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La collaboration entre deux contextes : acceptabilité d'une innovation pédagogique avec le numérique

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Abstract

As part of the Educational Technologies for Teaching in Context research project, we have conceived a pedagogical innovation with digital technologies by considering teaching from two different contexts. In this case, the context is characterized by environments that differ between two groups of learners and this is what we call context effects-based teaching. Thus, we consider context to develop a pedagogical innovation with digital technologies involving students from two different countries. They collaborate online and investigate an identical theme while facing strongly contrasting contextual realities. This pedagogical innovation with digital technologies involves a significant change for teachers and its acceptance can foster its use in the classroom. In this perspective, this article examines the acceptability of pedagogical innovation (context effects-based teaching) and digital use by teachers. Inspired by the Technology Acceptance Model by Davis, a qualitative design research was used and 7 semi-directed interviews were conducted. The finding showed the relevance of Context Effects-Based Teaching with digital and its acceptability is characterized by a positive perception of usefulness and intention of use, and teachers noticed in-depth learning in their students.

Keywords

Pedagogical innovation, context effects-based teaching, digital technologies, acceptance, collaboration.

Résumé

Dans le cadre du projet de recherche sur les Technologies Éducatives pour l'Enseignement en Contexte, nous avons conçu un dispositif pédagogique innovant utilisant les technologies numériques en tenant compte de l'enseignement dans deux contextes différents. Dans le cadre de cet article, le contexte est caractérisé par des environnements qui diffèrent entre deux groupes d'apprenants, ce que nous appelons les effets de contextes. Ainsi, nous considérons le contexte pour développer une innovation pédagogique avec le numérique impliquant des apprenants de deux pays différents. Les apprenants collaborent en ligne et explorent un thème identique tout en faisant face à des réalités contextuelles fortement contrastées. Cette innovation pédagogique avec le numérique représente un changement significatif pour les enseignants et son acceptabilité peut favoriser son utilisation en classe. Dans cette perspective, cet article examine l'acceptabilité de l'innovation pédagogique et l'utilisation du numérique par les enseignants. Inspirée par le Modèle d'Acceptation de la Technologie (technology acceptance model) de Davis, une recherche qualitative a été réalisée et sept entretiens semi-dirigés ont été menés. Les résultats ont montré la pertinence des effets contextuels sur l'enseignement avec le numérique et son acceptabilité est caractérisée par une perception positive de l'utilité et de l'intention d'utilisation, les enseignants remarquant un apprentissage approfondi chez leurs élèves.

Mots clés

Innovation pédagogique, effets de contexte, numérique, acceptabilité, collaboration.

1. Introduction

The term “context” is used in cognitive psychology (Bazire & Brézillon, 2005), and cognitive process is related to situated knowledge and is context-dependent (Anjou *et al.*, 2022). Despite the fact that the term “context” has not been settled (Delcroix, 2019; Zimmerman *et al.*, 2007). Savard and Mizoguchi (2019) mention that there are two definitions of context. The first is that context is internal and is a mental representation of an individual. The second defines context as external and environmental or circumstantial. Those two views of context (internal or external) can impact the learning process. In this article, we refer to external context, which allows us to perceive differences between two contexts (Forissier *et al.*, 2017; van Wissen *et al.*, 2013). Thus, learning based on different contexts involves two groups of learners from different environments whereby, depending on a theme, they can observe differences that exist between two contexts. When we observe differences between contexts, we call it *effect of context*. The idea of integrating context effects-based teaching (CEBT) in learning and provoking a shock between the two contexts can potentially improve learning (Anjou *et al.*, 2021; Anjou *et al.*, 2022; Forissier *et al.*, 2013; Forissier *et al.*, 2019). Two groups of learners are then remotely brought together as subgroups who collaborate synchronously and asynchronously on concepts related to the theme. Using an investigative process, the subgroups collaborate and compare their understanding of the concepts that are studied. The use of digital technologies for implementing CEBT is essential since many digital tools are necessary to support learning, ensure pedagogical management, and allow collaboration between the two groups of learners and teachers involved. In this case, the question is what is the acceptability of the pedagogical innovation and digital use, and more specifically when students collaborate with technologies? This innovation is deployed as part of Educational Technologies for Teaching in Context (ETTC) research project.

1.1. Inception of ETTC project

The ETTC project is based on the first experiments conducted in 2014, the Gounouy project. It was conducted in two different places that have contrasting contexts: Guadeloupe and Quebec (gounouy means "frog" in creole). Focused on the discipline of biology, the project was an opportunity to implement a learning scenario using CEBT (van Wissen *et al.*, 2013). In this case, investigations about the smallest frog (hylode), found in Guadeloupe, and the largest frog (bullfrog), found in Quebec, were taken as premises for contextual differences. Basing themselves on these premises, learners discussed themes in subgroups, provoking a clash between the two contrasting contexts.

Other experiments were conducted in didactic of French about experiment in language and literature. For example, collaboration between two elementary school classes in Guadeloupe and Quebec to highlight context-effects based between Quebec French and Guadeloupean French: difference between students' conceptions of different aspects of the language, such as lexicon, syntax or phonology. In science, a theme in geothermal energy was conducted, which is used for producing electricity in Guadeloupe and heat in Quebec. These themes have different characteristics for each context and can be compared to observe important differences.

The first experiments allowed the formalization of the necessary tools for the pedagogical innovation in ETTC project. The first findings showed us that digital technologies are omnipresent in this project and that exchanging between contrasted contexts without them would be impossible. For example, videoconference is an essential tool for exchanging on

themes investigated by learners and such learning management system is fundamental in order to communicate, pass on information and create learning scenarios. These tools are used as much to support learning as to support research and logistics, and file management.

1.2. Pedagogical innovation

The term innovation is often defined as introducing an idea, a practice or an object to an individual or a group of individuals (Ellis & Bond, 2016; Rogers, 2003). Using this definition, we examine a pedagogical innovation that is deployed in an academic environment and is characterized by a) a complex process aiming to improve the learner's learning (Stalheim, 2021; Timperley *et al.*, 2009) and b) new didactic approaches generated by theoretical and technological changes (Mioduser *et al.*, 2003). Therefore, innovation always entails a deliberate will to change practices (Depover, 2010), particularly in the case of using digital tools (Kukulka-Hulme *et al.*, 2022; OECD, 2012).

The ETTC project relies on the implementation of an instrumented and validated pedagogical innovation. This pedagogical innovation is based on a generic character of CEBT with digital use and it can be transferred and replicated in various disciplines and educational levels. Pedagogical innovation requires great flexibility to ensure its acceptability in an educational setting. When implemented in such a setting, numerous acceptability variables must be considered. These include access to existing technological infrastructure, implementation of new technological infrastructure, the digital skills of the participants (teachers and learners), the interoperability of digital tools, and flexibility to add new tools (Forissier *et al.*, 2017). This is why an analysis on educational acceptability of CEBT is essential to ensure the continuity of the pedagogical innovation when digital tools are used.

1.3. Digital tools

The use of digital tools, if new to teachers, could be perceived as complex. This could compromise the teachers' involvement and consequently lead to a rejection in their use for pedagogical innovation (Lavidas *et al.*, 2022; Stockless, 2018). In the ETTC project, the challenge is to allow learners to investigate their context while collaborating with a group that looks at another context (Table 1). To operationalize a pedagogical innovation in CEBT, complementary tools are used for identifying external context, permitting synchronous and asynchronous collaboration, and evolving their design. Also, we noted that the tools that are used are different depending on the age of the learners and pedagogical practices of teachers. The relationship between didactic principles and the digital use can be viewed as for characteristics of a pedagogical scenario for CEBT.

| Didactical principles | Digital use | Digital tools |
|---|--|---|
| Different external contexts | Learning objective showing different context. | External context comparator |
| | Learners located in different environments. | |
| Collaborations | Pedagogical design | Long distance meetings, discussion spaces reserved for teachers |
| | A common problem for all students | Videoconferences (with all participants who collaborate) |
| | Small working groups | Long distance work meetings. Spaces for exchanging specific data. |
| | Students who can be present, and meet | Chatting, discussion forums |
| Building contextual representation | Analysis of the data of the two contexts | Tools for treating the data |
| | Situated investigation | Collection of data on the field |
| | Development of a survey methodology by the learners | Digital workspaces for each group |
| Confronting contextual representations | Writing a proposed answer per context | Digital workspace for each group |
| | Multiplying the moments of collaboration | Presentation of investigations (journalism) |
| | Alternating between moments of working on their context and moments to exchange synchronously and asynchronously through the project | Digital workbook Weekly feedback on impressions |
| | Synthesis of the similarities and differences that question the representations of counterparts and one's own conceptions | Videoconference assessment (summaries and limits of concepts) Collaborative production tools |
| Building expert representation together | | |

Table 1: Relationship between didactical principles of digital use in context effects-based teaching (CEBT)

Therefore, we are interested in understanding the acceptability of this innovation better, given its complexity with regard to the didactical and educational use of digital technologies. As we have shown previously in the mapping of digital use, pedagogical innovation requires a number of digital tools and leads to a complexity in its operationalization in the field. Moreover, issues on the alignment of practices are equally present between the contexts.

2. Theoretical framework: The Technology Acceptance Model

The Technology Acceptance Model (TAM) is based on the Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975). The TRA is used to predict how individuals will behave based on their attitudes and behavioral intentions. It serves as a tool for explaining and predicting social behavior using a limited number of theoretical concepts. Developed at the end of the 1980s, TAM (Davis, 1989) is an adaptation of TRA model that specifically addresses the field of information technologies. Its goal is to predict the acceptability of technologies, and in our case a digital pedagogical innovation, by users. In the same spirit as the TRA, TAM identifies the acceptability of a technology using a reduced number of variables in its model.

Amongst numerous models that we can find in the literature, TAM is largely used by researchers to study the acceptability of an information system (Brangier *et al.*, 2010; Kreijns *et al.*, 2013; Scherer *et al.*, 2019; Van Raaij & Schepers, 2008; Venkatesh & Davis, 2000). The TAM model has undergone numerous modifications. For instance, the TAM 2 (Venkatesh & Davis, 2000) or Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh *et al.*, 2003) is largely used by researcher. Although new variables have been added, or named differently, many dimensions match the variables already present in the TAM model (Nistor & Heymann, 2010). From this perspective, almost all models of acceptability are based on the TAM (Venkatesh *et al.*, 2016). Whereas the original version of the TAM has been widely used

to study teachers' technology integration (Teo, 2009), in this case we are also using TAM to study a pedagogical innovation that includes a strong digital component. In addition, acceptability is an important element that ensures that the innovation is adequately implemented in the field and the dimensions of TAM model are evident for diverse teacher samples (Teo, 2015).

From a pedagogical innovation perspective, meaning CEBT with use of digital technology and for the operationalization of didactical principles in the field, the analysis of perception of usefulness and the ease of use dimensions are relevant indicators to understand the perception of teachers. In order to do this, Technology Acceptance Model (TAM) of Davis (Davis, 1989) is used, as it is the most appropriate model in this situation. To this day, TAM is one of the most used models for predicting the intentions for technological use in different contexts (Scherer & Teo, 2019; Vogelsang *et al.*, 2013). According to this model, the facilitated and the used perception of educational technologies have an effect on the attitudes and intentions of using them. These use intentions are known to have an effect on technological use (Davis, 1989) (Figure 1).

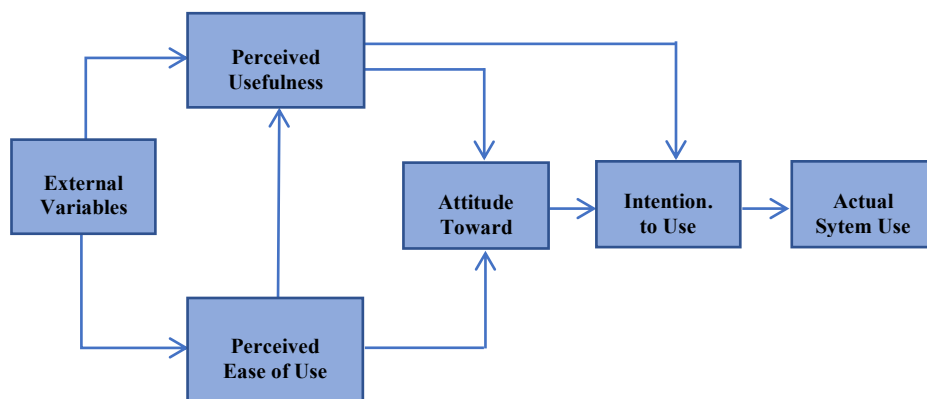


Figure 1: Technology Acceptance Model (Davis *et al.*, 1989: 985)

Perceived ease of use, perceived usefulness, attitude toward use, and intention to use are the main dimensions of the TAM model. The measure and the interpretation of these dimensions help us understand and explain acceptance of the user when certain technological tools are proposed. This helps us better understand the factors that contribute to the intention to use a technology. If applicable, the obtained results serve as inputs for the implementation of appropriate strategies for improving necessary interventions for its acceptance (Davis, 1989).

One of the strengths of this model is in its simple and universal conceptual architecture (Bagozzi, 2007; Scherer *et al.*, 2019). In fact, TAM is easy to operationalize, adapts itself to the majority of contexts and has produced many types of empirically validated measure instruments (Venkatesh *et al.*, 2003; Vogelsang *et al.*, 2013). Yet, some underline that this force is also the main weakness of TAM. They explain this weakness by pointing out the fact that most studies that use this model are quantitative ones, and while they shed some light, they do not allow researchers to have an in-depth investigation of the complex phenomenon of technological acceptance of users in different contexts (Bagozzi, 2007; Vogelsang *et al.*, 2013). For example, technological acceptance will be articulated differently according to the device that is involved (ex. a program for treating text such as Word versus a more complex one like a digital learning environment). Also, these studies often overlook important factors that explain usage such as the usage environment, the organizational culture, etc. (Venkatesh & Bala, 2008; Vogelsang *et al.*, 2013). Finally, according to Vogelsang *et al.* (2013), quantitative studies explain technological acceptability in theoretical manner, but often fall short of developing specific

research recommendations that lead to technological acceptance of users in their specific contexts of use.

Research question

In the implementation of a pedagogical innovation, we put forward the hypothesis that the ETTC project, in its complexity, can face resistance from teachers because it requires numerous changes in pedagogical practice. Thus, analysis of acceptability for a pedagogical innovation (CEBT) remains to be relevant to ensure the success of the project and the sustainability of CEBT.

Following what has been mentioned previously, the question of this research is what is the acceptability of the pedagogical innovation (CEBT) and digital use, and more specifically when students collaborate with technologies?

3. Method

We chose the qualitative-interpretive methodological approach because it seems to be the most appropriate choice for analyzing digital use in CEBT. The approach is also aligned with our research goal of learning about a phenomenon by observing the way meanings are conveyed by participants themselves (Thomas, 2006). The challenges that were discussed earlier regarding quantitative studies and TAM have also guided our choice for a qualitative methodological approach for examining digital use in the ETTC project. According to Vogelsang *et al.* (2013), we think that the qualitative research approach is necessary for an in-depth understanding of the articulation of the digital as lived by actors (teachers and learners) who participate in the project. In fact, since the analysis of qualitative data searches the meaning of experiences lived by participants, this type of analysis is the most effective for answering our research question (Miles *et al.*, 2020). This methodological approach hits two targets with one stone by allowing the improvement of knowledge used by participants in scientific research and directly in the field (Vogelsang *et al.*, 2013).

3.1. Participants and instruments

Seven participants from Guadeloupe and Quebec were interviewed (n=7). The testimonies from Guadeloupe were collected from three primary school teachers (CM1/CM2) and from a pedagogical adviser. In Quebec, they were collected from three teachers, one primary school teacher (4th grade), one secondary school teacher (1st and 2nd grades) and a university lecturer.

Semi-structured interviews were conducted with 7 participants using an interview guide developed beforehand. First, these interviews gave us an opportunity to capture the general perception of the participants regarding the project and see if the dimensions of perceived ease of use and perceived usefulness emerged. In order to understand the acceptability of pedagogical innovations better, two of the participants were questioned longer using an interview guide that explicitly drew on TAM. These interviews interrogated the perceived usefulness and the perceived ease of use of digital technologies and the ways they were used. All the interviews were filmed and transcribed, and the questions collected information on general perceptions. They looked at the initial motivation for participating in the project, what was appreciated the most by teachers and students, the most significant moments experienced, the recommendations to colleagues regarding participation in such a project and clarification of intention of use in relation to TAM as a pedagogical innovation model (Appendix A).

3.2. Data Analysis

A continuous and iterative data analysis process was used in line with the recommendations from Miles *et al.* (2020). Moreover, the inductive deliberative analysis strategy was chosen for data analysis (Thomas, 2006). This began with the analysis of interview contents concerning the general perception and intention. It was then followed by the analysis of two interviews conducted using TAM. In an inductive deliberative analysis process, all categories are provided in the theoretical framework. However, the possibility of fitting to these categories was left in order to allow for the emergence of new information from the data (Miles *et al.*, 2020). In other words, the process of inductive deliberative analysis is guided by the research goals and is based on the existing theoretical framework (Thomas, 2006) in our case, the TAM. This was particularly pertinent in our analysis of digital use for CEBT. As previously mentioned, while TAM has preestablished dimensions (for instance, perception of use, ease of use, intention of use), it does not present specific categories in different contexts. Inductive analysis is an efficient strategy for extracting the emerging meaning of what participants say because it "lends itself particularly well to the exploratory nature of the analysis of research objects' data, for which the researcher does not have access to already existing categories in the literature" (Thomas, 2006). The questions from the semi-structured interview guide are based on the dimensions of the TAM and they allowed for the creation of categories for coding. However, an attentive attitude towards the possible emergence of categories and sub-categories "outside of the model" was maintained through the process of documenting the pedagogical digital use in the project. Finally, as recommended by Miles *et al.* (2020), the emerging categories of the two data sets were adjusted in line with the research questions and the theoretical framework used.

The interviews were meticulously transcribed and were read multiple times for the purpose of writing a short summary of the key points that were discussed in each of them. This step allowed us to obtain a preliminary understanding of the teachers' discourse regarding digital use and their perception of the ETTC project. Following this, every section was coded and given a degree of importance (Mayring, 2014; Vogelsang *et al.*, 2013). The degree of importance (1) was considered when participants mentioned that a certain topic was more appreciated or significant during their interview and (2) was chosen when the interviewee mentioned the importance of an element many times during their interview. The 0 degree was attributed when the interviewee did not mention a key element in the theoretical framework or the interview guideline or when they mentioned it without attributing any particular value to it (Table 2). Following this, the coded statements were reassembled in the synthesis table (cross-referenced matrix) reassembling all the interviews (Miles *et al.*, 2020). This operation allowed us to count the presence of each category and sub-category according to the case and calculate their cross-referenced occurrence frequencies in relation to the importance attributed by respondents. Finally, this way of condensing the data in form of a synthesis table explained the results of the research (Miles *et al.*, 2020).

| Excerpts | Topics | Sub-topic | Attributed importance |
|--|------------------|--------------------------|-----------------------|
| "It's true that it was a bit shy, but it was a bit normal" | Videoconferences | Difficulties experienced | 0 |
| "I think that in the future, we should work in a way that makes the students more comfortable because we noticed that they felt relieved at the end of the project. It is a project that really that should be carried out by trying to overcome this barrier before starting" | Videoconferences | Difficulties experienced | 1 |
| "It allowed students to see who they talk to. The visual is very important and during the videoconferences, it put a face to a first name. It was telling" | Videoconferences | Perception of usage | 2 |

Table 2: Example of coding procedures (Analysis done by TAM model)

4. Results

4.1. Results from semi-structured interviews: general perception

The following results are concerned with the general perception of the participants. Five themes were identified in the content analysis of the interviews about the general perception of project participants. A sixth theme, regrouping elements that were scattered, was classified as "constraints". It must be noted that the interview with the academic advisor was not finally considered in the presentation of the analysis because it was mainly concerned with the pedagogical innovation that underlies the project as it was experienced in class. It proved not to be very relevant with the topic of digital use in class. The results therefore include six interviews that were conducted with participants (Table 3).

| Themes and sub-themes | Cross-reference frequency N=6 | Importance attributed by the respondents |
|--|-------------------------------|--|
| 1. Motivation for participating in the project at the beginning | | |
| The theme investigated by the students in their class | 4 | 6 |
| Interest in exchange with another culture | 4 | 8 |
| Discovering the theme of peers | 3 | 4 |
| Participating in a research project | 1 | 2 |
| Sharing between teaching counterparts on the same theme | 2 | 4 |
| 2. Fears and doubts at the beginning of the project | | |
| Attaining the learning objectives of the program within the framework of the project | 2 | 4 |
| Connecting with teaching counterparts | 2 | 4 |
| The researcher's language is not understood by students | 1 | 2 |
| Doubts about the students' interest in the project | 1 | 2 |
| 3. Most significant moments | | |
| Realizing the quality of learning in the project (investigations and exchanges) | 6 | 12 |
| Observing the students' keen interest provoked by exchanges with their counterparts (videoconference and learning management system) | 4 | 8 |
| Observing the students' strong interest in appropriating new technologies (Guadeloupe) | 3 | 6 |
| Feeling involved in the project by the research team | | |
| Collaborating with counterpart teachers | 4 | 8 |
| Support and attitude of the research team in class | 3 | 5 |
| | 3 | 5 |
| 4. Teachers' observation at the end of the project | | |
| Significantly more in-depth learning | 6 | 12 |
| Students' unique engagement in the investigation process due to the context | 6 | 12 |
| Personal fulfillment (students and teachers) | 6 | 11 |
| Fulfillment because of learning the technologies in question | 3 | 6 |
| 5. Recommending a colleague to participate in a similar project | | |
| Intention of use | 6 | 12 |
| 6. Constraints | | |
| Need for a better internet network (Guadeloupe) | 2 | 4 |
| Desire to have access to more tablets and keeping them (Guadeloupe) | 2 | 4 |
| Demonstrate flexibility and openness (Québec) | 2 | 4 |
| Having better sound quality during videoconferences (Québec) | 1 | 2 |

Table 3: Themes and sub-themes in the content analysis, cross-reference frequency of occurrence, and importance attributed by respondents

4.2. Initial motivation for participating in the project

First, the results show that the motivations to participate in the project included the interest for the investigated theme for one's class and the interest to exchange with another culture that followed a similar school year. In some cases, the interest in investigating a particular theme for one's class was the main reason while in other cases, the interest for meeting with a peer group was just above that of investigating one's theme. The strong interest for discovering other classes emerged in almost all interviews as shown in these excerpts:

“For me, the mere fact of being able to see what is happening in another country in relations to teaching history was a motivation, then that of allowing students to communicate with other students who are going to be teachers (...) So, already, we saw their enthusiasm, already, we saw that it was very relevant for them to be able to communicate with other future teachers who were in a university course on teaching history.” (Q3)

“Me, I really like my culture, and I am there to promote my culture. I have already said why I do not intentionally work on creole storytelling so to allow my students to discover it organically, something on which they have not really worked on. And on top of that, they have to share such discovery with their Canadian peers.” (G2)

The interest in the peer group theme was important for three teachers, but with a moderate importance compared to investigating the subject of one's own theme. Also, one teacher underlined that participating in a research project was their main motivation while two others indicated that their motivation for participating was to share with peers on the same theme. This statement is related to the dimension of perception of utility of TAM model. Initial motivation of teachers to participate in TEEC project represent a strong interest to implement a pedagogical innovation and shows acceptability of utility. In this case, the acceptability is a positive predictor of intention of use.

4.3. Fears and doubts raised at the beginning of the project

Despite the acceptability of utility, the findings showed fears and doubts occurred at the beginning of the project. The fear about the efficiency of the teaching process for the national program objectives was raised by mainly two primary school teachers in Guadeloupe as is illustrated in the following excerpt:

“I asked myself if the students will understand the scientific language of researchers and what will happen when putting oneself at the same level as the students. Then the questions about the Canadians themselves. I asked myself whether we will find similar objective in the program for working together?” (G3)

Two teachers expressed fear that they would not reach the learning objectives of their program and about their differences with their designated peers over learning approaches. Also, one participant feared that the researchers would use complex language in front of the students and expressed doubts about the interest in the project by their students. These fears and doubts can be indirectly related to the dimension perception of ease of use of the TAM model.

It is interesting to note that the moments, when these fears and doubts were dispelled during the project, were reported as the most significant moments experienced. In fact, for these participants, the observation of the excellence in achieving the learning objectives, contrary to what they anticipated, was a surprising revelation.

4.4. The most important moments experienced during the project

The results show that the participants have all experienced significant moments when they saw how much the process of investigation in conjunction with exchanging with peers sparked in-depth learning in their students. In addition, this significant moments stimulated in-depth exchanges and reflections in class, since students had to think about ways to present their theme and choose words, images, appropriate visual support, etc., wisely. It seems that many questions emerged in the classroom as a result of not only the theme that they investigated, but also exchanges with and information received from their peers. CEBT seems to motivate rich reflections in class groups as a result of videoconferencing with peers. Finally, the desire to share one's particularities of one's own country turned out to be a driving force that generated meaning throughout the project. These excerpts, presenting the comments of the teachers on the most significant moments experienced during the project, eloquently demonstrate this point:

"For the students, it stimulated them more because it was concrete, it was in a project, they knew that there was a good intention behind the project" (Q1).

"And in the end, I'm happy because we got a positive result with the students. When I evaluated, I was not disappointed with my evaluation" (G2)

"The learning contents become more easily anchored. They are facilitated by the idea of collaborating with others (...). They really appreciated these exchanges, these videoconferences that they impatiently waited for to meet their Canadian peers" (G3)

The results show that the enthusiasm of seeing others during videoconference is very present among learners and that it marked the experiences of participating teachers.

"...It is simply seeing the enthusiasm of my students when they saw students in the same level in Guadeloupe. There was some sort of shyness, and at a specific moment, they broke the ice and could exchange on what they saw... and what they approached as a theme, as a content... they spoke of the Quebec school versus the Guadeloupe school, of the West Indies." (Q3)

"...Sharing with others, discussing with other students, and seeing what happens there. They were surprised to learn that they have the same films, same videogames. And to see other things in the schools, whether in terms of the costume, the uniform, the temperature, for them it was really surprising at first to learn all this information." (Q1)

"They really appreciated these exchanges, these videoconferences, they were impatiently waiting to meet their Canadian peers" (G3)

The interest in digital tools, and more particularly the tablets provided to groups in Guadeloupe for the ETTC project, is evident among the students. The results show the students' keen interest in using various functionalities for communicating through Learning Management System (LMS) and use different tools to investigate their theme. Although some have similar equipment at home, others don't. Also, the use of educational technologies in the Guadeloupean groups has generated a climate of collaboration both between students and between students and teacher. For example, those who knew how to send emails taught those who had difficulties. Two teachers mentioned that it was often the students who taught them how to use various features. They also noted that their young students gained important learning experiences about the ways of behaving on the net. Moreover, both emphasized the exemplary supervision provided by the assigned researcher to their class group who showed the students how to use their access code, tools, etc. The fact that the LMS platform was fully configured from the start was mentioned as an important source of support.

The interest in technologies did not appear in the Quebec group's results except in the university group. Nevertheless, the interest in technologies in this context is different since it is more concerned with exploring digital tools that can be used in their future teaching profession.

Four teachers showed that they were very happy with their participation in the research, taking part in the research project, and exploring how a research project unfolds. They mentioned having learned a lot from these exchanges and having come away fulfilled.

The appreciation to collaborate to design pedagogical scenarios with a peer was important for three teachers. One of them mentioned how it added more work for them. They added, however, that they are used to working alone since they are the only persons responsible for the science program in their school and having to revisit their practices in the company of another teacher was, in the end, an appreciated source of personal development.

"All the collaboration with the other teacher in who was in another context with other students, that was quite nice" (Q2)

"(...) meeting with my peers at school in person was a great professional connection. For me, it was a defining moment" (Q3)

"After, we liked working with our teaching peers since we really hit it off. Right away, we knew on which points we agreed so to advance the project" (G3)

The importance of support and attitude from researchers who intervened in the class (those who are specialized in a specific theme and did not take part in this research) is also observed in the comments of several teachers. It seems that the research team was very present when it came to helping teachers and students with technical challenges. Also, the team had a positive attitude, which helped everyone keep their enthusiasm when different difficulties were encountered. Some teachers from Guadeloupe mentioned that they knew how to use the technology without receiving any previous training and mentioned how many students needed to be shown how to use different functionalities. One teacher from Quebec emphasized their appreciation for constant technical support by the research team. They pointed out that while they and their students had a good knowledge of technology use in general, the same was not true for technologies used for the theme on geothermal energy. In fact, the theme needed the implementation of a technology that was very difficult to implement on Quebec soil in comparison to Guadeloupe. Whatever it was, the feeling of being supported influenced the perception of ease of use, which certainly influenced the intentions of use as well, since all the teachers stated that they wished to relive the experience. In accordance with the TAM, these results show a positive perception of the moment experienced and this situation can have an influence on whether the teachers will recommend their colleagues to use this pedagogical innovation.

4.5. Teachers' observations at the end of the project

As it was stated in the section about the most significant moments experienced by teachers, the teachers in Guadeloupe and Quebec reiterated that they observed more substantial learning during and at the end of the project on many occasions. One teacher in Quebec even experimented with the project by separating one group in Quebec into two groups that investigated the theme independently and the other who exchanged with a peer group in Guadeloupe. This shows a difference in learning, notably on the multidimensional quality in the appropriation of the notions of the investigated theme by these two groups, as shown here:

"Several benefits. I had the chance to work with my two groups on this. There was one I used as a test group and the other as a control group. So, I only connected one of the two groups with the group in Guadeloupe while the other was isolated from the Guadeloupe group. And... in their answers, the students really took into consideration the continuous exchanges they had with the students from Guadeloupe. (...) The differences that I observed in the students' understanding of geothermal energy, the quality of production among those

who communicated with students from Guadeloupe was much higher than in the group which did not have access. So, I think there was added value there for the students." (Q2)
"(...) we shouldn't do it for ourselves, but for our students, for the educational benefits that it provides." (Q3)

In the same way, all these ideas are related to a strong engagement for learners in the investigation process because of its authentic character and the necessity to exchange with the peer group. Also, all the participants are unanimous on the fact that the project generated a great amount of fulfillment on a personal, learning, and professional level. Finally, the teachers in Guadeloupe all underlined the important contribution for the students' skills development with the handling of the project's various technological functionalities (For example, using LMS, making a film and learning about video editing techniques, taking photos, researching on the Internet).

4.6. Recommendations for colleagues to participate in this kind of project

Directly related to the TAM, the response of all the teachers who participated was unanimous when it came to recommending a colleague to participate in the project. They mentioned the advantages and benefits that they took for themselves and their students from participating in the project. On this point, intention of use based on TAM model's pedagogical innovation shows that its acceptability is well present.

4.7. Constraints

The "constraints" section includes the technical difficulties experienced by teachers due to the unreliable internet network and the low number of tablets that they had. This was predominantly mentioned among the participants in Guadeloupe. The two teachers received five (number of students not mentioned) and six (22 students) tablets respectively. They both mentioned that they had to work with an unreliable internet connection. Far from insisting on these disadvantages, both showed great gratitude for the tablets that were lent to them and concentrated their statements on the ways they took advantage of the restrictive situation of not having many tablets. For instance, they mentioned that given the limited number of tablets, they took the opportunity to integrate teaching skills such as sharing tools and interpersonal skills. This said, they both believe that a reliable internet connection and more tablets would drastically help them to work with this type of project. The following excerpts summarize the attitude of the teachers towards constraints that were experienced:

"I only had 5 tablets, we had difficulty with the connection because we don't always have Wi-Fi. But also, the advantages are that students learn to use a tablet in the group, so the community spirit, learning how to share, is a good thing, (...) and they arranged so that everyone had a chance to take turns and learn to connect. So, in terms of advantages, very interesting, because students learned to use a computer tool, download a document on the internet, and put it in an email, I found this fantastic." (G2)

In Quebec, two teachers mentioned how participating in a project like this required someone with an open and flexible teaching personality who can adapt to a new situation or constraint rapidly. The secondary school teacher brought up the difficulties connecting with their peers in Guadeloupe. They also told us that the videoconferencing experience was very difficult in terms of sound quality, which naturally affected the quality of the exchanges.

4.8. Results of specific semi-structured interviews on the digital technologies used

The results presented here show the analysis of the digital use as experienced by two participating teachers (Figure 3). Also, statements about the components of TAM in the interviews which captured the more general perceptions of the participants (Figure 2) have been compiled here. Therefore, Table 4 presents the synthesis of perceptions linked to digital use using TEEC project framework and organized with the TAM model (N=6). Problematic connection (G1-G2), sound quality (G1-Q2), lack of light in class (G1). Securing time to meet (Q2), The vocabulary of the counterparts' theme is too new for the group (Q1), Students freeze in front of the camera (G3).

| Used technology | Perception of use | Perception of ease of use | Intention of use |
|--------------------------|--|---|---|
| Videoconference | Discovery Fulfilling Stimulating Motivating Learning Seeing Other cultures Sharing Exchanging (all) | Not easy, but the interest overcomes the obstacles (G1-G2) Having a friendly personality; Capacity to adapt to the unexpected (Q1-Q2) Precious help of the research team (G1-G2-G3-Q2) Quality of relationship between students and research team (G1-G2-G3-Q2-Q3) | Would like to do this kind of project again (all) Strongly recommend doing this to colleagues (all) Would like to have more equipment (tablets) and a good connection (G1-G2) |
| LMS | Sharing documents Exchanging information Communicating asynchronously Sending cordial messages to each other (G1 et G2) Support for following the chronological steps of the investigation (G1) The teacher sees the usefulness at the end of the project only (the students used it alone) (G2) Formative for students (G2) | Not easy but worth it (G2) Little training (G1-G2) Students learn among each other and show how it works to teachers (G1-G2) | Would like to do this kind of project again (all) Strongly recommend doing this to colleagues (all) Would like to have more tablets and a good connection (G1-G2) |
| Investigation use | Learning technologies (photos, films, treating text, research on the internet, etc.) (G1) Investigating to share with peers naturally anchors learning (Q1-G3) Studying the theme in small peer groups is wonderful (G2) Not much information on the internet about the investigated theme (G2) | Limited number of tablets (G1-G2) The theme is not relevant to the Quebec context(Q2) The time between meetings among peers is short in comparison to the time allotted to create material to present to peers (film) (G3) | Would like to do this kind of project again (all) Strongly recommend doing this to colleagues (all) Would like to have more equipment (tablets) and a good connection (G1-G2) |

Table 4: Summary matrix of TAM on technology use

In addition, some important information emerged about difficulties encountered with the videoconferencing: Problematic connection (G1-G2), sound quality (G1-Q2), lack of light in class (G1), securing time to meet (Q2), the vocabulary of the counterparts' theme is too new for the group (Q1) and students freeze in front of the camera (G3). We didn't directly ask the other teachers if they experienced technical problems with technologies, but our analysis of constraint (Table 3) show it was the case. This situation is related to the perception of ease of use, but the intention of use is not affected by negative commentaries, and we saw they would do the project again. About the perception of useful, we note that teachers saw a clear advantage in using technologies.

5. Discussion

The objective of this article was to analyze a pedagogical innovation (CEBT) and digital use, especially collaboration with technologies. More specifically, we have examined the teachers' perception on the acceptability of a pedagogical innovation. The pedagogical innovation is characterised by digital use, collaboration between two different contexts that we call context effects-based teaching (CEBT). This is indeed not commonly used as didactical approach by teachers. From this perspective, we confer that this type of teaching and its implementation with digital can be viewed as a pedagogical innovation. Taking the complexity of the use of various digital tools such as those we presented in the digital use map into consideration, we had the belief that there would be resistance to a pedagogical innovation and a research project by teachers and that this aspect would emerge rapidly among those who participated in the project. Contrary to our hypothesis, this was not detected and the results that we obtained showed us that the teachers who participated in the ETTC project were rather very motivated to exchange with their peers in another country, and this, even though it was their interest in the studied topic that motivated them. The doubts mentioned by teachers were not related to digital technology, but rather to the achievement of learning objectives related to the program of study, the alignment with their peers, the use of incomprehensible language by the researchers that would make it difficult for students to understand, and the interest shown by students towards the project. Despite the barriers that were mentioned in the scientific literature on the educational uses of digital technologies such as accessibility, lack of time, and training (Bingimlas, 2009; Francom, 2020), teachers who participated in our research did not mention them. However, they did mention technical difficulties such as connectivity problems, poor bandwidth quality, sound problems during videoconferences, and for some, lack of equipment. In research on the representation of digital uses between two contexts, teachers' experience with technology is nuanced, and Ferrière and Ailincai (2022) mentions that teachers have had both positive and negative experiences when using technology. That said, technical problems were not an obstacle and the use of digital technologies did not create a negative perception that would stop the teachers from doing the project again and digital technologies can be considered as an added value for students.

One of the major fallouts of the project that was reported by teachers was regarding to the perception of usefulness of TAM model's pedagogical innovation. For instance, in the section about fears, we noticed a shift in attitude of teachers when learning objectives were achieved and in-depth learning by students was noticed. We consider CEBT can contribute significantly to in-depth learning (Anjou *et al.*, 2021) since it is an integral part of peer-to-peer exchanges (Forissier *et al.*, 2013; Le Bail *et al.*, 2021). As for the dimension of perceived ease of use, teachers did not report it as important. Comments regarding the support provided to teachers, both on the technological component and on the disciplinary content, lead us to believe that favorable conditions resulting in smooth operation of the project contribute to ease of use. Consequently, all teachers mentioned that the experience was positive and that they would recommend this type of project to their colleagues. This means that the intention of use is strongly present.

When implementing a project such as this one, where a pedagogical innovation is deployed, we can try to understand the challenges revolving around the reluctance of teachers relative to digital technology. Here, we are referring to the in-depth perception of the digital capabilities of teachers (Stockless & Villeneuve, 2017) and the obstacles that they may face (Francom, 2020; Stockless *et al.*, 2018). This is why we wanted to better understand the acceptability of such a project. Thus, using TAM model (Davis, 1989) model, we analyzed the teachers'

experience in the operationalization of the pedagogical innovation. Contrary to our hypothesis, digital technology use was found to be neither an obstacle nor a positive or negative element. This was true for the capacity of teachers to implement this project as it was for its management with the students in the classroom. In accordance with TAM, the results show a positive perception of utility of digital use, as we did for pedagogical innovation, and if the perception of easy of use is present, the importance of perception of utility can contribute to an intention of use of CEBT.

Our mapping shows that the large number of players involved in the project (see Figure 1) and the scale of the technological needs, particularly between the contexts, result in challenges regarding operationalization, choice of platform, data management, and interoperability of digital technologies. These aspects were not flagged as problems by participants, but considering the significant amount of time spent on the use of LMSs (Chartofylaka *et al.*, 2019), we must maintain alertness to ensure the smooth operation of the project, specifically the pedagogical innovation.

6. Conclusion

The implementation of the ETTC project is based on two fundamental foundations: digital technologies and CEBT. We have previously presented a digital technology map with complex features. Given this complexity and the implementation of a new pedagogical system, we consider CEBT and the resulting educational use of digital technologies as a pedagogical innovation. A qualitative approach with semi-structured interview ($n=6$) was used to analyze a pedagogical innovation and better understand digital use in a teaching research project. The results of the analysis of the digital use in the ETTC project and its pedagogical deployment showed us an acceptability characterized by a very good perception of usefulness. Thus, teachers noticed in-depth learning in their students.

In light of the findings mentioned following the teachers' experience, considerations related to digital technologies must be explicitly addressed. Given the important place of videoconferencing for exchanges between peers, bandwidth is an important requirement for allowing an optimal communication space and avoiding wasting time on solving image or sound problems. Digital learning environments are central to file sharing and interaction between peer teams. To do this, teachers must have support in the configuration of these educational spaces.

We have identified the limits of the pedagogical innovation in order to make it as acceptable as possible for teachers and students to be interested even before participating in it. By doing this, we addressed the fears that emerged when integrating such a project with existing practices in each context. We observe limits in the diversification of digital tools. This diversification is necessary to properly meet all needs. However, it poses problems for users, especially those in the field, since they get confused about the educational functionalities necessary for the project. This confusion could be overcome by integrating various digital tools (in particular the scenario tool and the context calculator) and offering users a unique and guided access. While this would reduce the flexibility of the system, it would succeed in providing coherence and acceptability among users.

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