ICT in Learning and Working Environments

Tietoverkot oppimis- ja työympäristöissä (TOP)

Research group:

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1. Background and significance of the research

Learning environments for knowledge society

Information and Communication Technology (ICT) has a dual role in our information society. On the one hand, ICT is assumed to cause partly unpredictable changes in our future information society and in its educational contexts in particular. Increasing challenges of rapidly changing, knowledge-intensive and technology-oriented working life presuppose that facilities for life-long learning and continuous competence development are guaranteed for people in different phases of life. On the other hand, with the aid of ICT, solutions can be built for answering these challenges. Considerable expectations have been set for the use of new technologies in education at the beginning of this millennium. For example, virtual universities have gained special attention to meet the challenges of the changing society. Distance learning solutions are assumed to provide answers to the problems of availability (accessibility and cost) and the demand for flexibility (time, place and pace) of learning. The most optimistic views suggest that global networks and the use of computers for intellectual communication will further enhance and expand the ways in which humans connect, communicate, and create a sense of community. However, also more critical questions about the possibilities and quality of virtual learning environments have been presented. Since traditional models of distance learning and technology-driven approaches have not inspired researchers and teachers to develop and study innovative pedagogical practices, research and development work of the field has started to focus more on creating many-sided pedagogical practices, utilizing ICT, that can support students in their efforts for deeper-level learning and interaction. This is also one of the central starting points for the work of this research group.

Research on collaborative learning

One of the essential requirements in the rapidly changing society is to prepare learners for participation in socially organized activities and in building of socially shared expertise. This area of research forms also an essential part of the work in this research group. Collaborative learning is nowadays a fashionable phenomenon, but collaboration among students in various learning settings (e.g. in classrooms) is much more complex phenomenon than what has often been thought. Recent research interests have shifted away from analysing the outcomes and products of collaborative work or from comparing whether collaborative learning is more effective than individual learning. Instead of treating collaborative learning as a single learning mechanism, the focus has been directed more towards analysing interactions as a means of gaining insight into the processes of collaborative learning. The aim of such analyses is to identify what constitutes productive collaborative activity (Littleton & Häkkinen, 1999). Recent research on collaborative learning has also called for more exact use of terminology related to the specific forms of collaboration (Dillenbourg, 1999). Collaborating participants learn if they generate certain collaborative activities (argumentation, explanation, mutual regulation etc.), which trigger learning mechanisms such as knowledge elicitation and reduced cognitive load. Baker (2002) has suggested that there is a need to move beyond simple demonstrations of the advantage of group

conditions and focus on studies that seek to understand the processes of collaborative interaction itself and its contribution to learning.

In addition to the cognitive variables, recent research trends have also emphasized the importance of affective, motivational and contextual variables of collaborative learning (Crook, 2000; Stahl, 2003). For example Crook (2000) has pointed out that current conceptions of collaboration focusing on cognitive skills do not pay attention to collaboration as something that is motivated. It is relevant, for example, to ask what then makes students engaged in collaborative activities and how the circumstances for potential collaboration are made for more optimal. Further on, does seeking after shared meaning require intentional activity or does it happen spontaneously? What makes playful and informal collaborations so tempting? Examining these kinds of questions presupposes a strong emphasis on situated and sociocultural theories of learning. Crook (2000) argues that the ecology of collaboration is about the immediate environments within which collaborative learning is supported – the artefacts, the technologies, and the spaces for acting. Also Stahl (2003) has emphasized contextual features of collaborative learning by suggesting that situation reflects previous social activities, and is transformed by current interactions and projections of the future. To sum up, while aiming to understand the diverse viewpoints to collaborative learning, the research we are conducting involves an extremely complex set of variables: cognitive, social, emotional, motivational and contextual variables interacting with each other in a systemic manner.

Research on Computer-Supported Collaborative Learning (CSCL)

Research on collaborative learning and the use of ICT has been integrated in the emerging research area called Computer-Supported Collaborative Learning (CSCL), which aims to create powerful learning and communication environments (Koschmann, 1996). Considerable successful results have been received in CSCL experiments, and many advanced technical infrastructures for fostering higher-level processes of inquiry-based interaction have been developed (e.g. Scardamalia & Bereiter, 1994). At best, shared workspaces and communication tools can provide a natural setting for explanation, knowledge articulation, argumentation and other demanding cognitive activities. They can also enable sharing and distributing cognitive load and bringing thinking out in open – in other words they can function as a collective memory for a learning community helping the storage of the history of knowledge construction process for revisions and future use. Research results of computer support for collaborative learning have, however, been contradictory, and several studies have indicated collaborative learning to be far more complex phenomenon and difficult to realise in real-life settings than what has often been thought (Baker, 2002; Häkkinen, 2001). Collaborative processes are often over-generalized, and any tools for communication and correspondence are called 'collaboration tools' (Roschelle & Pea, 1999). The problem is that if almost any interaction situation is called collaborative, it is difficult to judge whether and when people learn from collaborative situations (Dillenbourg, 1999; Littleton & Häkkinen, 1999).

Networked technology used in different learning environments nowadays provides a learner a relevant platform for communicating and sharing knowledge. Instead, more advanced technological solutions to support many problematic issues in virtual interaction, such as lack of sense of co-presence or difficulties reaching shared understanding in the distributed teams are still missing. It seems to be evident that it is not enough just to offer a forum for interaction, but we also need models and tools to support co-ordination of activities and knowledge approached from different perspectives. In this line of research, we have started initiating and analyzing pedagogical and technological innovations, the work of which will be continued and deepened in the projects that have just started.

Organizational challenges of knowledge management

Despite the fact that current technologies enable to circulate infinite amount of information, knowledge-intensive teams often complain concerns in the extent to which knowledge is actually shared, especially among geographically distributed teams. Further, a large part of the experience remains individual tacit knowledge, it is not shared explicitly, and is lost when experts leave the company. The problem of tacit

knowledge is that it is shared by participation in joint collective activities rather than by delivering information. Therefore, in developing new models for E-Learning, it is important not just to focus on delivering information, but rather to get people to engage in knowledge refining and elicitation activities. In addition to the questions of knowledge management, also the issue of learning at work raises challenges for the research conducted in the group. One of the essential prerequisites for successful functioning of organizations is the flexible integration of working and learning activities – knowledge acquisition cannot be separated from its application. Users are more and more often trained in their actual working environment, on the tasks they face everyday, with the tools and the colleagues, which are part of it. Training will not be a specific activity, such as following a course, but a reflective process on their professional practices.

2. Multimethodological approaches

Recent emphasis on the crucial role of social context in learning has forced researchers to think about what students actually learn in computer-based settings. And what do we want them to learn? Instead of collection of sub-skills we should perhaps emphasise also successful participation in socially organized activity and the development of students' identities as learners (Greeno, 1998). We can regard, for example, improved ability to work in a team and to solve complex and ill-structured real-life problems as important learning outcomes. However, it can be assumed that our traditional methods are not necessarily capable of measuring these abilities. One of the main goals for new kind of learning environments is to think about the suitable criteria and innovative methods for measuring learning in these environments. In addition to descriptions of activities and discourse processes, also knowledge acquisition and learning outcomes should be seen as essential part of research on learning environments.

Since the current methodologies used in CSCL research are not able to capture the theoretical challenges of focusing on processes and context of collaborative learning, we need multimethodological approaches as well as new methodological innovations and tools both for data collection and analysis. In the series of our studies, we aim to increase both specificity and effectiveness of data collection. With process-oriented approach and context-sensitive methods different nature of activity and engagement in learning context will be examined. The special methods applied for examining engagement and experienced effects of collaboration will be on-line interviews. Also on-line questionnaires (Järvelä & Häkkinen, 2003; Csikszentmihalyi & Larson, 1987) will be used in the design experiments where students' situation specific interpretations (e.g. reasons for collaboration or level of engagement) can be measured during the process of collaboration. It is also common to conduct participatory observation or to collect videodata of selected collaborative situations where students are working in certain virtual environments. Also repeated measures for collecting basic information of students' background, prior knowledge, learning outcomes and experience are typically conducted in different working phases. Continuous data collection includes also computer-generated data of students' activity as well as of collaboration and discussion in virtual environments.

The group has strong interdisciplinary collaboration with the researchers from the Department of Mathematical Information Technology on applying computationally intelligent and statistical methods for data analysis in human sciences. This long-term collaboration will be continued in this project, since the tools that have been developed during this collaboration have now reached the phase where they can be used for everyday research purposes. Neural networks are used for analyzing large-scale multidimensional data, especially for data reduction and visualization in clustering and profiling tasks (Häkkinen, 2000; Lensu & Koikkalainen, 1999). In our current research work, these methods are used for several purposes such as for analyzing questionnaires, log-files and text-based documents in follow-up settings as well as for improving the validity of choosing episodes for detailed analysis.

3. Mission and goals of the research group

The task of the research team is to exploit the potential of ICT in developing and evaluating learning environments with a view to developing teaching and learning. Attention will be paid particularly to the construction of meaningful knowledge from the perspective of individuals, groups and the learning

community as a whole. In this context, the team will focus especially on analyzing cognitive and social processes, as well as contextual features related to learning in virtual environments. The theoretical background is anchored into socio-constructivist (Palincsar, 1998) and socio-cultural theories of learning (Säljö, 2000). Particular focus is on various theories and recent research on collaborative learning (Baker, 2002; Crook, 2000; Dillenbourg, 1999; Stahl, 2003), Computer-Supported Collaborative Learning (CSCL; Koschmann, 1996), Computer-Supported Co-operative Work; (CSCW; Dourish, 1998) as well as on the questions of knowledge management (Nonaka & Takeuchi, 1995).

Research themes and questions can be characterized in the following way:
- What is the process of collaborative interaction and its' contribution to learning?
- How do distributed teams manage, monitor and co-ordinate their joint activities?
- How can technology better enable participants to find each other and form collaborative groups around mutual interests, skills, and needs in distributed teams?
- What are the mechanisms of establishing and maintaining the common ground in virtual interaction?
- What is the role of awareness tools in virtual spaces meant for supporting productive joint engagement and shared understanding?
- What is the role of contextual features of collaborative learning (material surrounding, shared socio-cognitive history and prior experiences and attitudes)?
- How can experience-based methods shed light on the functioning of virtual learning communities and interactive design of them?
- What are the conceptions of learning among designers of e-learning environments?
- How can ICT (Internet) support the development of guidance and counselling policies?
- How to develop innovative evaluation methods and methodological innovations related to evaluation of learning in virtual environments?

The contexts of the research conducted in this group and in collaboration with the relevant bodies vary from childhood education and school learning to universities and various work organizations. Development of sustainable and innovative pedagogical and technological solutions presupposes strong anchoring on knowledge base of basic research and multidisciplinary collaboration. Some of the research projects (especially the ones funded by the Academy of Finland and by various graduate schools) are more focused on basic research. However, the research of this field also has to be easy to be applied e.g. in developing pedagogical or evaluation practices among practitioners. Therefore, the research will be conducted in close collaboration with the representatives of schools, university and work-place contexts. More applied research and developmental work is conducted in Peda.net and Opintoluotsi projects as well as in some of the projects conducted in collaboration with Agora Center. Furthermore, since this research field easily undergoes transformations and new applications are needed, this also presupposes interaction between academic research and industrial partners.

The aim of the research group is to conduct multidisciplinary research of high international standards. This presupposes networking and strong collaboration within University of Jyväskylä as well as with national and international partners. The members of the group will publish actively in international and national forums, and participate in national and international scientific conferences as well as organize their own seminar activities. Some of the team members also have active roles in various national and international expert and specialist tasks in the panels and committees of graduate schools, international journals and scientific conferences. One of the specific challenges during this planning phase is to focus on career development of PhD students. Currently the volume of this research group is strongly directed to postgraduate training, which puts pressure for the future years to strengthen the post-doc and senior phases of research. Other particular challenges of the near future are related to developing models and tools for supporting distributed teamwork in the research group (e.g. communication within the group and outside it).

4. Networked research and development forum

This research group can be characterized as a networked research and development forum, the funding of which mainly comes from external sources. Since some projects finish and some others begin during the planning period, also the mission and goals get re-directed and sharpened during this time. This research groups is also an example of the collaboration that crosses the borders of different institutes of the university – the main collaborators in this sense are Agora Center and the Center for Applied Language Studies.

Sharing and Constructing Perspectives in Virtual Interaction (SHAPE)

Scientific leader: Professor Päivi Häkkinen
Researchers: PhD student Kati Mäkitalo, PhD student Johanna Pöysä, PhD student Peppi Taalas (SOLKI), PhD student Katriina Vakkila (SOLKI)
Duration: 2001-2003
Funding: Academy of Finland
Collaborators: Prof. Sanna Järvelä & research group (University of Oulu), Prof. Curtis J. Bonk (University of Indiana), Prof. Eileen Scanlon (The Open University / UK)

The project investigates the nature and quality of virtual interaction in higher education and work place contexts. The research will be carried out in two educational settings both in Jyväskylä and Oulu: a) In higher education (internationally networked teacher education) b) In workplace learning (knowledge-intensive organizations). By combining theories on the role of social interaction in learning as well as on the dynamics of discourse, this cross-disciplinary study claims that the processes of human interaction in negotiation of meaning are more complex than previous research has been able to show. Grounding on this theoretical rationale our assumption is that some of the most important processes in human communication such as the creation of mutual understanding or shared values and goals are hard to reproduce in the web environment. Therefore, our aim is to examine variables that mediate collaboration and interaction, and particularly the emerging processes of sharing and making perspectives in web-based learning. Since the tradition for research in the field is young, most research still lacks theoretical grounding. Therefore, in addition to theory-building, the aim of the project is also to develop methods for data collection and analysis, in order to capture the complexity of human learning and communication. One of the particular research themes is related to the establishment of common ground in virtual interaction (doctoral thesis of Kati Mäkitalo). In order to construct the common ground, individuals share mutual understanding, knowledge, beliefs, assumptions and pre-suppositions. The common ground can be constructed and maintained during the interactive process called grounding. The purpose of this study is to explore the mechanisms of establishing and maintaining the common ground as well as to develop method for analysing the grounding process in collaborative settings.

Ecology of Collaborative Learning: Collaboration as Motivated and Co-ordinated Activity (ECOL)

Scientific leader: Professor Päivi Häkkinen
Researchers: PhD student Kati Mäkitalo, PhD student Raija Moilanen, PhD student Maarit Arvaja (KASVA Graduate School), PhD student Johanna Pöysä (Graduate School of Multidisciplinary Research on Learning Environments), PhD student Ari Sievänen (COMAS Graduate School), Senior Researcher Marja Kankaanranta (Agora Learning Laboratory)
Duration: 2002-2005
Funding: Academy of Finland (LEARN programme)
Collaborators: Prof. Pierre Dillenbourg (Swiss Federal Institute of Technology), Senior Researcher Dr. Michael Baker (CNRS & Université Lumière, Lyon 2), Ass.Prof. Frank Fischer (University of Munich), Prof. Tommi Kärkkäinen (University of Jyväskylä), Senior Researcher Pasi Koikkalainen (University of Jyväskylä)

This research project focuses on the ecology of collaboration, which refers to certain forms of productive joint engagement in learning. The core of the ecology of collaboration is that collaborative and motivational processes of learning, as well as technological tools mediating social interactions are seen as a merged unit uniquely situated in a particular context. Ecology is about the immediate environments within which collaborative learning is supported – the artefacts, the technologies, and the spaces for acting. Linking research on motivational processes of collaboration contributes to the theoretical development of concept of motivation and extends the research on collaborative learning to its process. The empirical objective of the research project is to explore variety of virtual, technology-based environments meant for collaborative working, planning and studying in higher education and work-place contexts. In addition to continuous large-scale data collection, series of design experiment will be organized in order to explore whether the use of innovative applications such as 3D virtual spaces can be turned into effective places for collaboration. Having a focus on both theoretical development and empirical analyses as well as interdisciplinary partnership in technological design, the results of this research project will contribute to the future learning needs and promote practical competence in learning in different educational and work-place contexts.

Contextualising collaborative learning in virtual learning environments

PhD student: Maarit Arvaja
Supervisors: Professor Päivi Häkkinen, Professor Leena Laurinen (Department of Education, University of Jyväskylä)
Duration: 2000-2004
Funding: KASVA Graduate School

One major weakness of the study on computer-supported collaborative learning has been that it has failed to recognise the importance of classroom communities in which collaboration is embedded. The aim of this research project is to develop methodology to study student collaboration as a situated activity shaped by the immediate and mediated contexts. This kind of approach aims to demonstrate how students' shared knowledge construction process in computerised settings is shaped not only by the language or interaction per se but also by the concrete material situation as well as by students' shared socio-cognitive history and prior experiences and attitudes.

Interactive design for virtual learning communities - Student teachers' perspectives

PhD student: Johanna Pöysä (University of Jyväskylä & University of Leuven, Belgium)
Supervisors: Professor Päivi Häkkinen and Professor Joost Lowyck (University of Leuven)
Duration: 2002-2005
Funding: Graduate School of Multidisciplinary Research on Learning Environments

In this study, the metaphor of 'place' and its various layers serve as a conceptual vantage point to structure the design and development of virtual learning communities in higher education context. In order to construct a more holistic framework for social structure and to change attention from individual user to community level does not mean to do away with the dialogue with the participants in it. Rather, the interchange between 'designer', participants and their lived practice are addressed in this work. Definitions of virtual learning communities seem often to abstract participants from their offline environments. However, often students' virtual and physical environments are not essentially separated. Rather than only downloading archives and mainly relying on textual analysis, a more active form of ethnographic engagement with participants is needed. This Ph.D.-project aims to develop a methodological tool, a personal experience method (a combination of visual- and text-based online diaries and observations in virtual environment) that is expected to gain access also to the events outside virtual learning context connecting various social settings and simultaneous events.

Designers' conceptions of learning of e-learning environments

Doctoral student: Ari Sievänen
Supervisors: Professor Päivi Häkkinen and Professor Pasi Tyrväinen (Department of Computer Science, University of Jyväskylä)
Duration: 2003-2006
Funding: COMAS Graduate School
Collaborators: COMAS graduate school, Department of Computer Science, Agora Center

The aim of this study is to find out what are designers' and content producers' conceptions of learning in design process of e-learning environments. This research tries to map designers' conceptions of learning, conceptions of e-learning and how they expect their software to be used in education. These conceptions are compared with end-users (teachers and students) conceptions of learning. This research also focuses of design process of different e-learning environments. Parallel aim of the study is to utilize and apply methodologies developed in computer science to the purposes of behavioural sciences. Particular focus is on conceptual modeling (e.g. metamodelling) and further development of a Genre-based method. Furthermore, this research tries to clarify the direction where the designing process is heading and thus how learning environments are developed in the future.

Peda.net

Leader: Professor, Director Jouni Välijärvi
Staff: Pedagogical designer Jaana Kettunen, Application designer Juha Lahti, Teacher trainer Tuula Hauta-aho
Funding: municipalities, schools, projects etc., EAKR, Virtual University project, University of Jyväskylä
Collaborators: teachers of member schools, personnel of different R&D projects, Continuing Education Centre (University of Jyväskylä), Virtual University project

Peda.net (http://peda.net) is a research and development project. The aim of the project is to (1) develop schools and teachers easy and reliable web tools, (2) collect and create ideas for research on network pedagogy, and (3) train teachers to use web tools on their teaching. Web tools have been created in a close co-operation with teachers and schools. Schools can join Peda.net schoolnet, and as members they may use Peda.net web tools. Tools are used in about 100 Finnish municipalities and also in different international projects. Peda.net tools are used in different educational levels from pre-school to adult education. The main idea of Peda.net is the co-operation with schools. So members have possibilities to influence the further development of web tools. Peda.net is responsible for the administration, development and technical support of the services.
Peda.net tools:
- Web magazine (Verkkolehti) (http://verkkolehti.peda.net)
- Portal (Verkkoveräjä) (http://portal.peda.net)
- OPSpro (http://opspro.peda.net)

ICT in guidance and counselling

Researchers: Raimo Vuorinen
Duration: 2001-2006
Funding: European Social Fund
Collaborators: Prof. James P. Sampson Jr. (The Center for the Study of Technology in Counseling and Career Development at The Florida State University), John McCarthy (DG Education and Culture, European Commission), Michel Turcotte, (Counsellor Resource Centre in Canada, Human Resources Development Canada), Jyri Manninen (Palmenia Centre for Research and Continuing Education at the University of Helsinki). Ministry of Education, Ministry of Labour, National Board of Education, Centre for International Mobility CIMO

A recent evaluation of education in OECD member states concluded that quality guidance is one of the key factors in promoting effective transitions from education to work. Demand for guidance has been expanded due to the increasing rate of change in the labor market and new forms of co-operation between employers and educational institutions. Traditional forms of guidance that rely on individual counseling are too expensive to meet increasing demand within current budget constraints. The overwhelming amount of information generated by the Internet is also making it difficult to comprehensively manage guidance services using traditional methods.

The Opintoluotsi –service ("Study Pilot", "Study adviser") is a project set up by the Ministry of Education with European Social Fund backing. Opintoluotsi's (http://www.opintoluotsi.fi) aim is to help people to find information on education and training and its availability in Finland. Opintoluotsi helps people to discover and use education and training opportunities in a way that suits their individual needs. The Institute for Educational Research works as a sub-partner in the project, and has established a virtual resource center for guidance practitioners, researchers and policy makers as well as developed the professional front end "Expert Pilot" for this Opintoluotsi service (http://www.asiantuntijaluotsi.net). The use of the services is currently monitored and evaluated through user and usability studies. The problems faced by the users and their needs will be analysed, and the service will be developed towards even higher functionality. The research objective is to determine how the Opintoluotsi WWW services can support the development of guidance and counselling policies and the ways in which practical experience in guidance and counselling can be used in developing the overall service. Another focus of research will be to determine how counselling services utilizing information technology change the work of professionals in guidance and counselling.

5. Collaboration with Agora Center

The research group collaborates closely with Agora Center (University of Jyväskylä). In 2002 a Tekes-project 'Innovations in Business, Communication and Technology' (InBCT) was started in Agora Center. One of the sub-projects in InBCT is Agora Learning Laboratory, which is led by Prof. Päivi Häkkinen. The aim of Agora Learning Laboratory (ALL) is to facilitate research on virtual learning environments, research-based evaluation of these environments as well as the use of this knowledge in designing powerful learning environments, pedagogical innovations and evaluation methods for e-Learning purposes. The contexts of the research projects are related to different content areas and educational levels (schools, universities, work organizations). The aim is also to develop models of e-Learning and knowledge management in collaboration with the basic research of the university and the practical solutions of companies. This kind of integration of high-level scientific knowledge, pedagogical expertise and know-how on product development enables rapid transfer of knowledge from research and development projects to serve the needs of educational and working organizations.

Doctor Marja Kankaanranta works for the present at Agora Center but also contributes to the research at the Institute for Educational Research. She continues research projects like 'Digital portfolios' and the reporting of the SITES module 2 results, but also actively initiates new research projects especially on the area of e-Learning. At the Institute for Educational Research Kankaanranta is leading research projects on childhood education.

6. Research training

The aim of the research group is to continue its research training program, the aim of which is to contribute to the creation of new research culture. In developing innovative methods for research collaboration, strong national and international networks are utilized. The research training program consists of four main areas of research training: (1) basic research and theoretical development, (2) methodological training, (3) interdisciplinary research work and (4) international research work. In providing research training in these areas, complementary expertise of different collaborators will be utilized. For example, monthly research seminars or videoconference seminars are organized on theoretical and methodological issues of the research area. Interdisciplinary research training will be given in research methodological issues as well as in technological issues of virtual learning

environments. Particular emphasis in the creation of new kind of research culture is put on promoting young researchers for professional research work in the context of international collaboration. For example, together with the international research partners, seminars and joint workshops are organized for collaborative data analysis and international students' workshops for research training purposes. PhD students are also actively participating in national graduate schools and research training program. As a board member Päivi Häkkinen has been actively involved in establishing the scientific network for the "Graduate School of Multidisciplinary Research on Learning Environments". In addition to the funded positions in different graduate schools, several students of the research group also have status places in this particular school.

7. Dissemination and exploitation of the results

The research results will be published in high-level international and national refereed journals and compilation works. Two doctoral dissertations will be produced during the planning period, and they consist of international refereed articles. The aim is also to strengthen the publishing in Finnish and the visibility of research results in media.

The research conducted in the group will provide gradually specifying information about learning and working in virtual environments. Although there are high expectations towards the virtual university and networked models of life-long education, little is known about these basic processes and their contribution to the quality of learning in virtual learning environments. The expected results will contribute to the future learning needs and promote practical competence in designing pedagogical models for different educational (e.g. schools, Virtual University) and work-place contexts (e.g. learning in knowledge-intensive organizations). In particular, the results can be utilized in developing theoretically justified models, tools and optimal conditions for enhancing learning and working in these contexts.

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