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## **Beliefs about Digital Technologies and Teachers' Acceptance of an Educational App for Preschoolers**

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# **Beliefs about Digital Technologies and Teachers' Acceptance of an Educational App for Preschoolers**

**Abstract:** Preschool teachers' varying beliefs about the utility of digital technologies may affect their acceptance of educational tablet apps for classroom use. We tested this hypothesis via a two-stage study in which we first assessed 214 French *école maternelle* teachers' beliefs about digital technologies. Stage two of the study measured acceptance of an educational tablet app by a sub-sample of 62 teachers who had agreed to use the app in their classrooms. The main result of this study is that the social background of a school is an important factor to consider when studying teachers' beliefs and acceptance of technologies. Teachers who teach in schools with educational and social difficulties are less convinced by digital technologies' benefits for students. Their acceptance of our app is also lower than the other teachers.

**Keywords:** *acceptance, teachers' beliefs, education app, preschool*

## **1. Introduction**

Classroom use of information and communication technologies (ICT) has expanded greatly since the turn of the century, a trend that has been encouraged by numerous reports, most notably from the Organization for Economic Co-operation and Development (OECD, 2015). In France, the government has taken a number of measures to expand the use of ICTs in schools, including passing new legislation and implementing "education plans". For example, the Digital Education Plan launched in May 2015 was designed to reduce inequalities in access to digital technologies so all teachers and all students can benefit from the opportunities these technologies offer.

Researchers have responded to the ever-growing need to use digital technologies by investigating various aspects of everyday human interactions with these technologies, including the very important issues of acceptability and acceptance. Among these technological tools, the tablet seems to be a tool of choice for developing children's early learning (Kirkorian & Pempek, 2013; Hirsh-Pasek et al., 2015). Given the significance of the use of these tools, it seems necessary to present studies that try to understand the mechanisms of adoption of new technologies in the classroom, especially by trying to understand the factors that impact acceptance, such as beliefs about digital technology and environmental characteristics.

### **1.1. Models for Evaluating Technology Acceptance**

Acceptability and acceptance are two different concepts. Acceptability refers to factors that come into play when deciding whether or not to adopt a tool or a system in a given environment, whereas acceptance describes the factors that impact the degree to which users embrace an existing tool in that environment. Because individuals' relationships with objects are multidimensional, both acceptability and acceptance depend on a variety of factors.

Alexandre et al.'s (2018) literature review looked at how the concepts of acceptability and acceptance have evolved. Both concepts were initially defined in the field of psychological ergonomics from a tool-use perspective, according to which the most important factors in whether or not a tool is adopted are its usability and accessibility. This perspective shifted to a user-centered approach when the social psychologists Fishbein and Ajzen put forward their theories of reasoned action (TRA; Fishbein & Ajzen, 1975) and of planned behavior (TPB; Ajzen, 1985). They postulated that behavioral intention predicts both acceptability and intention to use, with these intentions being themselves determined by the user's representations of the object.

The TRA and TPB form the basis for Davis' (1989) technology acceptance model (TAM), a user-centered and productivity-oriented model that views acceptance from an ergonomic and social perspective. Indeed, when potential users encounter a new tool, they actively assess its perceived usefulness and perceived ease of use.

Perceived usefulness describes a potential user's evaluation of a tool's ability to improve their productivity in a given environment, whereas perceived ease of use describes the amount of effort a user expects to expend in order to familiarize themselves with and use the tool. Analyzing these two factors enables a user to decide whether a tool "is really worth using". This decision will lead to an affective response in the form of an attitude towards adopting the tool (acceptability), which will determine the subsequent behavioral response, that is, whether or not the tool is used.

Because the TAM is robust and applicable to many types of technological tools and many types of user, it has been widely applied in research into new technologies (Alomary & Woollard, 2015). Improvements to the original model, including the addition of new explanatory variables, alongside perceived usefulness and perceived ease of use, resulted in the development of TAM-2 (Venkatesh & Davis, 2000) and TAM-3 (Venkatesh & Bala, 2008). Nevertheless, all these versions of the TAM focus solely on intentions to use a tool without considering whether it is actually used, and studies have not always established a causal link between intention and actual use (Webb & Sheeran, 2006). In addition, these theories allow for only a binary behavior, that is, initial rejection or initial acceptance, even though the relationship between a human being and a technological tool is highly complex and includes "living with, being transformed by, being dependent on and being enhanced by" the tool (Sonia & Brangier, 2013, p. 47). Thus, an ergonomist's job is to increase a tool's acceptability and acceptance by reducing the distance between machine and user. As for all

types of relationship, acceptance of a tool changes with time, as the user gains experience and familiarity with its use.

Limayem et al. (2007) incorporated the links between use and intention into their post-acceptance model (PAM), while noting the importance of taking into account the impact of habit on whether or not intention translates into actual use. Because individuals who are familiar with a tool use it more frequently and for longer periods, habit and familiarity moderate the link between intention to use a tool and actual use.

Numerous scholars have attempted to identify the psychological mechanisms underlying the adoption of a new technology. Their work has resulted in as many models as there are technologies and usage environments but no one has yet produced a universal model. Alexandre et al. (2018) concluded their review of the literature with the idea that acceptability does not depend on a single explanatory criterion. Consequently, they proposed classifying the factors that impact a tool's acceptability into four meta-criteria: usefulness, ease of use, esthetic quality, and the context in which the tool will be used. This final criterion, which includes individual and social variables, is particularly important because a tool is introduced into a context in order to fulfill a specific need. However, assessing these individual and social variables, which are different in every context, requires specific measures. For example, Persico et al. (2014) describe how they adapted the TAM to evaluate the innovative potential of e-learning tools in the context of an Italian university. Indeed, education is a field with numerous particularities that may impact the acceptability and acceptance of digital technologies.

## **1.2. New Technologies in the Field of Education**

Following their systematic review of the use of the TAM in education research, Granić and Marangunić (2019) concluded that perceived ease of use and perceived usefulness were

major predictors of the acceptability of new technologies. Thus, the TAM is robust and widely used in this field. However, it is important to notice that more than half of the studies listed in their review included additional or modified variables compared with the base model, thereby showing the need to adapt the TAM to the particularities of each context. For example, Persico et al. (2014) describe how they adapted the TAM to evaluate the innovative potential of e-learning tools in the context of an Italian university. Education is a field with numerous particularities that may impact the acceptance of digital technologies. Among these particularities, we can find: the two level of users (student or teacher), the place of use (directly in classroom or at home), the purpose (e.g. to learn a new lesson, to organize schoolwork, to create a new material), etc.

Nevertheless, surveys show that the use of digital technologies in preschools remains sporadic (e.g., Wartella et al., 2010), so it is important to identify the mechanisms underlying the adoption and acceptance of these new tools. According to Foon Hew and Brush (2007), the barriers that slow teachers' adoption of new technologies are resources, institution, cultural environment (subject culture), attitudes and beliefs, knowledge and skills, and assessment. These factors can be divided into first-order and second-order barriers. First-order barriers are the result of external variables such as the equipment itself and the resources available within the school. Second-order barriers are the result of internal variables such as teachers' skills, beliefs, aptitudes, and behaviors. The present study focused on second-order barriers, as they appear to have the greatest impact on whether or not teachers adopt digital technologies in the classroom.

The use of new technology in classroom is controversial, especially for young children. It is associated to "screen time studies" that investigate the effect of spending time with devices like television, smartphone, tablet, etc. Most of those studies found negative associations between academic performance and screen time (Adelantado-Renau et al., 2019).

However, these studies are mainly focused on television, and a confusion exists between all types of screens while the question of passive screen use or active screen use should be raised. The findings on passive screen use, and what is conveyed by the media can create a fear of technology, hence their controversial nature.

Digital training for teachers is important. It can show teachers how to use the tools at their disposal, but also explain to them in concrete terms to what extent they can be relevant and for what purposes. However, such training does not always answer all the teachers' questions and should be better thought out in collaboration with the main actors (Peraya et al., 2002).

### **1.3. Educational Tablet Apps and Learning by Preschoolers**

Numerous studies have examined the objective effects of tablets on learning. According to Hirsh-Pasek et al. (2015), carefully designed educational apps can provide alternative and interesting ways of engaging children, especially preschoolers, in learning. They need to follow principles coming from studies on the learning process, and not simply emulate other tool like television or books.

Xie et al.'s (2018) meta-analysis of this research showed that learning situations involving tablets are more beneficial than situations in which tablets are not used. In addition, the impact of using tablets is moderated by a number of variables, including learner's age, the subject being studied, and the learning environment. However, the great variability in results between the studies analyzed by Xie et al. (2019) led Griffith et al. (2020) to suggest that a narrative synthesis might be more appropriate than a meta-analysis. In the end, Griffith et al. obtained comparable results to those reported by Xie et al. (2018), and therefore reiterated the message that interactive educational apps may be useful tools for supporting early learning.



Early learning for preschoolers includes the development of early literacy and early numeracy skills. On one hand, early literacy describes the knowledge, skills, and attitudes that underlie the development of conventional forms of reading and writing (Whitehurst & Lonigan, 1998; Snow et al., 1998). On the other hand, early numeracy describes a distinct set of skills that develop in interaction to build more advanced mathematical skills (Aunola et al., 2004; Purpura et al., 2013). Both of those skills are predictors of ulterior academic achievement (National Early Literacy Panel [NELP], 2008 ; National Mathematics Advisory Panel [NMAP], 2008 ; Rabiner et al., 2016), and preschoolers can work on them through educational apps.

Studies have reported a positive impact of digital technologies (e-books, tablet computers, etc.) on the development of early literacy skills such as alphabet knowledge, vocabulary (De Jong & Bus, 2004; Moody, 2010; Neumann, 2018), and phonological awareness (Chera & Wood, 2003; Karemaker et al., 2010; Wood, Pillinger, & Jackson, 2010). Educational tablet apps can also provide effective individual aids for developing early mathematics skills (e.g., Outhwaite et al., 2017), although their benefits depend on their content being based on a solid and well-constructed program suited to the child's age (e.g., Pitchford, 2015, Schacter & Jo, 2016).

#### **1.4. Study Objectives**

Although there is general agreement in the literature that digital technologies offer an interesting medium for working on early learning skills (e.g., Vernadakis et al. 2006; Xie et al., 2018), these technologies will be used effectively only if they are embraced by teachers. The issue of why people adopt or reject digital technologies is attracting ever-more attention

from researchers in the fields of ergonomics and human-machine interactions. Because teachers' beliefs about digital technologies appear to be an important factor in determining the acceptability and acceptance of educational apps (e.g., Ertmer et al., 2012), it is essential to assess these beliefs in order to better understand the mechanisms underlying acceptability and acceptance.

As noted above, the acceptance is a complex concept that incorporate all the factors influencing decisions on whether or not to use a tool in a given context (Alexandre et al., 2018). The paucity of studies in other educational contexts is particularly noticeable in the case of preschool (Granić & Marangunić, 2019), even though early learning creates the foundations on which subsequent academic performance is built (e.g., Chetty et al., 2011; Rabiner et al., 2016).

We conducted a study to answer the following three questions:

- 1) What do preschool teachers believe about the value of digital technologies as a teaching resource for their students?
- 2) How well will preschool teachers accept an educational app they are asked to use with their students?
- 3) Is acceptance of an educational app linked to type of school, teaching experience, or teachers' beliefs?

## **2. Method**

### **2.1. Participants**

We conducted our study in Lorraine, a region of northeast France with a population of approximately 2.4 million. Our sample comprised 214 kindergarten teachers (197 women, 17 men) with between 1 and 43 years' teaching experience (mean = 18.7 years, standard deviation = 12.6). We recoded this latter variable into three categories: between 1 and 15

years' experience (36%), between 16 and 30 years' experience (44%), and 31 years' experience or more (19%). As a way of reducing inequalities in education, French schools whose students face socioeconomic difficulties and who perform poorly on national evaluations are given extra financial and human resources via a program known as the "Priority Education Networks" (Réseaux d'Éducation Prioritaire). Thirty-nine percent of the teachers in our sample worked in Priority Education Network schools; the remaining 61% worked in schools outside Priority Education Networks.

## **2.2. Procedure**

We carried out our study in *écoles maternelles* (preschools), which are a pillar of the French education system. *École maternelle* is free and has been obligatory for all children from the age of 3 years since the start of the 2019 school year. Since 2015 the official *école maternelle* curriculum (MEN, 2015) has included an area of learning called "Explore the world", which includes teaching students to use digital technologies.

We conducted the study in two stages. In Stage 1 we asked the 214 teachers in our sample to provide socio-professional information and to complete a series of items measuring their beliefs about the use of digital technologies at school. Stage 2 of the study involved 62 of the original 214 teachers and was conducted as part of the LINUMEN (Littératie et Numératie Emergentes par le Numérique – Digital Technologies for Developing Early Literacy and Numeracy) project. In stage 2, our sample comprised 62 kindergarten teachers (59 women, 2 men) with between 1 and 40 years' teaching experience (mean = 22.6 years, standard deviation = 8.4). It should be noted that 97% of the teachers are women, which does not differ from the national figure of 95% (DEPP, 2019); the figure reflects the strong feminisation of the profession at this educational level. Similarly, the percentage of pupils at REP schools students in our sample is 22.5%, which is slightly higher than the national figure (20%, DEPP, 2019).

LINUMEN was set up to develop an educational tablet app, called AppLINO (Apprendre avec Linou en Maternelle – Learn in Preschool with Linou), for use in *école maternelle* classrooms. AppLINO was developed collaboratively by researchers and education professionals (teachers and school inspectors) in order to ensure it was suitable for use in France’s preschools. It includes ten early numeracy activities and ten early literacy activities (see Author et al., 2020).

In order to test AppLINO, we carried out a longitudinal study involving an experimental group of 62 teachers who used AppLINO with 40 classes of students, following a precise protocol, and a control group of 40 teachers (32 classes) who followed the standard preschool curriculum without the teachers being required or advised to modify their teaching in any way. The French school year runs from September to June. We started the experiment in March 2019 with students in the middle year of *école maternelle* (*moyenne section*, mean age 4.5 years). Teachers in the experimental group were required to use AppLINO in class for 10 weeks and to ask each student to do two early literacy activities and two early numeracy activities per week. The maximum length of each activity was set at 10-15 minutes, which meant that each student worked on the app’s activities for a total of around 1 hour per week. Teachers completed beliefs questionnaires in November 2018. In stage 2, teachers completed acceptance questionnaires in May 2019 after the experiment ended.

## **2.3. Measures**

### **2.3.1. Questionnaire on Teachers’ Beliefs**

To our knowledge, there is no questionnaire in French that measures teachers' beliefs about the use of digital tools in kindergarten. For this purpose, we have built a questionnaire in several steps. As a first step, we reviewed the scientific literature. The limited research on

the subject allows us to identify favorable or unfavorable beliefs about learning as well as favorable beliefs about transversal skills (e.g., Bebell & Kay 2010; Cho & Littenberg-Tobias, 2016; Hardy, 2014). In a second phase, an alpha version of the questionnaire was constructed and tested in a pilot study with 37 kindergarten teachers. This pilot study made it possible to verify the psychometric qualities of the different dimensions of the questionnaire and to keep the most relevant items. Finally, the current version of the questionnaire was developed.

We used LISREL 9.3 (Jöreskog & Sörbom, 1993, 2004) to perform a confirmatory factor analysis on the scores for the 18 items. All the analyses were based on the correlation matrix and used maximum likelihood as the estimation method. Testing the model against the data revealed three factors (Table 1). All of the items saturated significantly on their respective factor and the fit of the data to the model was satisfactory ( $\chi^2 = 245$  for 128 degrees of freedom;  $p = 0.01$ ; RMSEA (residuals) = 0.07; CFI = 0.92; NNFI = 0.90).

The first factor contained nine items referring to “favorable beliefs about learning”. Teachers with high scores on this factor believe that digital technologies have a positive impact on students’ learning. The second factor contained five items referring to “favorable beliefs about transversal skills”. Teachers with high scores on this factor believe that digital technologies can help students develop creativity, critical thinking, self-knowledge, and social skills. The third factor contained four items referring to “unfavorable beliefs about digital technologies”. Teachers with high scores on this factor believe that digital technologies do not help students develop and learn.

**Table 1 near here**

### **2.3.2. The App Acceptance Questionnaire**

Because teachers in the experimental group were required to use AppLINOU in the classroom during the test period, we evaluated its acceptance but not its acceptability. To

create our questionnaire, we decided to seek input from trainee teachers to create our questions and ensure that they would be relevant to the world of teaching. To begin with, we presented the TAM and Nielsen's model (1993) to the trainee teachers. Perceived usefulness and perceived ease of use are considered in our questionnaire as practical considerations. Usefulness corresponds to whether a tool contributes to attaining the desired goals. AppLINOU's goals are to get students to work and to help them progress in the areas covered by the *école maternelle* curriculum, which every teacher must follow. Usability corresponds to how easy the tool is to use. In our case, AppLINOU will be considered useable if students are able to use it on their own without input from their teacher. The model of Nielsen adds the concept of social acceptability. In our study, social acceptability corresponded to the teachers' perceptions of the tool: If teachers perceive a tool as being appropriate and in step with their teaching practices, they are likely to share it with their colleagues. After the presentation of those aspects of acceptance to the trainee students, we asked them how they relate in the context of the use of an educational app in the classroom. Then, we shaped our questions according to their insights and our definition of acceptance.

The questionnaire contained 10 items. Teachers stated the extent to which they agreed with each item, giving their answers on 5-point Likert scales (Table 2).

**Table 2 near here**

We conducted a confirmatory factor analysis on the scores for the items. Testing the model against the data revealed three factors (Table 2). All of the items saturated significantly on their respective factor ( $\chi^2 = 65$  for 29 degrees of freedom;  $p = 0.01$ ; RMSEA (residuals) = 0.09; CFI = 0.96; NNFI = 0.93).

The first factor contains three items referring to the social acceptability dimension of acceptance. Teachers with high scores on this factor believe that the app conforms to their

values and teaching methods. The second factor contains four items corresponding to the usefulness dimension. Teachers with high scores on this factor believe that the app is useful in helping their students learn. The third factor contains three items referring to usability. Teachers with high scores on this factor consider the app easy to use.

### **3. Results**

#### **3.1. Preliminary Analyses**

We calculated total scores for each variable by summing the scores for the items comprising that variable. Table 3 shows means, standard deviations, ranges, and Cronbach's alphas for each variable. Univariate normality indices (skewness and kurtosis) showed that the distribution of the data could be considered normal: skewness indices were all substantially lower than 3.00, the threshold above which data are considered asymmetrical, and kurtosis indices were all substantially lower than 10.00, the threshold above which the normality of a distribution is considered problematic (Kline, 1998). Correlations between the variables are shown in Table 4.

**Table 3 near here**

**Table 4 near here**

#### **3.2. Teachers' Beliefs as a Function of Teaching Experience and Type of School**

We compared teaching experience with the mean scores for each of the three dimensions of teachers' beliefs. ANOVAs showed that the only dimension to be significantly linked to teaching experience was favorable beliefs about transversal skills ( $F(2,211) = 5,482$ ,  $p < 0.01$ ): the youngest teachers had higher scores on this dimension than the other teachers. In addition, type of school was significantly linked to both positive dimensions of teachers beliefs. Compared with teachers in Priority Education Network schools, teachers in non-

Priority Education Network schools had more favorable beliefs about transversal skills ( $t(213) = -2,379; p < 0.01$ ) and more favorable beliefs about learning ( $t(213) = -2,813; p < 0.01$ ).

### **3.3. Links Between teaching experience, type of school and Acceptance**

We used multiple regression analyses to examine the effect of teaching experience, type of school and teachers' beliefs on the three dimensions of acceptance (Table 5). We introduced teaching experience, type of school and teachers' beliefs as explanatory variables in the six models presented.

#### **Table 5 near here**

The six models shown in Table 5 explained between 18% and 43% of the variance. This percentage was highest for usability. Teaching experience had no effect on any of the dimensions of acceptance, but type of school had an impact on all the dimensions except for usefulness with respect to numeracy. The teachers who worked in Priority Education Network schools had lower acceptance scores than the teachers who worked in non-Priority Education Network schools. Type of school had the greatest impact on usability ( $\beta = -.46$  and  $-.42, p < .01$ , for numeracy and literacy, respectively).

In terms of teachers' beliefs, favorable beliefs about transversal skills had a positive impact on the social acceptability ( $\beta = .41, p < .01$ ) and usability ( $\beta = .32, p < .01$ ) dimensions of numeracy activities.



## **4. Discussion**

### **4.1. Teachers' Beliefs about Digital Technologies**

Our questionnaire on teachers' beliefs about digital technologies had good psychometric properties and good internal validity, as shown by the confirmatory factor analysis, which revealed three factors: unfavorable beliefs about digital technologies, favorable beliefs about transversal skills, and favorable beliefs about learning.

Analyses of links between teaching Experience, type of School and their beliefs showed that teachers who were relatively new to teaching believed more strongly than their colleagues in the benefits of digital technologies for developing their students' transversal skills. This may be due to a generational difference linked to France's teacher training program, which has included modules on using digital technologies in education only for the last ten years (Bruillard, 2017). We also found links between teachers' beliefs and type of school. Compared with teachers in Priority Education Network schools, teachers in non-Priority Education Network schools had more favorable beliefs about transversal skills and about learning. In other words, teachers who taught in schools with educational and social difficulties were less convinced of digital technologies' benefits for students. This result showing an effect of the social background of the school is new and deserves to be pushed in future studies.

### **4.2. Teachers' Acceptance of the App**

We measured teachers' acceptance of the AppLINOu tablet app via a questionnaire we created specifically for our study, drawing on questionnaires used by other studies that have applied the TAM in the field of education (see Granić & Marangunić, 2019). Our questionnaire had good psychometric qualities and good internal validity, as shown by the

confirmatory factor analysis, which revealed three dimensions of acceptance: social acceptability, usability, and usefulness.

Overall, the teachers who used AppLINO had above average acceptance scores, indicating that the app was well accepted. Statistical analyses also showed that the most important dimension in explaining the app's acceptance was usability. This result is in line with the findings of other studies, which have found usability or perceived usability to be a very important factor in acceptance and acceptability models (Alexandre et al., 2018). Burney et al. (2017) examined the relationship between TAM and Usability testing. TAM identify the perception of user's usage of a technology whether they will use the technology in the end or not, while Usability testing is focused on how the user utilized or perceived the technology. It seems important to clarify how those two aspects play on the understanding of acceptance of technology, since usability has been proven to present positive influence when it comes to investigating educational technology acceptance and usage behavior (Holden & Rada, 2011).

#### **4.3. Links Between Teachers' Beliefs, teaching Experience, type of School, and Acceptance of the App**

Teachers with favorable beliefs about transversal skills evaluated the social acceptability and usability of the app's numeracy activities more positively than their colleagues. This finding provides empirical support for Foon Hew and Brush's (2007) model, according to which beliefs can either create barriers or facilitate the use of new technologies by teachers. According to Alexandre et al. (2018), beliefs contribute to the overall judgment meta-criterion for acceptance and acceptability. Nevertheless, our study is the first to obtain this finding, so it needs to be confirmed.

Although teachers who were relatively new to the profession had more positive beliefs than their colleagues about the utility of new technologies for developing transversal skills,

teaching experience had no effect on any of the dimensions of acceptance. In contrast, the type of school variable impacted all of the dimensions of acceptance except for usefulness for developing numeracy skills. When considering literacy skills, teachers at Priority Education Network schools evaluated the app's social acceptability, usability, and usefulness less positively than teachers at non-Priority Education Network schools. This was also the case for the app's social acceptability and usability with respect to numeracy skills, but not for usefulness. Furthermore, the impact of type of school was greatest for the usability dimension. This result shows the importance of the context in which a tool is used and supports Alexandre et al.'s (2018) decision to include social context as one of the four meta-criteria determining a tool's acceptance.

Two elements may explain the low acceptance of AppLINOu by teachers at Priority Education Network schools. Firstly, the intervention was relatively substantial for all the teachers, who were obliged to carry out several sessions over a ten-week period. Compared with other teachers, the teachers at Priority Education Network schools had to cope with more heterogeneity in the pupils' levels, and more schooling difficulties. Secondly, although the application was developed with pedagogical qualities, these remain insufficient to help students progress in Priority Education Network schools.

#### **4.4. Limitations and Future Research**

Our study contributes to research into the acceptance of educational apps by preschool teachers by revealing the links between teaching Experience, type of School and app acceptance. In addition, it allowed us to create and validate two new questionnaires for measuring teachers' beliefs about digital technologies and teachers' acceptance of an educational app. However, our study has some limitations.

First, although Stage 1 of our study involved a large sample of teachers, the sample for

Stage 2 was too small to conduct other types of analysis, such as comparisons as a function of teachers' sex. Second, the teachers who agreed to take part in Stage 2 of the experiment were volunteers, which undoubtedly impacted our results, as these teachers would be expected to have generally favorable beliefs toward digital technologies. Voluntarism is known to impact acceptance and acceptability (Alexandre et al., 2018). It would be interesting to conduct future research with non-volunteer teachers using a randomized experimental design. Third, the results obtained using our acceptance questionnaire may not be generalizable to other digital tools, as the questionnaire would have to be adapted to each tool's specificities. Finally, we assessed acceptance through a questionnaire. These are self-reported data that allow for quantitative. Ecological observations of teachers' use of AppLINOU could have provided qualitative data for more refined analyses of acceptance.

## **5. Conclusion**

Our research has contributed to understanding the relationships between teacher beliefs and acceptance of an educational app at preschool. It is important to remember our study was conducted before the Covid-19 pandemic. The crisis that resulted from this pandemic revealed that technology tools are means of adaptation to change in different professional contexts (Garfin, 2020). In the field of education, technology tools allowed for educational continuity when schools were closed. It is very likely that teachers' beliefs and acceptance of new technologies has changed during this last period. More research is now needed to further examine the links between the context in which a tool is used and its acceptance, and to ascertain whether there are other variables, in addition to teachers' beliefs and usability, that explain acceptance.

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**Table 1.** Confirmatory Factor Analysis of the Items on the Teachers’ Beliefs about Digital Technologies at School Questionnaire

	Factor		
	1	2	3
01. Digital tools favor learner autonomy.	0.74		
02. Digital tools help students concentrate.	0.70		
03. Digital tools help students who are struggling to learn.	0.68		
04. Students interact closely with digital tools they are asked to use.	0.67		
05. Digital tools can help students understand difficult concepts.	0.65		
06. Digital tools increase students’ motivation.	0.65		
07. Students work together better when they use digital tools.	0.65		
08. Digital tools allow more active learning.	0.63		
09. Students gain a better understanding of a subject when they use digital tools.	0.59		
10. Digital tools help students develop their creativity.		0.72	
11. Students find creative solutions to problems when they use digital tools.		0.65	
12. Digital tools enable students to have better social relations with other students.		0.64	
13. Digital tools help students develop critical thinking.		0.63	
14. Students develop greater self-knowledge when they use digital tools.		0.58	
15. Digital tools accentuate children’s social isolation.			0.70
16. Students become “lazy” when they use digital tools.			0.67
17. Using digital tools is detrimental to students developing social skills.			0.45
18. Digital tools can distract students in class.			0.41

**Table 2.** Confirmatory Factor Analysis of the Items on the Acceptance Questionnaire

	Factor		
	1	2	3
<b>01.</b> The tablet's activities are compatible with the way I teach.	0.65		
<b>02.</b> The content of the activities follows the progression described in the curriculum.	0.53		
<b>03.</b> I would encourage my colleagues to use these activities with their students.	0.87		
<b>04.</b> Doing the activities on a tablet is a plus.		0.81	
<b>05.</b> The activities helped students who were struggling to progress.		0.80	
<b>06.</b> The activities gained my students' interest.		0.87	
<b>07.</b> The activities helped students who were not struggling to progress.		0.50	
<b>08.</b> The priming for the activities (demonstration given at the beginning of each activity) allowed the children to understand what they had to do.			0.89
<b>09.</b> The feedback provided during the activities helped the children complete the tasks.			0.86
<b>10.</b> The vocabulary used in the instructions was suited to my students' abilities.			0.83

**Table 3.** Descriptive Statistics and Item Analyses for the Study Variables

<b>Stage 2</b>	Number of items	Cronbach's alpha	Mean	SD	Range	Skewness	Kurtosis
<b>1.</b> Unfavorable beliefs about digital technologies	4	0.63	2.85	0.78	1 - 5	0.06	-0.34
<b>2.</b> Favorable beliefs about transversal skills	5	0.79	2.64	0.74	1 - 4.40	0.22	-0.27
<b>3.</b> Favorable beliefs about learning	9	0.81	3.35	0.67	1.11 - 5	-0.42	0.56
<b>Stage 2</b>							
<b>4.</b> Social acceptability of numeracy activities	3	0.73	3.93	0.64	1.87 - 4.94	-1.14	1.98
<b>5.</b> Usefulness of numeracy activities	4	0.80	3.54	0.70	1.34 - 4.75	-0.78	1.01
<b>6.</b> Usability of numeracy activities	3	0.89	3.62	0.69	1.89 - 5.00	-0.28	0.21
<b>7.</b> Social acceptability of literacy activities	3	0.72	3.90	0.55	2.10 - 4.90	-1.01	2.07
<b>8.</b> Usefulness of literacy activities	4	0.83	3.45	0.68	1.75 - 4.61	-0.58	0.10
<b>9.</b> Usability of literacy activities	3	0.90	3.57	0.68	1.67 - 4.76	-0.72	1.01

NB. Stage 1: N = 167; Stage 2: N = 62

**Table 4.** Correlation Matrix for the Study Variables

<b>Stage 1</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>1.</b> Unfavorable beliefs about digital	1							
<b>2.</b> Favorable beliefs about transversal skills	-.33**	1						
<b>3.</b> Favorable beliefs about learning	-.37**	.63**	1					
<b>Stage 2</b>								
<b>4.</b> Social acceptability of numeracy activities	-.30*	.27	.26	1				
<b>5.</b> Usefulness of numeracy activities	-.26	.25	.35*	.74**	1			
<b>6.</b> Usability of numeracy activities	-.38**	.43**	.40**	.79**	.65**	1		
<b>7.</b> Social acceptability of literacy activities	-.12	.30*	.12	.78**	.63**	.64**	1	
<b>8.</b> Usefulness of literacy activities	-.22	.36**	.28	.53**	.72**	.53**	.74**	1
<b>9.</b> Usability of literacy activities	-.36**	.43**	.33*	.62**	.55**	.81**	.71**	.75**

NB. Stage 1: N = 214; Stage 2: N = 62; \*\*: p < .01. \*: p < .05.



**Table 5.** Effects of Teachers' Characteristics and Teachers' Beliefs on the Three Dimensions of Acceptance

	Numeracy activities			Literacy activities		
	Social acceptability	Usefulness	Usability	Social acceptability	Usefulness	Usability
	<b>M1</b>	<b>M2</b>	<b>M3</b>	<b>M4</b>	<b>M5</b>	<b>M6</b>
- Teaching experience	-.15	-.04	-.13	-.15	-.04	-.05
- Type of school (0 = non-PEN and 1 = PEN)	<b>-.41*</b>	-.21	<b>-.46**</b>	<b>-.40**</b>	<b>-.31**</b>	<b>-.42**</b>
- Unfavorable beliefs about digital technologies	-.08	-.09	-.08	.09	-.01	-.14
- Favorable beliefs about transversal skills	.13	-.08	.22	<b>.44**</b>	.29	<b>.33**</b>
- Favorable beliefs about learning	.18	<b>.36*</b>	.24	-.11	.07	.04
R <sup>2</sup>	28%	18%	43%	27%	23%	39%

NB: M1 = Dependent variable is social acceptability about Numeracy activities ; PEN = priority education network