Pressure when facing new challenges (3)	Lack of technological skills (4)		