Effects of studying tasks compatibility with tablets on their acceptance:
How experienced tasks with tablets can modify perceptions of tablets

Franck AMADIEU
CLLE research Institute, University of Toulouse, France

Charly Pecoste
CLLE research Institute, University of Toulouse, France

Claudette Mariné
CLLE research Institute, University of Toulouse, France

Cécile van de Leemput
Université libre de Bruxelles, Belgium

Colin Lescarret
CLLE research Institute, University of Toulouse, France

ABSTRACT
This chapter addresses the issue of tablets acceptance for studying. An experiment was carried out to test the effects of specific studying tasks experienced by students with no previous experiences with tablets on the perceived usability and usefulness of tablets. Students had to perform a high-compatible task (i.e. navigation/reading task) and a low-compatible task (i.e. writing task) for tablets. Subjective measures of usability, usefulness and use intention were designed to be more specific to the type of task than the classical measures used in the Technology Acceptance Model approach (Davis, 1989). Participants rated their answers before and after performing the tasks with a tablet. The results showed that the perceived usability and usefulness of tablets increased after the high-compatible task while their decreased with the low-compatible task. The findings stressed the need to consider the real user experience and to use more task-oriented measures to investigate the acceptance of mobile devices for studying.

Keywords: Cognitive Demand, Mobile Learning, Multimedia Document, Multitouch, Reading Task, Tablets, Technology Acceptance Model, Usability, Usefulness, Use Intention, User Experience, Writing Task
INTRODUCTION: CONTEXT AND GOALS OF THE CHAPTER

Mobile learning is a crucial issue for technology education, but also for education in general. The development and the diversity of devices (Mobile computers, Tablets, Smartphones, Netbooks, etc.), combined with the rise of Internet, entailed new learning situations including more and more digital information processing. Mobile learning, defined as learning supported or conveyed by a mobile device (Traxler, 2009), may support ubiquitous learning. The use of mobile devices by college students is higher than ever (Margaryan, Littlejohn, & Vojt, 2011; W. H. Wu et al., 2012), which is why empirical and scientific studies should be carried out to determine the efficiency of such mobile devices, and how they are perceived by students.

One of the most widely used mobile devices for learning today are tablets, while PDAs, laptops and mobile phones were the most commonly used between 2000 and 2010 (W. H. Wu et al., 2012). Tablets are mobile devices using screens with digitizers, allowing users to interact with the screen using a stylus or their fingers (multi-touch system). The traditional keyboard and mouse are no longer necessary to use tablets. Their light practical weight, small size and good autonomy make technology education possible both inside the classroom and out (e.g. at a museum). In the educational field, tablets are becoming increasingly commonplace (Falloon, 2015) and are usually expected to support teaching and learning; this implies good acceptance of such innovative tools by teachers and learners alike. As for any other innovation, to be successful, tablets must be accepted by users.

Investigations into the acceptance of tablets contribute to our knowledge of the effects of such mobile devices on studying activities. However, rather than generally assessing acceptance and its closest determinants as is the norm in technology acceptance research (Teo, 2010), this chapter aims to examine how acceptance may depend on the type of task performed with a tablet. Tablets can be used for various study-based tasks (e.g. taking notes, communicating, sharing documents, reading, recording sounds and videos, searching for information, etc.) and acceptance could depend on the type of tasks performed by students. Because acceptance partly relies on usability and usefulness as perceived by users (Davis, Bagozzi, & Warshaw, 1989; Venkatesh, Morris, Davis, & Davis, 2003), a study was carried out to investigate how tasks that are highly and low compatible with tablet use may impact users’ judgment concerning the usability and usefulness of such devices, and thereby the tablet’s acceptance. The study was conducted in the field of ergonomics and psychology.

TABLETS AS TOOLS FOR M-LEARNING AND U-LEARNING

Modern-day technological advances offer new perspectives for teaching and learning. In particular, they supply new tools that enable pervasive and ubiquitous learning. “Context-aware ubiquitous learning usually involves a learning activity situated in a real-world environment, the setup of a wireless communication infrastructure, and the use of mobile devices so that the learners can be guided to explore real-time information and interact with the learning environment” (Hsu & Hwang, 2014, p. 689). As mobile devices become increasingly powerful, they arouse more and more interest from teachers and researchers, and contribute to changing traditional educational contexts. Recent technologies support mobile learning (m-learning) and ubiquitous learning (u-learning), enabling anyone to learn, anywhere, anytime. In the classroom, using mobile devices allows students to access to digital resources that can be integrated into more classical activities involving books, paper and pens. For instance, students can use mobile tools to search for information on the Internet to assist with activities such as writing an essay. The main quality of m-learning and u-learning systems is the opportunity to learn in different contexts. Students can access online resources without being sat behind a computer. Compared with traditional contexts, wireless connections offer the possibility of conducting learning activities everywhere. These systems enable students to process information from digital resources but also from real outdoor environments. For instance, the extension of the learning environment allows students to investigate phenomena in real life by observing or manipulating real objects in natural contexts. Land and Zimmerman (2015) found that m-learning might encourage people to interact with the authentic natural
setting around them. M-learning tools are useful for collecting and comparing information from digital resources and natural settings. Digital resources can guide the exploration of objects from the real world, and information collected from the environment can complement that provided by mobile devices. These situations allow us to process and combine information from different sources. Finally, m-learning and u-learning can support education in both formal and informal settings.

In spite of its numerous qualities, m-learning may be demanding for students as it implies simultaneously dealing with both their physical environment (e.g., manipulating objects, observing phenomenon, writing) and a digital environment (e.g., consulting multimedia resources) (Chu, 2014). For instance, Liu, Lin, Tsai and Paas (2012) observed that m-learning involving texts, pictures and real objects led to lower learning performances than conditions involving text and pictures only, or texts and real objects only. These findings indicate that students have limited cognitive capacities to process different sources of information from m-tools and the natural environment. When designing m-learning environments, this type of limitation should be taken into account in order to create efficient m-learning activities. Too many resources to process simultaneously should be avoided. As with many new learning devices or environments, learners benefit from feedback and guidance. Hwang and Chang (2011) showed that guiding users in a mobile learning context could significantly improve learning and learners’ attitudes. To increase the efficiency of mobile learning systems, motivational aspects should also be considered. Mobile apps can incite motivation in learners by conveying challenges, controlling aspects of their learning, self-assessment and immediate and proper feedback (Ciampa, 2014). In other words, m-learning should be stimulating and assist the user through each task. For a successful learning process, m-learning systems must be designed according to these principles.

However, well-designed m-tools may be insufficient to promote good learning. The success of mobile educational tools also relies on the acceptance of such tools. Beliefs, competencies, skills and attitudes regarding innovative systems such as m-learning require long-term efforts to evolve (Looi et al., 2014). The adoption of mobile technology by educators and students is one of today’s great challenges, especially early on in the implementation process of these innovative tools. Even if mobile systems supply new ways to conduct learning activities and can lead to new pedagogical practices, they can be negatively perceived or unappreciated by users. For these reasons, the perception of mobile tools must be investigated. The study conducted by Tan, Ooi, Leong and Lin (2014) on m-learning acceptance revealed that the consumer intention to use depends mainly on the tool’s perceived usefulness and ease of use. Social influence also appeared as a great determinant of perceived usefulness. Mac Callum, Jeffrey and Kinshuk (2014) confirmed that perceived ease of use and perceived usefulness were strong predictors of m-learning being adopted or not. Students and educators base their intention to use on their expectation of how m-learning devices will be helpful for learning and teaching, and how using these technologies will be free of effort. In this study, the authors also showed that the level of ICT literacy can directly and indirectly predict behavioral intention. Learners’ acceptance of m-learning systems relies on various factors, such as performance expectancy, social influence, hedonic motivation, facilitating conditions, and habit (Kang, Liew, Lim, Jang & Lee, 2015). This chapter therefore addresses the factors for the acceptance of tablets, which are among the most used and innovative mobile tools used today. The next part deals with the attitudes towards and the perceptions of tablets in the education field.

**PERCEPTION OF TABLETS BY STUDENTS: USABILITY AND USEFULNESS**

**Attitudes towards tablets**

Implementing technology in an educational environment means taking into account the attitudes that users (i.e. students and teachers) have towards new technological tools (Teo, 2008). Students’ attitudes towards tablets for learning seem to be positive (Dündar & Akçayır, 2014; Sung & Mayer, 2013) as do teachers’ (Campigotto, McEwen, & Demmans Epp, 2013). However, positive attitudes towards tablets may be unrelated to their real learning performance and efficiency. For instance, Sung and Mayer (2013) compared two instructional methods (standard vs. enhanced method) and two types of devices (iPad vs.
iMac). While their results confirmed that the enhanced method provided better transfer scores than the standard method, the mobile device (iPad) did not improve learning performance compared to the static device (iMac). Conversely, while the instructional method had no effect on motivation ratings, the mobile device led to greater motivation ratings, meaning that students preferred to study with the mobile device. The assessment of attitudes towards tablets for learning is too general, and more attention should be paid to the aspects of tablets that underlie learners’ attitudes. Tablets’ usefulness and usability are two aspects that are assessed in the research field pertaining to the perceptions of innovative technology tools.

**Usability of tablets**

Usability, or ease of use, is a concept that refers to the quality of use of systems. Usable systems are systems with attributes that make them easily and effectively usable. Four attributes contribute to usability (Shackel, 2009): effectiveness (performance, speed, errors, usage), learnability (level of training and relearning), flexibility (adaptation to variations in tasks and environments), and attitude (tiredness, discomfort, frustration, satisfaction).

Tablets’ perceived usability is relatively high (Chien, Lin, & Yu, 2014; Morris, Ramsay, & Chauhan, 2012; Park, Han, Kim, Oh, & Moon, 2013). For instance, while tablets have smaller screens than laptops, reading on tablets is more effective as it is reminiscent of reading the paper. In comparison with computers, tablets enable flexible postures of reading as do paper documents. Tablets represent an advantage in terms of usability and making interaction more efficient and less costly for the handler. Interaction with multi-touch tablets is more efficient and simpler than with conventional computers (Baccino & Drai-Zerbib, 2012). Thanks to their size, portability and responsiveness, tablets are tools that can be easily used by students alongside other tools and for various learning tasks. Students can quickly access digital resources thanks to tablets during traditional learning tasks such as writing, manipulating objects, communicating with others students, etc. As they are quick to turn on, they are practical for urgent learning situations. In terms of familiarization, users can learn how they work in a short amount of time, contributing to their positively perceived ease of use.

**Usefulness of tablets**

While usability concerns how systems are easy and efficient to use, usefulness refers to how systems allow users to achieve their goals (work, study, leisure), and the benefits expected by users (Davis et al., 1989). Tablets and other mobile devices are attractive to students encouraging their involvement in the use of these new tools, and thereby their learning. Recent studies corroborated the idea of positive attitudes towards tablets and their use for learning among students and teachers (McCabe, 2011; Morris et al., 2012; Sung & Mayer, 2013). Users perceive these tools as engaging for learning tasks and contributing to the acquisition of skills and knowledge. For example, a recent study conducted by Campigotto et al. (2013) reported that after 3 months of using a mobile application to learn vocabulary, the tool was well received by students with disabilities as well as teachers. Whilst the tool did not seem to have contributed to a deeper motivation for the course, it helped students to gain confidence in the use of tools. The novelty of the tool and its interface’s affordance - which facilitates its use - contributed to students’ interest for the tasks performed. A study by Ferrer, Pamies and Belvis (2011) corroborated the finding of a positive perception of tablets’ impact on learning. Their study, conducted with school indicated that around 75% of participants considered they participated more in class with tablets PC. These tablets were perceived as contributing to improved grade levels (i.e. better learning), especially for learners with school difficulties. Kinash, Brand, Mathew and Kordyban (2012) assessed the extent to which students perceived iPads were useful for their studies by asking them to indicate their relative agreement with the following statements: “the iPad improved my learning” and “the iPad motivated me to learn”. While a large majority of students were neutral about the perception of learning improvement provided by the iPad (i.e. they rated “neither disagree, nor agree”), most tended to agree with the statement that the iPad motivated them to learn. Maurice et al. (2012) also showed that students expressed
a preference for multi-touch tablets rather than computers and smartphones, with a significant use of tablets (3 hours per day on average).
In sum, these studies reported a convergent, positive judgment about tablets’ usefulness and usability. Nevertheless, a positive overall perception of tablets does not ensure their acceptance by students for learning. A model describing how the learners’ perceptions of tablets can explain their attitudes and acceptance of tablets is required. In the following section, the Technology Acceptance Model used to study acceptance of tablets in educational situations, is presented and discussed.

TECHNOLOGY ACCEPTANCE MODEL AND ITS LIMITATIONS

The Technology Acceptance Model approach

A model of acceptance prevailing in the literature is the Technology Acceptance Model (TAM) (Davis et al., 1989). This model and its subsequent versions (TAM 3, Venkatesh & Bala, 2008; UTAUT, Venkatesh et al., 2003) provide a predictive model of technology acceptance by users for all types of users, technologies, aims and implementation contexts (business, schools, home). In the area of technology for learning, a meta-analysis on e-learning technology acceptance (Šumak, Heričko, & Pušnik, 2011) showed that the Technology Acceptance Model (TAM) is the most used model along with its derivatives. Overall, the results confirm the classical model’s predictions: the effects of perceived ease of use or effort expectancy (i.e. perceived usability), and perceived usefulness or performance expectancy on attitudes towards the use of e-learning are robust and consistent for all users (students, teachers, staff training) and all technologies.

More and more studies examine the acceptance of tablets in education by using TAM or UTAUT models (El-Gayar & Moran, 2011; Ifenthaler & Schweinbenz, 2013; Moran, Hawkes, & El Gayar, 2010; C. Wu, Kuo, & Wu, 2013). This type of work aims at discovering the determinants of behavioral intention. As for teaching, in a study including 37 school management teachers, Anderson et al. (2007) found that only the tablets’ perceived usefulness affects their self-reported use. A qualitative study where Ifenthaler and Schweinbenz (2013) conducted interviews with 18 teachers before deploying tablets in the classroom showed that their usefulness is expected to support students’ motivation and self-efficacy, but not their learning. The limitations to the use of tablets by teachers mainly included the lack of both technical and pedagogical support (the facilitating conditions in the TAM model). Concerning learning, studies conducted by Moran et al. (2010) and El-Gayar and Moran (2011) lead to equivalent results. Students’ intention to use tablets is influenced primarily by the perceived usefulness (or expectation of performance), either directly or through their more or less favorable attitude towards this technology and, to a lesser extent by the perceived ease (or pending effort). Both studies explore some variables evoked by the TAM; social influence (students’ perception of the importance of their entourage’s opinion concerning the use of tablets) and facilitating conditions (their belief in the existence of an organizational and technical infrastructure that helps support various uses). However, these factors had a limited impact on intended use in both studies.

The studies conducted within the TAM framework showed that usability and usefulness are among the strongest predictors of intention to use tablets for learning. Despite widespread use of the TAM, this type of model presents its limitations, notably the lack of objective measures concerning the real use of technologies (most of the studies assessed only behavioral intention).

Limitations of the TAM approach

Many criticisms have been made concerning the line of research based on the TAM approach (Brangier, 2009; Legris, Ingham, & Collerette, 2003). Firstly, most of the research examining technology acceptance within the TAM approach, uses questionnaire or interview methods. The behavioral intention is assessed rather than real use behaviors, and when the usages are examined, they are usually self-reported. One of the limits of only conducting subjective measures is that this might introduce bias; for instance, the low predictive value of the indented use on the real use. This result might be explained in the literature by the
differing measures between intentions and behavior (Ajzen & Fishbein, 1977). When objective usability is measured (e.g. the comparison ratio between a novice’s and an expert’s time to perform tasks), it may predict the perceived ease of use (perceived usability) as showed by Venkatesh (2000). The use of more objective measures for behaviors, focusing on the usability and usefulness of systems for example, should contribute to the development of acceptance models.

Secondly, when user behaviors are taken into account, the model can better predict behavioral intent than user behaviors. Besides, the acceptance of a technology is considered out of context in these models. They do not include the type of technology (inputs and constraints) or its organizational deployment conditions (e.g. mandatory or optional use). When the usages are assessed, the measurements used remain very general, as specific tasks and contexts are not taken into account (e.g. Venkatesh & Bala, 2008). The models should include more specific tasks and contexts to assess more precise acceptance of the concerned systems.

**ACCEPTANCE OF TECHNOLOGY ACCORDING TO THE TYPE OF TASK EXPERIENCED**

**Influence of user tasks and contexts**

Contrary to the TAM approach that does not study the effects of real user experience on the acceptance of tools, the user experience (UX) approach focuses on the users’ perception, based on previous use of said tools. The UX is defined as the perceptions and reactions of a person resulting from the user behaviors and/or intended use of a product, system or service (ISO FDIS 9241-210, 2009). Thus, it seems appropriate to link these two approaches, as was the case of Van Schaik and Ling (2011). Their framework combines interaction experience and technology acceptance. “Within a session with an interactive product, product characteristics influence users’ perceptions of product attributes and beliefs about the consequences of product use, and these, in turn, affect evaluations” (Van Schaik & Ling, 2011, p. 29). A study conducted by February (2011) showed, for instance, that the difficulty of the tasks affects the perceptions of the participants. Faced with difficult tasks, participants admitted to feeling in a more negative affective state and perceived a lower level of usability and usefulness than those experiencing an easy task. While the level of difficulty of the tasks had an effect on these variables, there was no significant effect on perceptions of the hedonic qualities of the system, the perception of the system’s affective qualities or the perceived appeal. However, participants experiencing easy tasks reported higher scores of use intention than those experiencing difficult tasks. Another study addressing the perceptions of tablets (Park et al., 2013) corroborated the influence of experience with the tool on perceptions. The authors measured UX dimensions (usability, use value and affect) over different tasks with an iPad. All participants were unfamiliar with the use of iPad tablets. The results indicated that usability and user value ratings significantly increased throughout the tasks, but the affect rating did not. Their results suggest that perceived usability can evolve positively during a short period of use (snapshot study). Usability is sensitive to the tasks performed by the user.

Most of the studies that investigate the perceptions of tablets and their acceptance in education do not take into account the use context or the type of task performed. Nevertheless, studies have examined preferences and perceptions of tablets within specific learning contexts. For instance, in a face-to-face collaborative learning (small group learning activity), Alvarez, Brown and Nussbaum (2011) showed that students preferred to use tablets PC and PDAs that facilitate drawing and handwriting rather than netbook devices. The use of measures related to specific tasks should contribute to the examination of the acceptance of tablets for particular goals.

**Developing measures related to the type of task**

Ever since Davis’ first article on the subject (Davis et al., 1989), the measurement of usefulness and usability (ease of use) relies on the collection of verbal data and answers to standardized questionnaires. Davis (1989) put forward two scales of 6 items, empirically validated, and inviting the user to position
themselves on a Likert scale in response to statements such as “Using (application would make my job easier” (Perceived usefulness) or “Learning to operate (application) would be easy for me” (Perceived user-friendliness). The good internal consistency of the questionnaire and the general wording of the items (thereby facilitating their adaptation to other research contexts) largely explain the strong impact that these questionnaires have in follow-up research published concerning the acceptance of new technologies. In a meta-analysis published in 2003 and incorporating the results of 22 articles explicitly citing TAM in their theoretical references, Legris, Ingham and Collerette (2003) demonstrated that all the articles included re-use as a measure of perceived usefulness and ease of use the items suggested by Davis in their analysis. The common approach to these research processes consisted in the selection of 3 or 4 items from those proposed by the original questionnaire and in the adaptation to the technological device concerned by the research in question. For instance, the Davis items have recently been adapted to the field of education in order to evaluate the acceptance of e-learning devices (Liaw & Huang, 2013), of mobile learning (Tan et al., 2014), and of digital tablets in a learning context (Gungören, Bektaş, Öztürk, & Horzum, 2014; Hur, Kim, & Kim, 2014).

Originally intended to assess the acceptance of software in the field of business, the scales put forward by Davis (1989) refer to a very general level of use, without taking into account the type of task the user is faced with (items given in Table 1). The adaptation of these items for the measurement of perceived usefulness or ease of use in the case of devices such as digital tablets thus remains problematic. As tablets offer potential for widespread use, they may lead, depending on the task encountered by the user, to radically different user experiences. A given user may find the use of a tablet straightforward for the purpose of browsing the Internet and searching for information, but much more difficult to use when writing a long multi-page document with only a touch keyboard. Similarly, a tablet may be perceived by another user as much more useful for play or entertainment than for work or exam revision. It may not be possible to encompass many variations in the use of general items such as “Using a tablet enables me to accomplish my work/learning/life tasks more quickly” or “Learning to operate a tablet is easy” (Hur et al., 2014). Therefore, it appears necessary to elaborate new scales of perceived usefulness and usability, which are more specific and directly take into account the type of task encountered by users, in order to approach their actual acceptance of the tool as accurately as possible, based on the tasks which they must effectively carry out.

The studies assessing usefulness, usability or attitudes employ either only 1 or 2 items (e.g. Kinash et al., 2012) or a sample of items on the basis of the acceptance models (Moran et al., 2010). Concerning the first type of studies, using only 1 item presents strong methodological limitations. Concerning the second type of studies, the items used to assess attitudes and perceptions of tablets respect the classical measures from the TAM, in that the items reflect overall perceptions unrelated to specific tasks. For instance, the following item from those used by Moran et al. (2010) to assess performance expectancy does not refer to a specific task: “Using the tablet PC in my classes would enable me to accomplish tasks more quickly”.

Table 1: 6-item scale proposed by Davis (1989) to measure the perceived usefulness and ease of use of professional software
### Perceived Usefulness

| Using (application) would enable me to accomplish tasks more quickly |
| Using (application) would improve my job performance |
| Using (application) would increase my productivity |
| Using (application) would enhance my effectiveness on the job |
| Using (application) would make it easier to do my job |
| I would find (application) useful in my job |

### Perceived Ease of Use

| Learning to operate (application) would be easy for me |
| I would find it easy to get (application) to do what I want it to do |
| My interaction with (application) would be clear and understandable |
| I would find (application) flexible to interact with |
| It would be easy for me to become skillful at using (application) |
| I would find (application) easy to use |

### Rationale and Assumptions of the Study

Our study is influenced by the analysis framework of user experience proposed by Thüring and Mahlke (2007). This analytical framework has the benefit of positioning human-technology interaction in a context of use, including the properties of the tool, user characteristics and the environment. In addition, it includes an instrumental or pragmatic dimension that is found both in the TAM and in cognitive ergonomics (including usefulness and usability). It includes non-instrumental dimensions such as motivational effects, which may be important in learning behaviors and emotional reactions that are not considered in the TAM. In this experiment, we only focused on the instrumental dimension. The acceptance of technology for education cannot be assessed solely through general perception measures of technology. The study conducted here aimed at investigating how specific tasks conducted with this type of technology can influence its technology acceptance. To investigate the influence of the type of task on how users perceive tablets, two different tasks were designed according to their level of compatibility with tablets attributes: a reading and navigating task within a hypermedia document (high compatibility with tablets) and a writing task (low compatibility with tablets). These tasks were highly representative of the use of tablets for studying (searching for information and taking notes). Moreover, for each task, we manipulated the level of cognitive demand. The nature of the tasks in the measures of usability, usefulness and use intention should lead to different perceptions of tablets. Experiencing tasks that fit more with the tablets’ functions like reading/navigation task should increase, or at least maintain, perceived usability and usefulness. Conversely, experiencing tasks less adapted to tablets’ features such as writing tasks should decrease perceived usability and usefulness. Moreover, increasing the level of cognitive demand imposed by the tasks should accentuate the expected effects. Thereby, because the intention to use depends on perceived usability and usefulness, the use intention of tablets should be higher after experiencing highly compatible, lowly-demanding tasks, whereas it should be lower after experiencing lowly compatible and highly-demanding tasks.

### Method

#### Participants

30 undergraduate social and human science students from the University of Toulouse, France, volunteered to participate in the study (mean age = 21.43 years; ranging from 19 to 24 years). They were selected according to their previous experience with tablets. None of them owned a tablet or had used tablets before. Recruiting students unfamiliar with tablets made it possible to limit bias due to previous experiences with tablets and therefore reinforced the effect of the use experience manipulated within this study. Moreover, participants were not familiar with the subject matter addressed by the multimedia document they studied with the tablet (i.e. gorillas), in order to avoid prior knowledge effect on tasks.
Material

Writing and navigation/reading tasks

In order to assess the acceptance of tablets for studying, two types of tasks were designed for the experiment: a writing task and a navigation/reading task. Two criteria guided the choice of these tasks. Firstly, the tasks were chosen among the various tasks performed by students for studying. Writing and navigation/reading tasks were representative of the most frequent use of technological tools by college students for learning (Judd & Kennedy, 2010; Kinash et al., 2012; Margaryan et al., 2011). For the writing task, a study by Morris et al. (2012) observed that over several weeks using tablets, students reported using more word processing tools on the tablets for taking notes, and therefore reduced their use of pencils and paper. The use of emails also increased. Secondly, these two types of tasks were chosen to contrast the level of compatibility with the tablets. A navigation/reading task is expected to be more adapted to the tablet’s features than a writing task, due to the use of a virtual keyboard where accurate key-selection might cause usability issues for unfamiliar users. Then two versions of each type of task were designed to introduce different levels of cognitive demand.

Navigation/reading task: participants were asked to read a multimedia document (texts and pictures) and to answer different questions about the content dealing with gorillas. The level of cognitive demand varied according to the structure of the document (Amadieu & Salmerón, 2014; Mayer, 2014) but the texts and picture materials were alike.

- **Low cognitive demand**: the document was structured with headings; pictures were close to the text. The document was designed to facilitate the selection step through the presence of headings that were intended to help the user to find and select information more easily. Pictures also allowed them to quickly identify the different information in the text. The document should also facilitate the organization of the content step because headings already provided a primary sense of semantic organization. The presence of illustrations next to the text and not in the annex section was expected to avoid split-attention effect.

- **High cognitive demand**: the document had no apparent structure, no title, and no organization. The pictures were in the annex section. Participants had neither headings nor pictures in the text to clearly identify the information, which required additional effort in the selection step. The fact that the structure is not apparent at first forced the participants to organize the content with more effort than in the low-demand document. Finally, the pictures in the annexes caused split-attention effect.

Writing task: Both cognitive demand versions were based on the same text. This text was selected from a dedicated website.

- **Low cognitive demand**: the text was given to participants on a sheet of paper. Participants had to copy it onto the tablet. For this task, there is no planning step. The production process was facilitated, as the spelling is visible on paper. Participants were copying, so they could write at their own pace. The fact that the production process is facilitated implies that the revision process is less important because mistakes are less frequent.

- **High cognitive demand**: the task was divided into two stages. A text in the form of a dictation was read to the participants. Once the dictation was complete, the script of the text was given to the participants. They then had to correct and complete their first production. The dictation phase involves an important production process, as the writing speed was imposed upon participants. This pace imposed a higher typing speed that could potentially involve errors. If the spell-checker wrongly changes words, the participant must inhibit the desire to correct the mistake in order to continue the dictation, potentially causing significant frustration. The text was presented orally, so participants had to find how to spell certain words themselves. Once the script was handed out,
the revision phase was particularly intricate, as participants needed to review their text, to select the words or sentences in which to correct their errors.

Both types of tasks were performed on a Microsoft Surface 2. The operating system used was Windows 8.1RT. The writing task was on Word 2013 and the navigation/reading task on the “Reader” application that is compatible with PDF files.

**Measures**

The perceived usability and perceived usefulness were measured before and after the experimental tasks. Two different sets of items according to the type of task (writing or navigation/reading task) were used. The questionnaires contained the same items used by Davis (1989) but were adapted to the type of task. After the tasks were performed, the use intention was also measured, but for the perceived usability and usefulness, the items were specific to the type of task. The items in the pre-questionnaire as well as in the post-questionnaire were highly reliable (Cronbach’s alphas from .82 to .94) for each dimension (usability specific to the reading/navigation task, usability specific to the writing task, usefulness specific to the reading/navigation task, usefulness specific to the writing task). For each type of task, the use intention was measured by a single classical item but related to each type of task (“I tend to use tablets to read multimedia documents” and “I tend to use tablets to write”; from “completely disagree” to “completely agree”).

In order to control the level of cognitive demands of these tasks, questions about perceived difficulty of the task were added (“I think that the task I performed was:”; from “very easy” to “very difficult”). All items were rated on paper.

**Procedure**

Participants first completed a participation agreement. They rated their perceptions of tablets in a pre-questionnaire (one week before the experimental session), making it possible to assess their initial perception before using the tablet during the experimental session. Next, each participant performed two tasks with the tablet: a navigation/reading task (participants had to read and understand a hypertext document with the tablet and to answer questions about it) and a writing task (participants had to write a text with the tablet). Half of the participants had the low-demand tasks while the other half had the high-demand tasks. Afterwards, they completed the post-questionnaire, similar to the previous one, to assess how their perceptions of tablets (usability and usefulness) evolved through their experiences. Finally, they rated their intention of using tablets for each type of task and the difficulty they experienced to perform them.

**RESULTS**

The statistical analyses were computed using IBM SPSS Statistics software Version 21. A three-way mixed ANOVA was conducted with the type of task as one within-subject factor (writing task vs. navigation/reading task), the measurement moment as one within-subject factor (pre- vs. post-questionnaire) and the level of cognitive demand as the between-subject measure (high vs. low demand).

**Level of cognitive demand**

A 2X2 ANOVA was conducted on the complexity ratings after the tasks, including the level of cognitive demand and the type of task (descriptive data is given in Table 2) as factors. The analyses confirmed that the high-demand tasks were perceived as more difficult than the low-demand tasks, $F(1, 28) = 63.26$, $p < .001$, and the lowly-compatible task (i.e. writing task) was perceived more complex than the highly-compatible task (reading/navigation task), $F(1, 28) = 23.60$, $p < .001$. There was no significant interaction, $F(1, 28) = 2.86$, $p = .102$. As expected, the level of cognitive demand and the level of compatibility of the tasks led to higher perceived complexity.
### Table 2: Ratings of perceived difficulty according to the type of task and the level of cognitive demand

<table>
<thead>
<tr>
<th>Task Type</th>
<th>Demand Level</th>
<th>N</th>
<th>Mean Ratings (SD) from 1 to 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navigation/reading</td>
<td>Low</td>
<td>15</td>
<td>0.87 (0.78)</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>15</td>
<td>2.39 (1.31)</td>
</tr>
<tr>
<td>Writing</td>
<td>Low</td>
<td>15</td>
<td>1.74 (1.16)</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>15</td>
<td>4.19 (0.62)</td>
</tr>
</tbody>
</table>

### Table 3: Means and standard deviations of usability and usefulness according to the type of task and the level of cognitive demand

<table>
<thead>
<tr>
<th></th>
<th>Reading/navigation task</th>
<th>Writing task</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low level of cognitive demand</td>
<td>High level of cognitive demand</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Ratings of usability before the task</td>
<td>5.10</td>
<td>1.10</td>
</tr>
<tr>
<td>Ratings of usability after the task</td>
<td>6.07</td>
<td>0.84</td>
</tr>
<tr>
<td>Ratings of usefulness before the task</td>
<td>3.42</td>
<td>1.06</td>
</tr>
<tr>
<td>Ratings of usefulness after the task</td>
<td>4.23</td>
<td>1.43</td>
</tr>
<tr>
<td>Ratings of use intention</td>
<td>2.07</td>
<td>0.80</td>
</tr>
</tbody>
</table>

### Usability

The descriptive data of usability and usefulness is given in Table 3. A three-way ANOVA revealed a significant main effect of the type of task on usability perception, $F(1, 28) = 130.08, p < 0.001$. Overall, the usability ratings for the reading/navigation task ($M = 5.6, SD = 0.92$) were higher than those for the writing task ($M = 3.7, SD = 1.21$). An interaction was also significant between the moment of rating and the type of the task, $F(1, 28) = 15.68, p < 0.001$. Pairwise comparisons were conducted to examine the structure of the interaction. For the navigation/reading task, the usability ratings increased significantly between the pre- and post-questionnaires, $p = 0.003$, whereas for the writing activity, the usability score decreased significantly between the pre- and post-questionnaires, $p = 0.041$ (see Figure 1).

Another significant interaction was observed between the type of task and the level of cognitive demand, $F(1, 28) = 8.02, p = .008$. Pairwise comparison revealed that there was no effect of the cognitive demand for the highly compatible task (navigation/reading task) while for the low compatible task (i.e. writing task) the usability ratings were lower in the highly-demanding task than in the low-demanding task, $p = .007$ (see Figure 2). No other significant effect was observed.
The analyses conducted on the usefulness ratings indicated a significant main effect of the type of task on the perception of usefulness, $F(1, 28) = 77.48$, $p < 0.001$. Overall, the usefulness ratings for the navigation/reading task ($M = 4.1$, $SD = 1.32$) were higher than the ratings for the writing task ($M = 2.3$, $SD = 1.32$).
As for the usability ratings, a significant interaction between the moment of rating and the task was observed, F(1, 28) = 25.25, p < 0.001. Pairwise comparisons showed that for the reading/navigation task, the usefulness ratings increased significantly between the pre- and post-questionnaires, p = 0.001, whereas for the writing activity, the usefulness ratings decreased significantly between the pre- and post-questionnaires, p < 0.001 (see Figure 3). No other significant effect was observed.

**Figure 3: Interaction between the time of ratings and the type of task on the usefulness ratings**

**Intention of use**

**General intention of use**

A 2X2 ANOVA was conducted on the ratings of the use intention. The nature of the task had a significant effect on the intention of use, F(1, 28) = 64.5, p < 0.01. The use intention ratings were significantly higher for the navigation/reading task (M = 5.07, SD = 1.70) than for the writing task (M = 2.07, SD = 1.38). However, no other significant effect was observed.

**DISCUSSION**

This chapter aimed at studying how the acceptance of tablets for learning could be dependent on the types of tasks conducted (high compatibility vs. low compatibility task) and on users’ experiences. Overall, the results confirmed the expectations that the type of task experienced by students with tablets would affect their perceptions of tablets. Measuring usability and usefulness using items specific to types of tasks yielded contrasted ratings. Regarding the reading/navigation task (i.e. high-compatibility task), positive perceptions concerning the usability and usefulness of tablets both increased after having experienced the task. Conversely, with items related to the writing task (i.e. low-compatibility task), the students’ perceptions of tablets’ usability and usefulness for this type of task decreased after having their experience. Moreover, the results interestingly highlighted a greater usability and usefulness of tablets for the navigation/reading task before and after the experienced task. The difference between the various types of tasks had already observed amongst students before using the tablet. The results concerning a more global use intention, based on the two types of tasks, confirmed that students were more willing to use tablets for navigation/reading tasks than for writing tasks. Furthermore,
the examinations of the use intention for very specific tasks revealed that assessment of use intention could be more specific. In terms of usefulness and usability, the use intention was sensitive to the task’s level of compatibility with the mobile system they used. As far as the level of cognitive demand of the tasks was concerned, higher perceived difficulty ratings for the high-demand tasks corroborated an expected significant difference between low- and high-demand tasks. The results tended to show that the level of cognitive demand was linked to lower usability ratings only for the low-compatibility task, but no effect was observed on the usefulness and the use intention. This result suggests that students based their perceptions of tablets on the level of task compatibility with tablets rather than on the cognitive demand of tasks. Nevertheless, the relationships between the level of compatibility and the level of complexity of tasks should be examined in further experiments.

Limitations

The study provided evidence that the perceptions of usability and usefulness of tablets diverged depending on the type of tasks performed with tablets (i.e. the level of compatibility with tablets’ features), and that experiencing the tasks amplified this difference. Nevertheless, it is worth noting that each participant experienced both types of tasks; thereby, the differences in perceptions due to the type of task might have been increased. It might be possible that participants rated their perception for each type of task by comparison with the other task. In sum, a contrast effect might have magnified the result patterns. A between-subject design could limit this possible bias. The experienced tasks and the functional relevance of systems to perform these tasks are important factors to take into account to understand the perception of systems and the intention of use. More attention should be paid to user behaviors and their impact on the users’ perceptions. In the present study, the interaction behaviors with the tablet were not recorded due to technical issues. Examination of the interaction behaviors should provide information about the real level of difficulty experienced by users and the objective level of usability (Shackel, 2009). It could be claimed that users call upon different strategies that could make the task more or less difficult with the system in hand.

In line with the previous point, this study only focused on the effect of the tasks’ compatibility with tablets and the tasks’ level of cognitive requirement in a laboratory context. In addition, only students unfamiliar with tablets participated. Therefore, the findings cannot be transposed to real studying contexts without adaptation. In order to test these effects in real situations, investigations should be conducted on the real use of tablets in a class-based context, and should examine how their different uses may influence studying. Moreover, longitudinal studies should be conducted to trace learning effectiveness, and how acceptance evolves over months of use (Courtois et al., 2014).

Educational implications and future research directions

The studies investigating the perception of tablets and their effect on motivation use different measurement methods (focus groups, interviews, questionnaires), but also different conceptual frameworks, sometimes even no conceptual framework at all. More rigorous definitions of learners’ perception and expectancies about tablets for their study activities are required. A shared conceptual and methodological framework between the studies will increase the reliability of comparisons between studies’ findings, and guide more accurate investigations of perceptions for further research. The TAM approach is already widely used, but comes with its limits. Contrary to classic research works on technology acceptance, which examine the effect of a technology’ perceptions on its use, the present study highlighted the effects of the type of tasks experienced by learners using certain technology on their perception thereof (Venkatesh, 2000), and thereby on their acceptance. Technology is not intrinsically useful or usable for education; the use context and the types of studying tasks must be considered. The level of compatibility between a task and a device is an important issue. In the case of mobile devices such as multi-touch tablets, claiming that tablets are good or bad for education is trivial as long as the type of learning task is not taken into account.
As shown in this chapter, the perceptions of tablets for studying depend on the type of task, but devices are continuously evolving with modern technological developments. Thereby, the devices’ functions and capacities can influence the type of activities conducted therewith. Moreover, the term “tablet” can refer to different tools (Microsoft tablets, iPads, Android tablets, hybrid devices between computer and multi-touch tablet). Indeed, the tablets’ OS (iOS, Android, Windows) can influence their perception (Chien et al., 2014). Therefore, when assessing perception of tablets we should focus on specific dimensions that characterize them (e.g. portability, specific applications, multi-tool devices including video cameras and microphones).

Although the study was a snapshot study with short tablet use, the findings demonstrate the strong influence of user experience. Even though the deployment of technology takes time, only a few studies examined how acceptance evolves (e.g. Venkatesh, 2000). An interesting procedure would consist in distinguishing a priori acceptance (i.e. before any use of technology) based on expectations, and a posteriori acceptance based on an opinion formed after first using or owning ownership tablet. Acceptance should rely on different processes at different times as the perceptions of tablets can evolve over the space of a year in an educational context (Courtois et al., 2014).

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REFERENCES


**KEY TERMS AND DEFINITIONS**
**Technology Acceptance:** It occurs when users intend to use or use technology.

**Mobile Learning:** It refers to learning in different contexts enabled by mobile devices such as tablets or smartphones.

**Multimedia Document:** They are digital documents displaying both verbal and pictorial information.

**Tablets:** They are mobile devices with multi-touch interaction system.

**Usability:** It refers to the level of ease and learnability to use a system.

**Usefulness:** It refers to the extent to which the goals of a task are reached thanks to a system.

**Cognitive Demand:** Level of memory and attentional resources required to process the task.

**APPENDIX 1: ITEMS OF THE PRE- AND POST-QUESTIONNAIRES**

Below are presented the questionnaires for the pre- and post-measures for each type of task. All items were 7-points scale items (from 1: completely disagree, to 7: completely agree)

**Pre-questionnaire**

**Usability items adapted to reading/navigation task with tablets:**
- I think it will be easy to learn to use a tablet to interact with a multimedia document.
- It will be easy to me to manage to make what I shall want by manipulating my multimedia document.
- The way of interacting with a multitouch tablet to manipulate a multimedia document seems to me simple and clear.
- I think that the way of interacting with a tablet to understand a multimedia document is flexible.
- I think that he will be easy for me to become skillful and successful to interact with the multimedia document on a tablet.
- Altogether understanding a multimedia document on a multitouch tablet will be easy.

**Usefulness items adapted to reading/navigation task with tablets:**
- Using tablet would help me to understand (include) faster a multimedia document.
- Using tablet would improve my quality of understanding of the multimedia documents.
- Using tablet to understand a multimedia document would be a method more productive than the way that I use at present.
- Using tablet would improve my efficiency to understand a multimedia document.
- With tablet it would be easier to understand a multimedia document.
- I find tablet very useful to understand multimedia.

**Usability items adapted to writing task with tablets:**
- I think that it will be easy to me to learn to use a tablet to draft a written document.
- It will be easy to me to manage to make what I shall want by drafting my written document.
• The way of interacting with a tablet to draft a document seems simple and clear.
• I think that the way of interacting with a tablet to write a document is flexible.
• I think that it will be easy for me to become skillful and successful in the textual writing on a tablet.
• Altogether drafting a document on tablet will be easy.

Usefulness items adapted to writing task with tablets:
• Using tablet would help me to take faster my courses.
• Using tablet would improve the quality of my taking of courses.
• Using tablet to take my courses would be a more productive method than the way which I takes them at present.
• Using tablet would improve my efficiency to take my courses.
• Using tablet it would be easier to take my courses.
• I find tablet very useful to take courses.

Post-questionnaire
Usability items adapted to reading/navigation task with tablets:
• It was easy to me to learn to use a tablet to interact with a multimedia document.
• It was easy to me to manage to make what I wanted by manipulating my multimedia document.
• The way of interacting with a tablet to manipulate a multimedia document is simple and clear.
• I think that the way of interacting with a tablet to understand a multimedia document is flexible.
• It was easy for me to become skillful and successful to interact with the multimedia document on a tablet.
• Altogether understand a multimedia document on tablet is easy.

Usefulness items adapted to reading/navigation task with tablets:
• Using tablet would help me to understand faster a multimedia document.
• Using tablet would improve my quality of understanding of multimedia documents.
• Using tablet to understand a multimedia document would be a method more productive than the way that I use at present.
• Using tablet would improve my efficiency to understand a multimedia document.
• With tablet it would be easier to understand a multimedia document.
• I find tablet very useful to understand multimedia documents.

Usability items adapted to writing task with tablets:
• I think that it was easy to me to learn to use a tablet to draft a written document
• It was easy to me to manage to make what I wanted by drafting my written document
• The way of interacting with a tablet to draft a document is simple and clear
• I think that the way of interacting with a tablet to write a document is flexible
• It was easy for me to become skillful and successful in the textual writing on a tablet
• Altogether to draft a document on tablet is easy
Usefulness items adapted to writing task with tablets:
- Using tablet would help me to take faster my courses
- Using tablet would improve the quality of my grip of court
- Using tablet to take my courses would be a more productive method than the way which I takes them at present
- Using tablet would improve my efficiency to take my courses
- With a tablet it would be easier to take my courses
- I find tablets very useful to take courses