CSCL and Vocational Education: A Bond Worthy of Investigation?

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Abstract: Vocational education and training (VET) is tasked to develop its practices to enhance learners' collaboration skills. Collaborative technologies play an increasing role in initial VET. This paper presents a systematic review on the use of CSCL in initial VET. Starting from an initial set of 823 papers, identified in major databases, each paper was coded by multiple researchers to identify demographics (sample sizes, countries, work domains), methods (data sources, technology design) and outcomes (analysis, forms of collaboration). Finally, only 26 papers met our selection criteria, which illustrates that CSCL research is dominated by K-12 and higher education contexts, while vocational learning contexts are under-represented in this field of study. This observation spurs the question if there is anything unique in VET worthy of being investigated through a CSCL framework. Our analysis hints at a positive answer to this question, both for technological and collaborative components.

Introduction

Vocational education and training (VET) must meet the challenge that future workers need to have a broad range of skills. Stamm (2007) showed how vocational learners are qualified for professional life as they hold "practical intelligence", which includes both specialized knowledge in the professional domain and its application into practice. Practical intelligence articulates technical, specific, practical skills to "personal characteristics - like reliability, willingness to take responsibility, social skills, ability to participate, team work/player, emotional intelligence, intuition" (Strahm, 2016, p. 43) and therefore constitutes a key factor to comply with the needed qualifications for labour market.

The global workplace is changing radically (OECD, 2012; Hämäläinen, De Wever, Nissinen & Cincinnato, 2017). In parallel with rapid changes in contemporary work environments, initial VET (undertaken before or upon first entering work life) is required not only to support the development of professional knowledge (i.e. specific content-knowledge on e.g. marketing, nursing, or electrical engineering) but also to prepare students for their future working lives (European Commission, 2013). Collaboration has always been an important element of learning and working. However, what has changed is the extent to which modern society and global working life requires collaboration skills, particularly in technology-enhanced environments. As a direct result of these changes, VET is under pressure to develop its practices to enhance learners' collaboration skills. This raises the question about how the CSCL society responds on VET needs to meet the challenge of developing and improving a broad range of collaboration skills needed in working life.

In view of preparing future workers for their jobs, using technology-enhanced learning can be an important driver. One the one hand, technology allows to bring more practice in the training of VET students. Especially in dual systems combining school-based and company-based tracks, technology can be exploited to reduce the gap that learners often perceive among learning locations (Taylor & Freeman, 2011; Eteläpelto, 2008). On the other hand, technology can be used to support collaboration, together with the application and practice of the abovementioned practical intelligence skills and attitudes. Specific models to exploit both these affordances of technology in vocational education have been elaborated recently (Schwendimann et al. 2015). Therefore, it seems that computer-supported collaborative learning (CSCL) may hold some promises for VET. So far, however, there is no comprehensive review of studies on CSCL in VET.

Aim of the study

Given the lack of a comprehensive review on the topic, the aim of this paper is to provide a systematic review of studies that are focusing on CSCL within an initial VET context. More specifically, the following research questions will be investigated:

- What are the demographics of the selected studies on CSLC and initial VET (sample groups, countries, work domains)?
- What research methodologies were used in the selected studies on CSCL and initial VET (type of study, data sources, focus on outcomes and/or processes, framework, actors and interactions, and technology design and usage)?

Method

We have conducted a systematic literature review to answer these research questions. The review consisted of several phases. In a first phase, papers were gathered by searching seven databases (Scopus, ISI Web of knowledge, LibHub, ERIC, Proquest, ISTOR, and Sciencedirect) and Google scholar with the search query [collaborat*] AND [VET OR vocational OR education OR training] AND [technolog* OR online OR web-based OR computer*]. Whenever possible, searches were restricted to peer-reviewed paper. In total, 823 papers were gathered based on matches with the title, abstract, or keywords of the paper.

Next, all 823 papers were evaluated based on their abstracts. Papers were excluded if there was no indication that the study was on (1) VET, (2) collaborative learning, or that the study had (3) empirical results and adequate descriptions of their methodology.

The remaining 189 papers went through a second screening in which two coders independently decided for inclusion or exclusion based on the three criteria described above, together with a fourth criterion: a focus on initial VET. Studies that focused on professional development, including, amongst others, teacher training or medical training, were excluded. Disagreements between coders were resolved with the help of a third researcher.

In total, 84 papers remained for full-text analysis. Of those, 55 were excluded after analyzing the full-text version (again with the same procedure: Two independent coders, one extra coder when they disagreed). Finally, 26 papers remained, which were now analyzed in detail, with respect to the number and nature of the participants, work domain, research method, data collection, focus of analysis, theoretical framework, specific technologies used, type of technology, and novelty (see the full list of papers here: http://dx.doi.org/10.6084/m9.figshare.4203333.v3).

Results

Overview and background of the studies

To provide an overview of the background and demographic of the reviewed studies, we focused on the amount of studies found, their sample sizes, work domains, and country context. First, we were surprised that only 26 articles, out of 823, met the criteria for reporting empirical evidence for initial VET and CSCL and thus were included in our review.

Second, when having a look at the sample sizes, results show that most (n=21/26) studies were rather small-scale. Twelve studies had less than 50 participants, while nine had between 50 and 100 participants. Four studies reported findings on a sample between 100 and 200. Only one study included more than 200 participants.

Third, there is a large imbalance in the geographical distribution of the papers. Most papers have been produced in Finland (10 studies; 39%) and Switzerland (8 studies; 31%). The contributions by Swiss researchers can be traced back to an extensive national funding program supporting studies on technology enhanced learning in initial VET contexts. In addition to this, most studies focused only on one country (25 papers), taking country-specificities into account. Only one paper included multiple countries, but not as a comparison (Hämäläinen & Cattaneo, 2015).

Fourth, with respect to the work domains, the most frequently studied work domains were 'business administration' (15%) and logistics (12%). Other frequently studied professions included construction and planning (each 8%). Only one study each referred to woodworkers, electronics, administration, health, and information technology. It is noteworthy that most studies did not investigate a specific profession: Six studies (23%) referred to 'general studies', while 20% reported findings from multiple professions.

Methodologies and focus of the studies

Our analysis of the types of studies and their data indicated that about two thirds of the reviewed papers were case studies (n=18). This means that only about one third of the papers reported on (quasi-)experimental studies (n=8). When examining the data collection methods, the three most popular methods were questionnaires (n=15), video (n=13), and artefacts (n=8). Other forms of data collection included fieldnotes (n=7) and pre/post-

tests (n=7), as well as log data (n=6) and interviews (n=6). Most studies (n=18) combined multiple forms of data collection. Related to this, most studies focused on describing and analyzing learning processes only (n=13), while six studies focused on the outcomes (e.g. learning gains) and another seven studies included both processes and outcomes.

Second, we investigated the theoretical frameworks of the studies. The most frequently reported frameworks were 'scaffolding' (including 'scripting' and 'orchestration', n=20) and 'game-based' learning (including 'gamification', n=11). Other reported frameworks were 'boundary crossing' (n=5) and 'reflection' (n=4) as well as 'peer tutoring', 'self-regulation', 'problem-based learning', and 'community of practice' (each n=3). It is important to notice that two studies used only one framework; 13 studies used two frameworks, and 7 studies combined more than two frameworks. Four studies did not refer to any specific framework.

Third, when considering the actors and interactions studied, we found that the majority of studies focused on students (n=16) and two studies focused only on teachers. Eight studies included both teachers and students in their analysis. Similarly, most studies focused on collaborative student-student interactions (n=26), eight studies on student-teacher interactions, and only one study included student-supervisor - the supervisor is the learner's trainer within the company - interactions. Given the importance of workplace-based learning in vocational education, it is surprising that there was only one study that included the role of supervisors.

Fourth, we explored the use of technology. When dealing with the application of vocational learning in CSCL, a distinction can be made between the design of new technologies to support learning and the use of existing technologies. In this respect, 10 studies made uses of existing technologies to enhance vocational learning and 16 studies presented novel technologies for enhancing learning in vocational contexts. The two most frequently used forms of collaborative technology were serious games (n=10), typically based on authentic workplace situations and applied to learning holistic work processes and online learning platforms (n=8). Other technologies were tangibles (n=4) and blogs/wikis (n=3). One study did not specify any specific technology as students accessed a range of different online sources.

Discussion

This paper aimed at investigating the current state-of-the art of CSCL research in the context of initial VET. One of the first findings that catches the eye is that there is not a large amount of studies within the field of CSCL that focuses on initial VET. One important conclusion of our research is therefore that VET remains an under-researched field of study. Our final corpus included only 26 papers, most of which (more than 60%) originated from two main research groups in Finland and Switzerland, which is partly due to the availability of specific funding programs. The research focus of these two groups from Finland and Switzerland also affected the selection of professional domains, which are otherwise scattered across a wider spectrum. Additionally, the foci of the included studies are diverse with respect to their design, research methods, data collection, and focus of analyses. They are also scattered with respect to the underlying theoretical frameworks. It is also surprising, given the focus on collaborative learning technologies, that only six out of 26 studies analyzed log data. To summarize, the finding that the combination of CSCL and initial VET is hardly found in research is striking, as there are many opportunities for studying CSCL in the VET context, especially given that it is generally agreed that collaborative skills and technologies are increasingly important at the workplace and particularly in initial VET.

On one hand, there seems to be a general agreement that initial VET is an interesting field of research with implications both for educational and professional contexts. However, the CSCL community seems to have just started to notice the potentials of this line of research. This led us to the question if there is anything distinct about initial VET worthy of investigation from a CSCL research perspective. Based on our data, a first hint to answer this question comes from the analysis of the technologies used across the studies and their intersection with the model of collaboration and the kind of expected outcomes. This latter aspect is probably the most VET-specific variable, given the aim to improve the skills and attitudes required by the labor market, and within them the strong emphasis on collaborative skills.

In this sense, three patterns emerge from the reviewed studies. A first pattern refers to collaborative writing-to-learn, where writing was used to foster scaffolded reflection on one's and peers' professional experiences and to exchange views and advice with peers. Existing technologies like blogs and wikis were used to test the effectiveness of specific pedagogical scenarios where the content was specific to the profession involved and aiming at developing declarative as well as procedural professional knowledge in the domain.

A second pattern concerns gamification. Simulations and game-like solutions offered quasi-authentic ways to practice different socio-cognitive collaboration skills, starting from problem-based situations which involved interactions with peers and required the contribution of each group member to be solved. In this case, novel, discipline-specific virtual environments were built to practice work situations that would otherwise be

impossible or very expensive to arrange. The environments allowed enhancing both discipline-independent and discipline-specific vocational skills and attitudes.

A third pattern describes the use of ad-hoc developed technologies integrating tangible objects and augmented reality. Similar to game-based learning, the learning activities were mostly based on collaborative problem-solving tasks. This is the most specific pattern, as both technologies are specific to the needs of the target professions. Content and skills are context-dependent and not transferable to other professions. In this sense, this can also be seen as the most VET-specific implementation of CSCL.

Additional insights come from considering collaboration independently. Looking at the technological component, it enabled new kinds of activities to supplement traditional vocational classroom and workplace practices. For example, mobile tools were introduced to broaden the physical boundaries of the schools and workplaces; 3D spaces provided safe environments to practice dangerous team-work practices; tangibles provided the possibility to deal with abstract complex tasks by reproducing concrete objects and elaborating data provided by them through augmented reality; and, more generally, technologies enabled the elaboration of group tasks to learn work processes holistically through simulating them in a secure, game-based environment or through documentations (using texts and pictures) that assist collaborative analyzing erroneous practices.

While these technologies are promising, a common framework on how to design both collaboration and collaborative learning is often lacking in the studies. Beyond CSCL, it seems that other frameworks are more central in VET research even when collaborative learning is used to design the studies. This suggests that a more specific framework for CSCL in VET is still lacking. Specifically, the combination of school-based and work-based actors (teachers and supervisors) and actions (intertwining learning activities at both locations) defines VET as a specific research field. We see this field as an interesting opportunity to investigate how collaboration structures in a context, where the interaction among people inhabiting different locations is fundamental for the effective functioning of the system itself.

These results suggest the existence of many opportunities for establishing a specific field of research on CSCL in initial VET. It can benefit from investigating the intersections between vocational practices, learning specific work-related skills (such as motor skills, factual knowledge, procedural knowledge), and general skills (such as social and communication skills). To strengthen and further develop this research field, it requires the development of a theory-based, VET-specific framework informing technology design and its intersection with collaboration and learning processes.

To conclude, we hope that the current review is of use to the community by identifying possible streams of research such as the opportunity for developing a common framework and by fostering future CSCL VET research.

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