Designing a pedagogical strategy for the implementation of Educational Technology in collaborative learning environments

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Abstract. Educational Technology (Ed. Tech) can provide different approaches to our learning designs and engage and motivate students to achieve their academic aims. However, few efforts have been made to use response tools in collaborative settings systematically. It has been argued that removing the social factor in a collaboration, i.e., the ability to micro-communicate and socially interact, makes it challenging to enhance the learning experience. This article investigates a possible pedagogical strategy to mitigate the potential adverse effects of moving the collaboration into an online or hybrid environment. The article aims at determining which pedagogical strategies are necessary to implement to heighten the learning outcome from collaborative work when using Ed. Tech. The results are extracted from previous research in the project iLikeIT2 and quantitative and qualitative data obtained through instructor training in four different countries with 46 participants. The data is analyzed according to codes and interpreted in the research group. The results provide recommendations on what to consider when using Ed. Tech in collaborative settings. For instance, how to design groups, how to do assessments, the type of facilitation needed, the amount of individual work within the group, and more.

Keywords: Education Technology, pedagogical strategy, collaboration.

1 Introduction

The 21st Century will include digital tools in learning environments at all levels of the educational system, also within higher education institutions in Europe. In addition, digital strategies on governmental and international levels are shaping and transforming our digital future within education.

Digital tools with innovative functionalities, ICT expertise, and various infrastructures and platforms enable students and instructors to explore and investigate new ways of interaction. At the same time, one can distribute and manage learning and teaching differently than earlier. However, these new possibilities require a higher focus on learning design and pedagogical approaches to maximize the potential of the tools.

New digital tools also demand that instructors and experts worldwide acquire new skills and competencies to take full advantage of the innovations to adapt, improve and sometimes change their existing methodological approach. When introducing Educational Technology (Ed. Tech) in modern learning environments, in-class or online, one always needs to keep both these aspects in mind. Technology can enhance the learning experience in various ways, heightening motivation, improving communication, creating engagement, and more. However, one is still most interested in ensuring a better student learning outcome in a learning environment. Technology does not work without pedagogy; therefore, it is necessary to work with both technology and pedagogy simultaneously. Including expertise from different areas of the educational system, like students, instructors, AudioVisual(AV) personnel, and IT, should be the standard when working with Ed. Tech.

The study presented in this article aims to determine which pedagogical strategies are necessary to implement to heighten the learning outcome from collaborative work when using Ed. Tech.

2 Background

Digitizing has often been used to move from one medium to another without changing or adapting the content: Same content, new wrapping/mode of delivery. In other words, technology is a direct substitute/digitized version of traditional activities and materials with no functional change. This statement coincides with the first level in the SAMR – model [1]. Furthermore, the higher levels in the SAMR- model describe enhancement, modification, and redefinition of educational practices and the creation of new tasks due to digital tools/technology. There are also other models for connecting pedagogy and technology, showing that the challenge is real. Still, a literature review shows that the area is still not sufficiently explored [2].

Hence, one needs to investigate further which functionalities in the new technologies can improve existing pedagogical practices and how pedagogical practices can improve the development of new functionalities in technologies. Traditional methods are in use for a reason; they work, and therefore innovative technology needs to be different and bring something new to the table to have an effect. Ordinarily, traditional exercises and activities have mainly been copied and pasted into the digital form, with obvious

advantages of distance learning and faster distribution of materials and tasks to the students, allowing students to be more effective. However, there has been too little focus on applied pedagogy when using technology in learning environments. As the 21st-century technological revolution has changed our lives, the view on digitalization has changed accordingly. Digital tools and skills can change the concept of time, place, and format, enabling "on-the-fly" learning and ownership of the learning process and improving motivation and interest [3]. Utilizing these effects can create new and exciting learning environments that can improve traditional and conservative pedagogical approaches, for instance, considering how one conducts group work.

Modern technology provides new opportunities, like active collaborative learning approaches, fast access to learning materials, and possibilities to investigate materials in a new way. And instant access to an increasing amount of external sources. Consequently, the students can be active in setting the terms for communication and interaction in the classroom. Obtain a clearer view of their knowledge and perception, and maybe even better their self-regulation of learning processes. These new opportunities do not mean that digital tools solve all problems or even make it easier to be a teacher; on the contrary. The need for a pedagogically and digitally competent instructor is even higher today than ten years ago. Therefore, one must find ways to integrate the technology with existing knowledge and expertise. Otherwise, it will only cost lots of time and effort without much gain.

We know it is often difficult in a classroom to get students involved in discussions with peers and the teacher. Some students are seldom able to raise their voices, discuss, or enhance their analytical and social skills in an academic environment. There have been and are many initiatives in order to overcome this challenge. Educational technology is "the combined use of computer hardware, software, and educational theory and practice to facilitate learning" [4]. It has the advantages of involving students, raising engagement and motivation, enhancing peer learning, and ensuring easy diagnosis for the student groups when used correctly [5]. It also provides the lecturer with possibilities of facilitating the usage of EdTech, giving immediate feedback to the group, and it should be easy to integrate into existing lectures.

Collaborative work has the advantages of enhancing social skills, redirecting educational and social strategic goals for the students, and enhancing the learning environment [6] [7]. Collaborative learning is nothing new, neither in work life nor higher education, and it has gained interest in recent years, often connected to concepts of active learning [8]. Allowing students to learn from peers, refine their arguments in a "safe" environment, and take active control of their learning process is something that all lecturers seek. There are several ways to perform collaborative learning in class and online, but they should all caretake the student's various needs to achieve the highest possible learning outcome from these activities. In order to have a successful implementation of online learning environments, it is necessary to encourage students to actively participate and create a sense of belonging to a community of learning. "In the new culture of learning, people learn through their interaction and participation with one another in fluid relationships that result from shared interests and opportunity" [9]—implying that the pedagogy behind the activities is even more crucial than before.

This paper's essence is how to combine new and innovative Ed. Tech with pedagogical strategies.

2.1 iLikeIT2

The results presented in this paper are part of the Erasmus+ co-funded project "Learning Through Innovative Collaboration Enhanced by Educational Technology (iLikeIT2)", running from 2020 to 2023 [10]. This paper elaborates on one of the four significant outcomes of the project: The pedagogical strategy for implementing Educational Technology in a collaborative learning environment.

The project iLikeIT2 focuses on sharing innovative practices in the field of education and, in particular, creating a collaborative learning platform that enables computer-supported cooperative learning functionalities, including communication, coordination, and collaboration tasks [11]. The platform functions mainly as a response tool that builds on research done throughout the three years the project has been running. To build a functioning prototype, it is necessary to (i) identify different aspects of collaborative learning that can support students in their learning, (ii) determine those functionalities that are necessary for enhancing collaborative learning processes, and (iii) design a platform that can support instructor-student-group collaboration, communication, and coordination. These elements are the essential parts of a system that might enhance the learning effects of introducing Ed. Tech in a learning environment.

2.2 Previous research

In a previous study in the project iLikeIT2, the focus was on functionalities inherent in digital tools and their ability to facilitate better collaborative work [12]. The study based its theoretical framework on ideas of Computer Supported Collaborative Learning (CSCL). CSCL has been proven in previous studies to improve "student motivation and critical thinking" [13]. During the early years of shaping CSCL, Lehtinen et al. (1999) argued that "there are not too many well-controlled experiments which could answer the questions concerning the wider applicability of CSCL in normal classrooms and the added value of computers and networks in comparison to collaborative learning environments without technology" [14]. Of course, there has been a radical improvement in the CSCL framework since the beginning of this millennium. The refinements have shown six categories essential for developing functional tools for collaborative work.

- Delivery – we believe it is necessary to enable instructors and learners to collaborate and communicate without interrupting learning delivery, such as : A teaching presentation, demonstration of an application, use of a browser to show a website, display of visual content or video, and sharing files.
- Interaction – we determined that the leading exchanges between instructors and learners during a teaching session would be assessment, questioning, and polling.
- Learner support – we anticipated that learner support during scheduled sessions is affected by the emphasis on covering certain content. Therefore small interventions should be driven by the instructor's ability to access statistics about the entire class's

progress, the performance of certain groups, and the achievement of individual learners.

- Communication – we expected that instructors and learners would use either audio or chat functions to exchange information during a session.
- Collaboration – we determined that collaboration would require team formation and allocating roles.
- Coordination – we established that instructors would need to coordinate the learning activity by (i) reflecting on whether specific tasks need improvements, (ii) appraising which topics are challenging for the learners, (iii) testing which questions are appropriate for the session, (iv) evaluating whether groups perform according to certain thresholds and (v) assessing individuals' knowledge and understanding. [12]

CSCL categories	Areas of interest	CSCL categories	Areas of interest
Delivery	Time efficiency & control Split screen Visuals Dynamics Misuse Cost & fees Connection	**Communication**	Sharing Communi-cation Regularity Messaging system
Interaction	Recording Learning effect Responsibility Teacher view Statistics/results	**Collaboration**	Peer learning Collabora-tion. Indicating uncertainty Roles
Learner support	Initiation Preparation Control system for the moderator Learning design	**Coordination**	Collabora-tion/ Assignments Coordination Grouping Teachers' preparation

Table 1. Areas identified as essential for improving collaboration when using Ed.Tech.

In order to figure out what instructors and students found useful when using Ed. Tech as a collaborative tool, the study first performed pilots on different functionalities using different tools and distributed a questionnaire to all involved informants. Secondly, the study conducted a reflectional conversation with 31 participants (11 students and 20 instructors). Finally, the study identified 28 areas of interest within the six defined CSCL categories based on the results.

These areas provide insight into technological features necessary for developing a tool that aids collaboration and academic achievements in such a work. Nevertheless, technology is nothing without pedagogy, and when incorporating Ed. Tech in a collaborative setting, one needs to analyze and design the work pedagogically. Thus, there is a need for a pedagogical strategy when implementing Ed. Tech in collaborative learning environments.

2.3 Theoretical framework pedagogical strategy[1]

The pedagogical strategy includes a theoretical framework. In order to design the framework, the consortium has identified key factors and categories necessary to consider when working with Ed. Tech and collaborative work. The following elements have been identified as necessary. However, in this paper, they are only mentioned in order to frame the included data, interpreted and analyzed to expand results underlining the research aim:

1. Educational technology as a part of Higher Education
2. Learning environments in a modern age
3. Mobile learning
4. Response technology
5. Active learning
6. Collaborative learning
7. Digital competencies
8. Formative assessment
9. Moods of delivery, mainly focusing on face-to-face, hybrid and online moods

These nine areas frame the idealization of a collaborative tool with functionalities that might enhance the learning outcome of collaborative work. Within the frame, a teacher/instructor needs to build learning designs, cases, aims, and more to utilize the effects digital tools might provide in a modern learning environment. The question remains in which areas are essential to consider and how to redefine strategy when implementing Ed. Tech in collaborative work?

In the following, we will focus on pedagogical aspects that traditionally are discussed when doing collaborative work, and the study also shows what both theory and real-life instructors claim to be more or less critical in this case.

3 Methodology

In order to ensure data that reduced the bias, it was decided to use a three-stage methodology in the study. First, the consortium wanted quantitative and qualitative data from the research, and the methodology should enhance results from previous phases in the project. It was also crucial that the data collected should aid the building of a

[1] The full strategy can be retrieved from the homepage of iLikeIT2 [10].

prototype of a response tool under construction, which would be piloted according to the methodology at a later stage in the project.

3.1 Literature review

The consortium started with an integrative literature review [15]. Previous research in the project had focused on how Educational Technology can best enhance collaborative work and which functionalities need to be present to make the tool work positively for the collaborative work (see chapter 2.2 Previous research). The main results from this research showed 28 areas of importance when using Ed. Tech in collaborative learning environments. These areas were thus the basis for developing a pedagogical strategy for implementing Ed. Tech in collaborative settings. In order to investigate which pedagogical aspects were most valid for the best integration possible, the consortium decided that an integrative approach was most suitable when conducting the literature review.

The searches was based on the keywords "collaboration", "communication", "coordination", "Educational Technology," and "pedagogy". However, the search was revised to "collaboration + Educational Technology" due to many potential hits. The findings were then related to the data collected previously in the project.

The data collected from the integrative literature review was interpreted using qualitative content analysis [16]. As described previously, five experts from different countries collected articles from different databases. In the abstracts from the articles, the researchers looked for combinations of "collaborative work", "Educational Technology" and "pedagogy/didactics". However, only a few articles matched all requirements, and some were included for the theoretical framework in the pedagogical strategy.

3.2 Expert discussion

Results from the integrative literature review were discussed in the consortium, moderated by the authors of this paper. The consortium includes researchers, teachers, programmers, AV experts, and stakeholders involved in and working with Ed. Tech for several years. Hence, the consortium is considered an expert group on the subject. Therefore, the discussions obtained a multifaceted view and shared experiences to caretake all stakeholder opinions. The discussions were structured as small group discussions [17]. The discussions were based on principles developed by Vennebo and Aas (2019), called Leading professional group discussions (LPGD).

The process for finding elements from the literature that were influential for the pedagogical approaches to be implemented consisted of four stages; 1) setting the stage, 2) Examining, 3) Interpreting and 4) considering results [18]. The discussions identified fifteen elements as most important when achieving increased learning outcomes from collaborative work. The elements were also considered vital when designing collaborative work in different learning environments; face-to-face, hybrid mode, and online environments.

3.3 Instructor training

To ensure the results were adequate, they needed to be validated. This result will be a strategy and pedagogical approach for the instructor in the project. Therefore it was necessary to include more voices from these types of end-users. The consortium designed and held five instructor training activities in four countries (Norway, Italy, Greece, and Spain), focusing on using Ed. Tech in collaborative settings. In total, 46 instructors were involved.

The training consisted of a project presentation and an introduction to both Ed. Tech and collaborative work, and the practical use of a tool of the trainer's choice. The last part consisted of a questionnaire and discussions on how to use Ed.Tech in collaborative learning environments.

Data collected from the instructor training were gathered and included in the work with the pedagogical strategy. During the training, teachers (and some other participants, consultants, and IT employees) were presented with a case-based survey in three parts.

- Part A was designed to get the participants in the right mood, asking for individual perceptions of the importance of 12 elements when doing collaborative work. The participants were asked to rate the importance on a Likert-scale from 1-5, 5 being very important.

- Part B was directed toward the individual usage of Ed. Tech when lecturing. The participants were asked 12 questions to be answered with yes or no.

- Part C consisted of three allegations concerning the central elements of collaborating with Ed. Tech. that the participants needed to discuss. One of the involved participants collected notes from the discussion, and all the collected data was submitted to the consortium for processing

4 Results

In the following, we will present the instructor training's results and discuss them according to the background materials presented in parts 1 and 2 of this article[2].

4.1 Quantitative results from instructor training

As mentioned earlier, part A of the questionnaire was individual and designed to get instructors into the mindset of collaborative work in a learning group.

Table 2. Results from answers to the questionnaires part A

Part A	**Identify, on a scale** 1 (low) – 5 (high). **Your perception of the importance of the following elements when doing collaborative work.**	**Average score**	**Score category**
Coordination	The roles allocated to group members	4,04	**4,35**
	The division of tasks within the group	4,37	
	The possibility of interaction between the group members	4,76	
	The possibility of storing and sharing information between members	4,22	
Cooperation	The infrastructure (i.e. classroom set-up, breaks, comfort, number of members, and more) of the group context	4,09	**4,29**
	The ability to gain insight into other members' ideas and thoughts	4,26	
	The ability to comment on other members' ideas and thoughts	4,33	
	The possibility to think together, visually or orally	4,46	
Communication	The possibility of discussing content	4,54	**4,24**
	The ability to micro-communicate (i.e., mimic, sighs, smile, and more)	3,78	
	The possibility of indicating that you are uncertain of something	4,28	
	The possibility of indicating that you want to say something	4,35	

[2] The quantitative results from this article has also been discussed in a smaller format in an article presented at INTED2023, to be held in Valencia, Spain 6th – 8th March 2023.

Part B of the questionnaire was designed to get participants to reflect on their use of Educational Technology in general, both the software and the functionality inherent in the software.

Table 3. Results from answers to the questionnaires part B

Part B	Indicate your usage of educational tools for collaboration by answering yes or no to the following questions	Numbers Y/N	Score category
Coordination	Do you use an LMS or similar to upload curricular elements?	36/10	**145/39**
	Do you send texts/e-mails/notifications to students via an LMS or similar?	34/12	
	Do you collect answers/opinions using an educational tool during lectures?	36/10	
	Do you allow students to organize group-work digitally?	39/7	
Cooperation	Do you use any type of shared screen to cooperate with students and/or colleagues?	35/11	**129/55**
	Do you use chat functions to cooperate/talk with students or colleagues?	41/5	
	Do you allow students to use social media to cooperate in lectures?	25/21	
	Do you use animations/GIFs or similar to illustrate your talking points in a lecture or with student assignments?	28/18	
Communication	Do you have the ability to discuss content digitally with your students?	42/4	**141/43**
	Do you use an educational tool that allows you to monitor the student's progress during a lecture?	26/20	
	Do you allow students to digitally post anonymous/private questions during a lecture?	32/14	
	Do you allow students to raise their hands digitally during a lecture?	41/5	

4.2 Qualitative results from instructor training

Qualitative results are collected through a discussion monitored by an expert in the consortium. The participants were divided into groups of approximately five participants at each training and asked to discuss and comment on the following three statements:

1. It is essential to have a collaborative setting where group members are physically present and close to one another.
2. Educational technology can enhance any type of collaborative work, both in class and in an online/hybrid environment.
3. Videoconferencing is the online environment that best resembles physical presence. Thus, it is the only way to solve a problem when collaborating online.

The participants discussed one and one statements and tried not to progress until all topics were fully debated. During the discussion, the expert was supposed to monitor passively, only providing insight or questions if the discussion was at a dead end or on the wrong track. One of the involved participants was asked to take notes of the discussion, refine them, and send them to the consortium [19] to reduce the possible sources of error in collecting data. It negatively impacts the data if the survey designers interfere too much; this could lead the participants in a specific direction in their discussion. The same is the case if the facilitators themselves take notes. It could lead to only favorable notes being registered. The facilitator naturally took their own notes, and after the training, the data has been interpreted and aligned with the notes from the facilitator. There has been no need to remove any data. The authors have not corrected spelling mistakes in the delivered materials.

Fig. 1. Wordcloud illustrating the data provided from instructor training

The qualitative data was later processed through the NVivo programme [20]. All comments and keywords have been collected by participants in the five trainings throughout Europe. The document has been included in NVIVO three times to reduce bias. One researcher has been doing the interpretations of the materials, and the results presented in 2-5 are based on the codes created by the research group.

Previous research indicates that the three C's (Communication, Collaboration, Coordination) frames collaborative work, including Ed. Tech in a sensible way and functions well for designing a new collaborative software [21] [22]. In the project iLikeIT2 this has been the fundament for all the work being done. Therefore, it was natural that real-life instructors' comments were also interpreted and analyzed according to these three keywords.

In fig. 2, we can see the distribution of results coded according to the three C's: Collaboration, communication, and coordination.

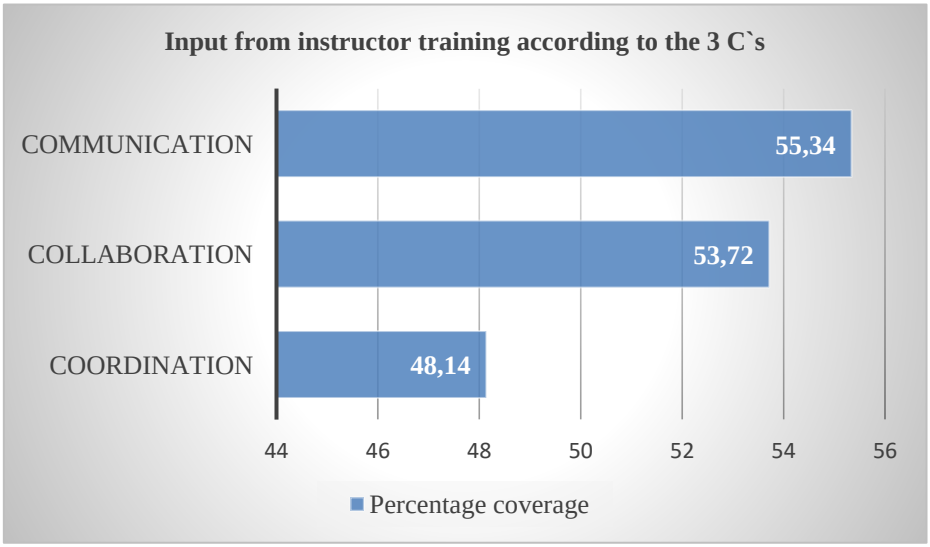

Fig. 2. Data organized according to the three C's

These codes do not give us much and show no significant differences considering the three C's. However, it says that instructors consider collaboration, communication, and coordination critical when discussing Ed. Tech in collaborative learning environments.

Analyzing the word-cloud and connecting the data to the theoretical framework and literature review, it seemed that some categories were more interesting than others. We, therefore, processed the data two more times in NVIVO. As a result, seven categories were identified; 1) Digital competencies, 2) Efficiency, 3) Modes of delivery, 4) Pedagogical advantages, 5) Pedagogical challenges, 6) Tools – advantages, and 7) Tools – challenges.

Fig. 3-5 shows the distribution of references coded to each category, and table 4 summarizes the findings throughout the statements.

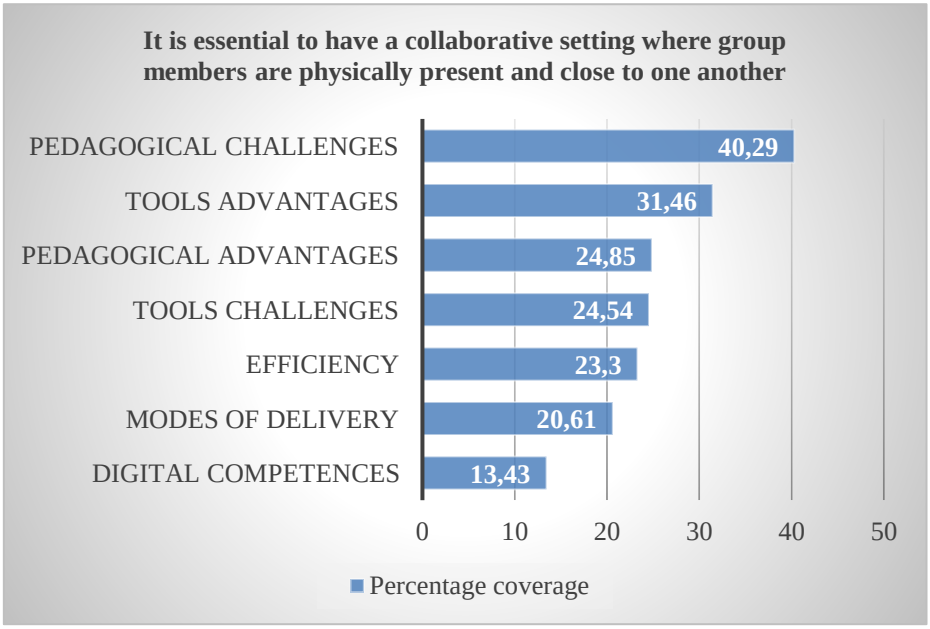

Fig. 3. Statement 1: "It is essential to have a collaborative setting where group members are physically present and close to one another" coded according to categories

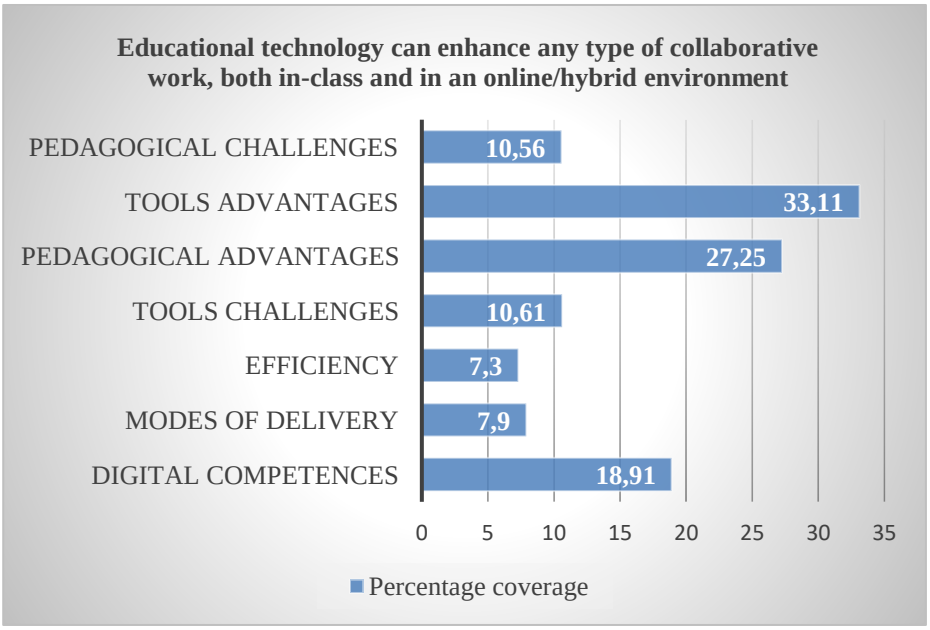

Fig. 4. Statement 2: "Educational technology can enhance any type of collaborative work, both in-class and in an online/hybrid environment" coded according to categories

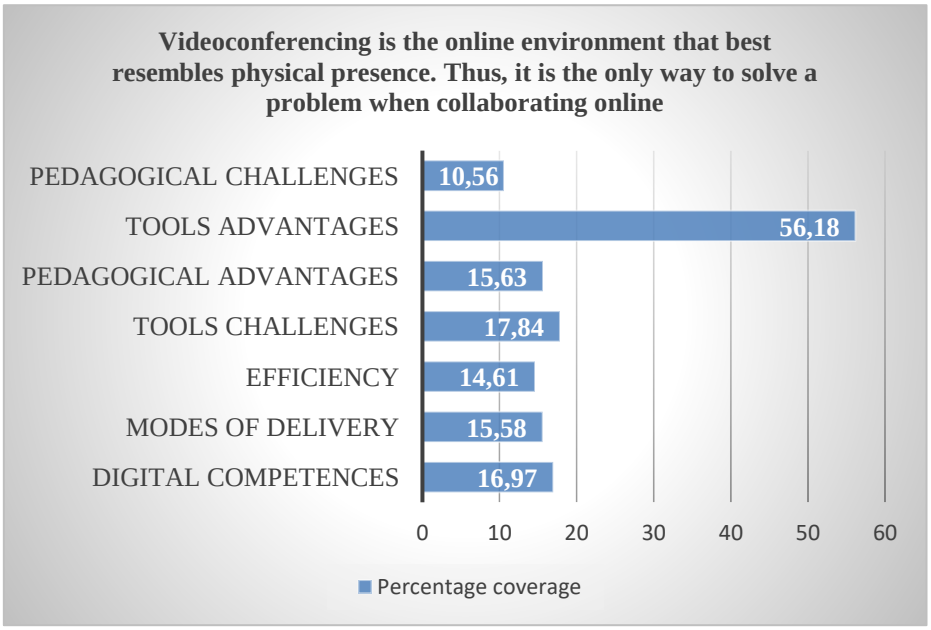

Fig. 5. Statement 3 "Videoconferencing is the online environment that best resembles physical presence. Thus, it is the only way to solve a problem when collaborating online" coded according to categories

To verify the results, the data was analyzed a third time to see if there was any significant difference between the categories, and how often they were mentioned in the materials. As seen in Table 4, the instructors has been led to think about digital tools, and their inherent advantages (27%) and challenges (12%), but there are also a lot of discussions about pedagogical advantages (16%) and challenges (15,5%) in the discussions.

Table 4. Summary codes in all three statements instructor trainings iLikeIT2

Code	References	Percentage
Digital competencies	23	12,5
Efficiency	17	9,5
Modes of delivery	14	7,5
Pedagogical advantages	29	16
Pedagogical challenges	28	15,5
Tools - advantages	49	27
Tools - challenges	22	12

It was expected that instructors would be concerned about different modes of delivery, i.e., F2F, hybrid, and online modes. Considering we have experienced two years of pandemic conditions and learned a lot about both online and hybrid learning delivery, it was anticipated that instructors would also be aware of this duality in collaborative

settings. However, 7,5% of the comments mentioned "modes of delivery", which is lower than expected. It indicates that collaborative learning environments revolve more around pedagogics and structures than physical rooms and environments. Still, instructors are very aware of the pitfalls in different modes. Some of these will be commented on later in this section.

4.3 Discussion

Several exciting findings need to be commented on in this study's materials. First, looking at the quantitative data, it is evident that instructors, to a large degree, recognize and acknowledge the literature identified as important by the consortium (see 3.1: Literature review). The average scores are high throughout the whole sample of elements included. With a variation from an average score of 3,78 to 4,76 of 5,0, we find that instructors agree that these are all important areas.

Secondly, from the quantitative data, we see that instructors are more concerned about the challenges and possibilities introduced via Ed. Tech than what might be called more traditional elements. For example, we see that challenges concerning learner roles and communication score pretty low, while interacting and thinking with others are rated very high.

Considering the low(er) scores on communicative elements in the quantitative data, it is a paradox that communication is discussed the most during part C of the training (see fig. 2). This might be due to instructors' focus more on communication WHEN using Ed. Tech. The qualitative data gives us more insight into the materials later in the discussion.

When instructors were asked if they use an LMS or similar to upload curricular elements, 36 of 46 attendees answered yes. At the same time, the average score on the question about the possibility of storing and sharing information between members was as high as 4,22. Even if this is no surprise, the finding is emphasized during the discussions. Several instructors mention coordination as a positive effect of Ed. Tech in various ways. Still, there are discussions that even if there is an abundance of different tools available, the tools need to be adapted or used in a good way to function positively. If not, the technical difficulties and the sheer inclusion of an extra element might reduce the learning outcome. When implementing technology to distribute better and gain access to statistics and theory, the instructor should consider the effectiveness and coordinative function of the tool.

In the theoretical framework, the need for heightened digital competency is highlighted, and the instructors often mention the need to train both themselves and the students in using the tools before applying them in the learning environment. The instructors are concerned with both the effectiveness of new tools, specific languages (like mathematics), ethics, and general behavior when using digital tools in the classes. Consequently, this might also be why the lowest average score in our materials is on whether instructors allow students to use social media to communicate during lectures (average score 3,78). When instructors introduce and use Ed. Tech in Higher Education classrooms, the fear of tools disturbing or causing reduced attention spans is still high.

Another interesting finding concerns the room structure when doing collaborative work. This was especially connected to online environments, and it seems as if the instructors, to some degree, seek to represent ordinary classroom structures also in online environments. Looking at the Communication category in part B of the questionnaire, we see that instructors want students to raise their hands during online lectures (41 YES/5 NO), while they are not too interested in anonymous questions during the lecture (32 YES/14 NO). At the same time, we see that the instructors cannot monitor the student's progress during the lecture (26 YES/ 20 NO). It is evident that even if the instructors have the tools, they do not use them to differentiate the lectures from ordinary lectures. During the training, one instructor had an interesting observation concerning how to work in an online environment. When discussing if online teaching can function without video-conferencing, a lecturer at the university level claims that video-conferencing is just a worse replica of physical presence. It includes the argument that video conferences can never achieve the same aims as a physical collaboration, thus, one should never seek to replace something with something else that is not as good. Instead, one needs to find the inherent advantages in the learning environment available for the work.

Pedagogy engaged in the discussions with every aspect of the collaborative work. There are comments on elements of coordination, peer learning, and heightened digital and cooperative skills. There are especially two things that are mentioned often, which can also help improve the pedagogical approach for a new teacher. First, it seems as if one is to introduce Ed. Tech in a collaborative setting, one needs to have a clear pedagogical purpose. The primary pedagogical approach that Ed. Tech aids, according to the discussions, is interactivity. This includes simple functionality like emojis, raise hand, shared screen, digital post-its and more, but it also makes the plenary parts or lectures more engaging. One could, for example, introduce GIFs or animations to a PP to enliven it. When answering individually on the question if instructors use these elements, it is almost 50-50, showing that this is something that is considered attractive, but not introduced and used to its fullest yet.

We all know that one of the most essential learning aspects of collaborative work is communication between the participants, which increases engagement [23]. This is also something that the instructors regard as important. When discussing the statements, the instructors are aware of the lack of micro-communication and body language when doing digital lectures. At the same time, they claim that often the discussions are better, freer in terms of exchanging ideas and experiences when the camera is turned off. Some claim that digital tools themselves improve the student's ability to communicate and collaborate and that students are more willing to defend their arguments via a more anonymous setting in a digital framework. It is essential to consider this when designing rules and guidelines for internal discussions and when starting collaborative work. At the same time, it is mentioned that the implemented tools must be adapted for the purpose and that participants must be trained in digital etiquette and manners to make the communication work.

The qualitative data also shows some concern about students staying inactive and passive in discussions, especially when doing an online collaboration. It indicates that there is a need for smaller groups when introducing Ed. Tech in collaborative work. It

can also shed some light on the results from the individual parts. For example, in part A, they are asked about the importance of micro-communication (i.e., use mimic, sighs, smiles and more), and the average score is the lowest we find (3,78). Accordingly, the scores indicating uncertainty (4,28) and turn-taking (4,35) are not impressively high. These are elements that come more naturally when doing more traditional collaborative work.

Since more or less the introduction of Ed. Tech in learning environments, the aim of efficiency has been central to the development of new tools and strategies [24]. It is undoubtedly one of the advantages of introducing and using Ed. Tech in a classroom is evident that the teachers are aware of it in data presented in this survey. 9,5% of the mentions all together in the materials is about the efficiency of digital tools, mostly in a positive manner (see table 4). Some comments claim that the tools may make learning less efficient than physical presence, but this effect is often reduced by training or the number of digital competencies in the student and instructor group. Digital competencies are naturally mentioned a lot (12,5%), and very often in connection with how to make the tools work in a collaborative setting (see table 4). It is also noteworthy that instructors repeatedly mention infrastructural elements considering digital competencies, like GDPR, ethics, and how to use the tools themselves.

Learning design is always the most important when considering pedagogy in any situation. In a collaborative work, the students should learn from each other; therefore, the learning designs need to aim for this. When introducing Ed. Tech, the learning design needs to utilize strengths and benefits that cannot be found in a traditional F2F-situation. It is interesting to look at the answers from the individual questionnaires in the instructor training to see how the learning design reflects this view.

When answering individual questions in the instructor training, the three first questions might give insight into what a good learning design should provide in a collaborative setting. The instructors agree that the division of tasks within the group (average score 4,37 of 5,0) and the possibility of interaction between the group members (4,76) is the most important when collaborating. Less critical, it seems, is the roles allocated to group members (4,04, with a standard deviation of 0,83). Interestingly, as many as 21 out of 46 instructors do not allow their students to use social media to interact during the lecture. It means that one either has to facilitate physical or online interaction or create a chat channel or shared screen opportunity to utilize the benefits of communication in the learning situation.

5 Conclusion

Several factors need to be considered when designing a pedagogical strategy for integrating educational technology in a collaborative learning environment. In order to answer the research question on which pedagogical strategies are necessary to implement to heighten the learning outcome from collaborative work when using Ed. Tech, we will try and summarize some of the most significant findings in our materials.

The basis for every collaborative work, including Ed. Tech needs to be the three C's: Collaboration, coordination, and communication.

When implementing Ed. Tech in digital learning environments task/cases should allow for a monitoring role more than a facilitating/participative role for the instructor.

All tasks must be designed to enable all participants to be seen and heard. Thus, all will experience the same quality/effects of the learning experience. It can be done via asynchronous lectures (available online resources) when the curriculum/theory is the lecture's main element.

All cases and tasks provided need to be designed to allow both cooperation and individual work. It is one of the inherent advantages that Ed. Tech provides and needs to be utilized to its fullest.

One of the most important recommendations is to provide small training tasks before the participants start their work. The training should be directed towards turn-taking, attention to the speaker and coordinating the work, especially considering sharing of materials.

Digital competency is an obvious factor, both for students and instructors. If there is a discrepancy between the experience in a group, one should cater to this and ensure that all involved participants have an adequate level for participating actively in the work-related tasks.

There are already many digital tools being used by both instructors and students. Instructors should not be afraid to use existing tools and train students to use them for coordination, communication, and collaboration. In addition, it will raise awareness of the tools and their pedagogical effects.

Maybe the most crucial recommendation is that the learning design needs to facilitate using opportunities found in the introduced Ed. Tech. One needs to find new ways of using ED. Tech to reach a higher learning aim than possible in traditional lectures.

The both qualitative and quantitative data point to the coordinative functions in Ed. Tech-tools are the single most important innovations for collaborative work. Thus, the coordinative role in the group is more important. Make sure always to include one strong coordinator in each group. It is essential to consider the coordinative role in the group when dividing members—introducing Ed. Tech makes this role more complex and vital than in more conservative collaborative environments.

These are primarily recommendations based on the research presented in this article and not a complete list of pedagogical approaches. Still, the data shows the significance of these recommendations, and considering these will improve the quality of a collaborative learning environment when introducing Ed. Tech to it.

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