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REVIEW ARTICLE

A Critical Literature Review of Perceptions of Tablets for Learning in Primary and Secondary Schools

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Abstract
There is growing interest in the use of tablets in classrooms, and educational policies from different countries promote their integration. Previous literature reviews were conducted on the effects of the use of tablets in learning. There is, however, a strong need to understand how students perceive the use of tablets for learning as these perceptions determine the adoption, use and, thereby, the value of tablets for learning. Thus, the purpose of this article is to systematically review the existing literature on students' perceptions toward the use of tablets in primary and secondary schools. The literature search selected 41 relevant qualitative and quantitative studies meeting our inclusion criteria. Their results and methodological aspects were analyzed and discussed. Overall, the results showed that students have rather good perceptions of the use of tablets, though some limitations were highlighted, particularly in the qualitative studies. Moreover, this review highlighted the complementarity of quantitative and qualitative methods. Finally, educational implications and recommendations for further research were discussed.

Keywords Acceptance · Critical review · Learning · Perceptions · Primary and secondary school · Tablet

Introduction

For the past two decades, mobile-learning (m-learning) has been spreading in education settings. Several definitions of m-learning exist, focusing on various characteristics according to the field of research. According to Keskin and Metcalf (2011), early perspectives of m-

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learning focused on technology: m-learning refers to learning supported by mobile devices such as mobile computers, personal digital assistant (PDA) devices, smartphones, or tablet PCs. More recently, several researchers focused on the mobility and ubiquity of m-learning and associated devices (Peng et al. 2009). According to Sharples et al. (2009), these characteristics of mobile learning allow continuity of the learning experience across various learning contexts: this led to a new phase in the evolution of technology-enhanced learning.

Among existing mobile devices, PDAs, laptops, and mobile phones were the main mobile tools used in education before 2010 (Wu et al. 2012). Tablets appeared in the early 2000s: these are wireless touch-screen personal computers that allow users to interact with the screen using a stylus or their fingers. The first studies on tablets in education emerged in 2004 (e.g., Anderson et al. 2004; Golub 2004; Simon et al. 2004). For the past decade, the use of tablets has garnered increasing interest for education due to their device qualities (weight, autonomy, portability, interactivity, etc.) and pedagogical benefits. Indeed, tablets allow learning in and out of the classroom, provide learners with access to multimedia learning materials (texts, pictures, videos, animations, hypertexts), and allow them to perform consultation tasks (e.g., viewing an animation, searching for information on the Internet) and production tasks (e.g., recording videos, designing multimedia documents). They can also deliver interactive learning resources (e.g., mapping tools, interactive multimedia documents). Moreover, thanks to their mobility and small size, tablets are thought to facilitate communication and collaboration between students (Clarke and Svanaes 2014). Because of their popularity in educational contexts, many studies from various fields of research have focused on the use of tablets for learning. At this point, it seems essential to compare these studies in order to gain insight into the issues of tablet integration in education.

Background

Previous literature reviews have focused on the effects of tablet use on learning outcomes. For example, in primary and secondary education contexts, the issue of tablet effectiveness for learning was addressed by Haßler et al. (2016). These authors concluded that the use of tablets supported positive learning performance in 16 out of 23 studies. Their findings support the conclusion that tablets can be as efficient as other learning tools for primary and secondary school students. Another range of studies assessed perceptions toward the use of tablets in educational contexts. Some studies focused on teachers' perspective (e.g., Ifenthaler and Schweinbenz 2013), whereas others focused on students' perspective. In higher education, students' attitudes toward the use of mobile learning (i.e., smartphones and tablets) are usually positive (e.g., Al-Emran et al. 2016). In their literature review, Nguyen et al. (2015) pointed out various studies corroborating students' positive attitude toward using an iPad for learning. Nevertheless, some limitations to these positive attitudes were observed due to distraction caused by noneducational usage.

Perceptions of digital devices for learning have mainly been investigated in the research field of technology acceptance for learning (e.g., Cheung and Vogel 2013; Park et al. 2012; Wu and Chen 2017). Technology acceptance models are based on social psychology theories. The most widely cited and applied behavior theories in this field are the theory of reasoned action (TRA) (Fishbein and Ajzen 1975) and its extension, the theory of planned behavior (TPB) (Ajzen 1991). These theories argue that intention to act is the best predictor of behavior. Intention depends on attitudes (which refers to the "sum of beliefs about a particular behavior weighted by evaluations of these beliefs"; Fishbein and Ajzen 1975), on subjective norm

("Influence of people in one's social norms environment on his behavioral intentions; the beliefs of people, weighted by the importance someone attributes to each of his opinions that will influence one's behavioral intention"; Fishbein and Ajzen 1975), and on perceived behavioral control ("People's perception of the ease or behavior difficulty of performing the behavior"; Ajzen 1991). Subsequently, the technology acceptance model (TAM) suggested that behavioral intentions are determined by perceived ease of use (to what extent users perceive the technology as easy to use it efficiently) and perceived utility or performance expectancy (to what extent users perceive that the technology can help them achieve their learning goals) (Marangunić and Granić 2015; Šumak et al. 2011; Venkatesh et al. 2003). Although they were initially not included in the TAM model, the social influence processes were added later in TAM models (TAM2, TAM3). Finally, existing models were combined into the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al. 2003). The UTAUT was meant to serve as a comprehensive model that can be applied across a range of applications. Behavioral intention depends on performance expectancy (which refers to the degree to which someone believes that using the system will help to attain the intended performance), effort expectancy (the degree of ease associated with the use of a technology), and social influence (the degree to which an individual perceives that important others believe he or she should use the new technology). The UTAUT also includes facilitating conditions (the belief that an organizational and technical infrastructure exists to support the use of the system) as a direct determinant of behavioral use. The influence of these factors may be moderated by user-related factors: age, gender, experience, and voluntariness. These models focused primarily on utilization and their antecedent, but they did not consider the task component. The task–technology fit (TTF) model (Goodhue and Thompson 1995) concentrates on the appropriateness of the technology to the task. In the TTF model, the adequacy between task and technology characteristics can determine users' utilization and task performance. Other models, such as user experience models, have broadened the scope of users' perceptions of technologies by adding perception of noninstrumental qualities as hedonic perceptions of technology, such as perceived social values of technology or perceived esthetic values (Mahlke and Thüring 2007).

Acceptance models offer a strong theoretical framework to achieve a picture of how users perceive the use of tablets for learning. These perceptions determine the intention and behavioral use of tablets but may also predict other critical factors for learning. They can influence students' involvement in learning tasks, the value they ascribe to learning tasks with tablets, and more widely their motivations. For instance, compared to a traditional lesson, the use of iPhone devices might lead to higher motivational outcomes for children (Furió et al. 2015). However, more investigations are needed to understand the nature of motivations and their real predictors. Examination of perceptions should contribute to a better understanding of motivations linked to learning tasks with technologies, especially in a perspective of expectancy-value models of motivation (Barron and Hulleman 2015). Indeed, these approaches of motivation consider two main components: the expectancy of being successful in a task and the perceived value for engaging in the task. Moreover, some studies have also showed that perceptions can be related to learning engagement or perceived self-regulated learning. For example, Liaw and Huang (2013) showed that perceived satisfaction and perceived usefulness of an e-learning system predicted perceived self-regulation of using e-learning. Soffer and Yaron (2017) found that the more students experienced ease of use with a tablet, the more they perceived themselves as engaged in learning. Thus, it is important to achieve a deeper picture of how users perceive the use of tablets for learning. Finally,

examining the learning technology perceptions that students have can contribute to a more objective view of the heavily controversial notion of "digital natives" (Bennett et al. 2008). To date, however, no literature reviews have focused on how learners perceive the use of tablets for learning activities in school contexts (i.e., in primary and secondary schools).

Purpose of This Review

In this paper, we critically review the literature reporting on perceptions of the use of tablets for primary and secondary school children. This literature review has two main objectives. Firstly, it aims to examine the type of methods that the studies used to assess students' perceptions and/or acceptance of the use of tablets. Secondly, it identifies the types of perceptions that students constructed, along with the main factors that explain these perceptions. The answers to these two questions will contribute to research on the acceptance and adoption of learning technology by students and will lead to applied recommendations for teachers and educational policies.

Methodology

In this section, we detail our methodological approach to article selection.

Research Questions

The question of tablet perception for learning is far from insignificant in understanding the adoption and subsequent use of this tool in the classroom. As methodological approaches are important for understanding findings concerning students' perception, this review first focused on applied methodologies, then on the results of these studies. Thus, two main research questions are addressed in this review: [1] How are students' perceptions toward the use of tablets for learning studied? [2] What are these students' perceptions and their determinants?

Search Process

For our literature search, we first extracted major search terms from the research questions and identified the relevant terms and alternative spellings. The search terms selected were: ((student) OR (learner)) AND ((acceptance) OR (attitude) OR (adoption) OR (perception)) AND ((tablet) OR (iPad)). We included the specific term "iPad" because we noticed that studies dealing with Android devices always use "tablet" as a generic term, whereas some studies that deal with iPad never mention the term "tablet." Thus, we included "iPad" in order to avoid missing these studies. We then selected databases for searching from different fields of research (psychology, ergonomics, education, etc.). The following databases were included: ERIC, PsycINFO, PsycARTICLES, Psychology and Behavioral Sciences Collection, Scopus, Web of Science, and Education Research Complete. Only peer-reviewed publications published in English after 2000 were selected. This initial search retrieved 1030 articles. We then screened the abstracts and selected papers according to several exclusion criteria. We excluded articles if:

- The study focused on higher education and parents' or teachers' perceptions.
- The study focused on the use of tablets without studying perceptions.
- The study focused on students with disabilities.

- The assessment of perceptions focused on a specific application without comparison between apps or without considering the tool's characteristics.
- The paper studied general "mobile learning" without focusing on tablets.

Because one aim of this review was to determine how students' perception are studied, we wanted to cover a broad range of studies: thus, methodological rigor was not an exclusion criterion. On this point, the literature aimed at evaluating the recurring methodological issues of perception measures. Moreover, the studies were not selected according to the context of use, as we wanted to compare and discuss the applied methodologies (e.g., focus on specific or general use).

In September 2018, 41 articles corresponding to our inclusion criteria were selected. We extracted the following data to be later discussed for cross-analysis: author and publication year, purpose of the study, theoretical aim, population studied (primary or secondary school students), number of participants, type of tool used (iPad, Android tablet), duration of tool use before data collection, tasks performed with tablet, data collection method, and country in which the study was conducted. These data are presented in the Appendix.

It is important to note that Courtois et al. (2014), Montrieux et al. (2014), Cacciamani et al. (2018), and Villani et al. (2018) conducted collective studies which resulted in different publications. Thus, in both cases, the studies are not independent. However, these publications focused on different variables; for this reason, we decided to consider them as different studies in this review.

Results

Descriptive Analysis of Studies: Theoretical Frameworks, Purposes, and Applied Methodologies

Although they all considered the question of students' perceptions toward the use of tablets for learning, the studies selected were heterogeneous regarding their theoretical framework and methodologies. As we wanted to cover a broad range of studies, methodological rigor was not an exclusion criterion. For each study, however, we identified the quartile of the journal that published it (based on the index SCImago). Seventeen studies were published in reviews classified in the first quartile, ten studies in reviews classified in the second quartile, five studies in reviews classified in the third quartile, and three studies in reviews classified in the fourth quartile. Six studies were published in five journals that are not indexed in SCImago. We considered them for analysis because one of the review's aims was to compare the methodologies used to assess students' perceptions.

Studies Aims, Theoretical Frameworks, and Approaches

Of the 41 studies selected in this review, only a minority was explicitly based on theoretical models of acceptance ($N = 12$). The models involved are the TPB (Courtois et al. 2014; Montrieux et al. 2014), the TAM (Cacciamani et al. 2018; Çukurbaşi et al. 2016; Dündar and Akçayir 2014; Gokcearslan 2017; Horzum et al. 2014; Lin 2014; van Deursen, ben Allouch, and Ruijter 2016; Zubković et al. 2016), and the UTAUT (Cacciamani et al. 2018;

Ifenthaler and Schweinbenz 2016; van Deursen et al. 2016; Villani et al. 2018). Ifenthaler and Schweinbenz (2016) also based their study on the TRA. Two studies longitudinally assessed the dynamic nature of students' acceptance over a 6-month period (Courtois et al. 2014; Montrieux et al. 2014).

One study conducted by Kim and Jang (2015) aimed to create a structural research model by integrating some components of acceptance models (i.e., perceived usefulness, perceived ease of use, satisfaction, self-efficacy) with others (i.e., beliefs about the future).

The other 28 studies did not explicitly rely on theoretical models. They focused on experiences with tablets and aimed to identify students' perception by investigating feedback toward positive and negative aspects of tablet use. Some used theoretical concepts without linking them to a well-defined theoretical model. For example, Huang et al. (2017) assessed perceived usefulness, ease of use, satisfaction, and behavioral intention, which are components of various acceptance models (e.g., TAM model). The data relating to these perceptions, however, were presented at a descriptive level and were not analyzed through theory. Instead, researchers added qualitative data (collected by interview) to propose a more detailed and contextualized view of students' perceptions.

Based on the taxonomy proposed by Trudel et al. (2007), we identified two general goals of these no-model-based studies. Some inventoried students' perceptions after a period of tablet use, and these were classified as descriptive research ($N = 18$). Others determined whether perceptions differ according to learner-related (i.e., gender, age, experience) or situational (i.e., the degree of control of the teacher) variables. Finally, one assessed perceptions in a longitudinal manner (Tay 2016). These studies were classified as explicative-descriptive research ($N = 10$) (see Appendix).

Description of Applied Methodologies

Quantitative, Qualitative, and Mixed Methodologies

In order to identify students' perceptions and attitudes toward tablets in schools, several methodologies were applied. In this section, we only reported measures of students' perceptions; the other variables studied in some experiments (e.g., performance, type of tablet use, teachers' perceptions, etc.) are not mentioned. Overall, the methodologies applied were written surveys with closed and/or open questions and semistructured interviews.

We identified quantitative, qualitative, and mixed methodologies. Studies using closed questionnaires and processing data with inferential statistics were classified as quantitative methodologies. Fourteen studies were quantitative, using closed surveys. Qualitative studies ($N = 18$) involved data collection by semistructured interview or by written questionnaire with open or closed questions. Two studies used only closed questionnaires, though they presented results at a descriptive level (i.e., without inferential statistical processing): we classified them as qualitative methodologies. Nine studies used only interviews, three used surveys with open questionnaires (sometimes combined with closed questions), and four used both. Finally, nine studies used a mixed approach, combining qualitative and quantitative measurements.

There was a varied number of participants enrolled in the studies. Nine studies enrolled fewer than 30 participants (between 8 and 27), 8 enrolled between 50 and 100 participants, 19 enrolled between 100 and 500 participants, and 5 enrolled more than 500 (between 676 and 2023).

Methodologies in Model-Based Studies

The 12 model-based studies used quantitative measures based on questionnaires with closed questions. Only three of these studies added open questions to collect additional qualitative data (Dündar and Akçayir 2014; Gokcearslan 2017; Lin 2014). The measurement tools, however, differed slightly according to the theoretical model used by the studies. Most of the surveys were based on existing questionnaires linked to the theoretical model, with the exception of Çukurbaşi et al. (2016), who created their own item pool. Courtois et al. (2014) and Montrieux et al. (2014) used a survey based on the theory of planned behavior (Taylor and Todd 1995). Ifenthaler and Schweinbenz (2016) used the advanced technology acceptance test (ATAT), based on the UTAUT model. The UTAUT model does not include attitudes, but this construct was included in ATAT with self-efficacy and anxiety because of their significance in other technology acceptance models. Gokcearslan (2017) and Horzum et al. (2014) used a scale based on TAM, the acceptance of TPC scale (ATPS) developed by Güngören et al. (2014). Gokcearslan (2017) added two open questions to assess qualitative and nondirected students' perceptions. Zubković et al. (2016) based their research on TAM2 and TRA and used a survey constructed by themselves, and van Deursen et al. (2016) used a scale proposed by Venkatesh et al. (2003) to measure attitudes. Dündar and Akçayir (2014), Villani et al. (2018), and Cacciamani et al. (2018) used the Computer Attitude Measure for Young Students (CAMYS) (developed by Teo and Noyes 2008). Villani et al. (2018) and Cacciamani et al. (2018) also added items from the Technology Acceptance Measure for Preservice Teachers (Teo 2010) after having adapted them for students. Lin (2014) used the Technology Acceptance Model Questionnaire. In sum, even for model-based studies, heterogeneous measures of perceptions were used. This heterogeneity could limit comparisons between studies and generalization of results.

Methodologies in No-Model-Based Studies

The methods used by the 29 no-model-based studies for data collection were mostly based on interviews ($N = 9$), surveys ($N = 13$), or both ($N = 7$). Surveys were based on previous empirical studies, from previous interviews, or by the authors according to the assessed concepts, but not from validated questionnaires linked to specific theoretical models. We noted that Norqvist (2016) and Kontkanen et al. (2017) can be distinguished by their use of specific data collection methodologies. Norqvist (2016) used an original interview method based on the theory of group cognition. He asked students to answer the following question: "what is learning?". He then determined whether the students spontaneously raised the use of tablets in order to assess the integration of this tool in the students' representations. Kontkanen et al. (2017) based their methodology on the TPACK framework (Mishra and Koehler 2006). They asked students to write two advisory letters: one giving instructions for a new student about how to use tablets for learning and another for a new teacher about how to use tablets for teaching. These verbalizations gave an overview of students' perceptions toward the use of tablets for learning. In conclusion, the privileged methods of the no-model-based studies rely on verbal protocols that provide richer and more detailed perceptions. The lack of theoretical background, however, led to verbal protocols being analyzed with different coding and interpretation techniques.

Contexts of Tablet Use and Perception Measures

Three dimensions are discussed here: tablet use context (kind of task, duration of use), times and number of measurements, and the type of tablet used.

Most studies ($N = 31$) did not control the types and frequencies of activities performed with tablets. Some questioned a large sample of students from various classes, sometimes various schools (e.g., Çukurbaşi et al. 2016), rendering use control very difficult. These studies were mainly conducted in secondary schools. Others focused on classes with a smaller sample of students, but they assessed perceptions in a general way. These studies were mainly conducted in primary schools, where one teacher teaches multiple school subjects (e.g., Yanikoglu et al. 2017). One study specified the context of use (English courses) but not the activities performed (Shadiev et al. 2017). Four studies assessed perceptions after the use of a specific app involving collaborative work (Fokides and Mastrokoukou 2018) or individual exercises and document consultation (Huang et al. 2017; Hwang et al. 2015; Lin 2014). One study involved several reading tasks (Kaman and Ertem 2018). Only four studies focused on specific learning tasks. Dündar and Akçayir (2012) assessed perceptions after a controlled reading task. Hyppa-Martin et al. (2016) aimed to test an augmentative and alternative communication system. Lin et al. (2012) compared two modalities of collaborative concept mapping (collaborative work with one tablet for all versus one tablet per student). Finally, Montrieux et al. (2017) compared three modalities of use (as a digital book, as a research tool for guided inquiry tasks, or as a research tool for unguided inquiry tasks).

Another strong variation concerns the adoption stage of tablets when perceptions were measured. Ten studies measured perceptions from students who had used their tablet for at least 1 year, 12 studies measured perceptions after 6 to 10 months of use, 7 studies focused on perceptions after 3 to 18 weeks, and 2 studies after only one (controlled) task performed. Ten studies do not specify the adoption stage. Concerning the number of measures, the vast majority ($N = 37$) made only one data collection. Two studies conducted two data collections, before adoption and after 14 weeks of use (Kaman and Ertem 2018) or after 6 months of use (Ozdamli and Tavukcu 2016). Montrieux et al. (2014) and Courtois et al. (2014) assessed the same pool of students 3 times: before tablet adoption, after 2 months of use, then after 6 months of use.

Finally, the studies differed according to the kind of tablet used. In 28 studies, students used iPads. In eight studies, students used Android systems. Most studies ($N = 26$), however, did not provide this information (particularly studies focusing on a large sample of students from several schools).

In conclusion, the studies were considered as varied according to the contexts of use and measurements of perceptions.

Learners' Perceptions of the Use of Tablets for Learning

As mentioned before, the model-based studies relied on multiple theoretical frameworks. To facilitate the comparison of results, we will present their findings through the UTAUT model, which brings all these models together. In the UTAUT, perceived usefulness is included in the more general concept of performance expectancy, and ease of use is included in effort expectancy (Venkatesh et al. 2003). Thus, to simplify the reader's understanding in this section, we referred to performance expectancy and effort expectancy, even when the considered studies measured perceived usefulness and perceived ease of use. Moreover, we included no-model-based studies

when they measured the concerned theoretical constructs. We also mentioned that some studies were more descriptive and aimed to identify feedback from students after they used tablets for academic tasks. We tried to offer a reading of these results through the UTAUT conceptual framework (see Tables 2 and 3) in order to combine qualitative and quantitative data for a more general understanding of learners' perceptions toward the use of tablets for learning.

Performance Expectancy

Overall, the performance expectancy ratings varied from moderate to high in model-based studies (Ifenthaler and Schweinbenz 2016; Lin 2014; van Deursen et al. 2016; Hwang et al. 2015). Results from qualitative studies confirmed that students perceive several benefits in using the tablet for their school tasks. Students think that these learning resources are useful and enrich the courses (Duran and Aytaç 2016; Huang et al. 2017; Soffer and Yaron 2017; Soykan 2015), making them more interesting and pleasant (Dündar and Akçayir 2014; Huang et al. 2017; Shadiev et al. 2017; Soykan 2015; Tay 2016). According to students, tablets facilitate learning and understanding (Soykan 2015), document organization (Ferguson 2017), and make learning more efficient and faster (Dündar and Akçayir 2014; Soykan 2015). Students like the possibilities of personalization (Fekonja-Peklaj and Marjanovič-Umek 2015; Prince 2017) and the delivery of immediate and personalized feedback (Fekonja-Peklaj and Marjanovič-Umek 2015; Huang et al. 2017).

However, despite all these advantages expressed in most studies, some students had rather neutral or negative perceptions and did not think tablets may foster course interest or make learning easier (Duran and Aytaç 2016). Two main limits appeared from the studies: the device as a distraction tool (e.g., Sommerich et al. 2007) and the lack of content and tasks adapted to the device. Some students in Kontkanen et al. (2017) also highlighted that students need to take responsibility for their learning and not get distracted by game apps. Moreover, for students, tablet-based learning activities need to be carefully planned and designed by teachers (Kontkanen et al. 2017). For example, 47% of the students interviewed by Dündar and Akçayir (2014) highlighted the importance of having educational content adapted to tablet use, while students interviewed by Kontkanen et al. (2017) raised the point that some tasks are not educationally beneficial, looking more like artificial use of the tablet.

Interestingly, other aspects were not equally evaluated by students, such as tablet use for communication, that can be considered as a useful task to reach educational goals. Some students though that tablets enhance communication possibilities (e.g., Ferguson 2017; Kontkanen et al. 2017), whereas others did not. For example, approximately 15% of the students interviewed by Dündar and Akçayir (2014) reported that tablet use negatively affects social relationships and one of the more important disadvantages raised in Duran and Aytaç (2016) is that tablets reduce visual contact and interactions with the teachers. Another limitation relates to the fact that some schools limit access to specific features, which was deplored by students (Dündar and Akçayir 2014; Pamuk et al. 2013; Soykan 2015). Table 1 presents positive and negative feedback related to performance expectancy in qualitative studies.

Effort Expectancy

The studies considered in this review found low levels of effort expectancy (Cacciamani et al. 2018; Dündar and Akçayir 2014; Duran and Aytaç 2016; Hwang et al. 2015; Lin 2014; Liu and Hwang 2010; Montrieux et al. 2014; van Deursen et al. 2016; Villani et al. 2018).

Table 1 Positive and negative feedback related to performance expectancy in qualitative studies

Positive	Negative
Quick access to courses, learning resources, and practical information (Ferguson 2017; Kontkanen et al. 2017; Soykan 2015; Tay 2016)	Does not enhance learning or interest (Duran and Aytaç 2016; Kontkanen et al. 2017)
Usefulness of available resources (Duran and Aytaç 2016; Huang et al. 2017; Soffer and Yaron 2017; Soykan 2015)	Source of distraction (Duran and Aytaç 2016; Kontkanen et al. 2017; Sommerich et al. 2007)
Makes courses more interesting and pleasant (Dündar and Akçayir 2014; Huang et al. 2017; Shadiev et al. 2017; Soykan 2015; Tay 2016)	Negatively affects communication and interactions (Dündar and Akçayir 2014; Duran and Aytaç 2016)
Facilitates and improves learning, understanding and document organization (Ferguson 2017; Soykan 2015)	Access limitations (Dündar and Akçayir 2014; Pamuk et al. 2013; Soykan 2015)
Accelerates learning (Dündar and Akçayir 2014; Soykan 2015)	Lack of well-defined and planned learning activities (Dündar and Akçayir 2014; Kontkanen et al. 2017)
Personalization (Fekonja-Peklaj and Marjanovič-Umek 2015; Huang et al. 2017; Prince 2017)	
Enhances communication (Ferguson 2017; Soykan 2015)	

Qualitative studies confirmed that students generally find tablets easy to use (Ciampa 2014; Dündar and Akçayir 2012, 2014; Duran and Aytaç 2016; Shadiev et al. 2017). For example, students found it easy to read on tablets (Dündar and Akçayir 2012; Kaman and Ertem 2018), to communicate or to share and manage material with tablets (Kontkanen et al. 2017), and to access learning resources (Ferguson 2017; Kontkanen et al. 2017; Soykan 2015; Tay 2016). Interestingly, qualitative approaches also highlighted some limitations. Writing on a tablet seems to be an issue (Dündar and Akçayir 2014; Soffer and Yaron 2017; Soykan 2015). In Ling (2016), approximately one third of all students (33%) reported a preference for paper and pencil, 35% preferred the computer, and 31% preferred the iPad. Among these students, a majority preferred using an external keyboard (21%): only 10% preferred using the virtual keyboard. However, technological developments may improve the effectiveness of writing tools with the advent of digital pens. Effort expectancy can also depend on learning tasks performed. Students interviewed by Kontkanen et al. (2017) perceived tablets handier than traditional tools under some circumstances (e.g., searching for information, gaining information tasks). The perception was more negative for generating and doing tasks. Another issue reported in several studies pertained to bugs and application freezing (e.g., Fekonja-Peklaj and Marjanovič-Umek 2015; Kontkanen et al. 2017; Soykan 2015). Beyond the problems related to the tool itself, bugs may be due to automatic updates (Pamuk et al. 2013), internet disconnections (Soykan 2015), or manipulation errors (Soykan 2015). Finally, short battery life was also mentioned (Clarke and Abbott 2016; Dündar and Akçayir 2014; Ferguson 2017; Soykan 2015).

Another range of factors that may be related to effort expectancy is the physical discomfort associated with the use of tablets and reported by some secondary students. They complained that tablet use results in eyestrain and headaches (Dündar and Akçayir 2014; Duran and Aytaç 2016; Ferguson 2017; Kontkanen et al. 2017; Soffer and Yaron 2017; Sommerich et al. 2007; Soykan 2015). Students stated, however, that there is no need to carry school books anymore (Dündar and Akçayir 2014; Ferguson 2017; Soykan 2015), which can be interpreted as a positive evolution in school life

(avoiding strenuousness). Table 2 presents positive and negative feedback related to effort expectancy in qualitative studies.

Attitude and General Perceptions

Attitude is a general component of several acceptance models (theory of planed Behavior, theory of reasoned action, technology acceptance model 1) and is defined as an affective reaction when a person uses a system (Venkatesh et al. 2003). Davis et al. (1989) found that attitude offers little value in predicting system use, and this component disappeared from subsequent models of TAM. Other authors have suggested that attitude is an ill-defined concept (e.g., Yang and Yoo 2004). Though there is a lack of clarity around the definition of this concept and its operationalization, attitudes were often mentioned in the model-based studies presented in this review. Attitude was sometimes considered as the sum of different perceptions (e.g., Dündar and Akçayir 2014). Most of the time, attitude was considered as a theoretical construct assessed by specific items and separated from other constructs.

Some no-model-based studies also assessed general perceptions, sometimes identified as attitudes, without relying on a clear theoretical definition. Overall, the studies show that attitudes and general perceptions are positive (Duran and Aytaç 2016; Ferguson 2017; Huang et al. 2017; Hyppa-Martin et al. 2016; Pruet et al. 2015; Tay 2016) and tablets seem to be well-integrated into learning culture (Norqvist 2016).

Factors of Perception Toward Tablets in a School Context

As mentioned previously, the factors influencing students' perceptions were examined in most of the studies considered in this review, especially regarding factors of attitude and general perceptions.

Performance and Effort Expectancy Factors

Only a few studies focused on factors influencing performance and effort expectancy. The factors investigated were learner-related (gender, grade, self-efficacy, anxiety toward tablets) or use-related (frequency of use, and topic to learn). Regarding the effects of gender on

Table 2 Positive and negative feedback related to effort expectancy in qualitative studies

Positive	Negative
Easy to use (Ciampa 2014; Dündar and Akçayir 2012, 2014; Duran and Aytaç 2016; Shadiev et al. 2017)	Hard to use for writing(Dündar and Akçayir 2014; Ling 2016; Soffer and Yaron 2017; Soykan 2015)
Easy to use for reading (Dündar and Akçayir 2012; Kaman and Ertem 2018)	Bugs and freezing (Fekonja-Peklaj and Marjanovič-Umek 2015; Ferguson 2017; Kontkanen et al. 2017; Pamuk et al. 2013; Soffer and Yaron 2017; Sommerich et al. 2007; Soykan 2015)
Easy to use for communication (Kontkanen et al. 2017)	
Easy to use for sharing and managing material (Ferguson 2017; Kontkanen et al. 2017; Soykan 2015; Tay 2016)	Short battery life (Clarke and Abbott 2016; Dündar and Akçayir 2014; Ferguson 2017; Soykan 2015)
No need to carry school books (Dündar and Akçayir 2014; Ferguson 2017; Soykan 2015)	Physical discomfort (Dündar and Akçayir 2014; Duran and Aytaç 2016; Ferguson 2017; Kontkanen et al. 2017; Soffer and Yaron 2017; Sommerich et al. 2007; Soykan 2015)

perceptions, Gokcearslan (2017) found that perceptions are significantly higher for girls than for boys and Sommerich et al. (2007) noted that girls reported less discomfort than boys did. Conversely, Soffer and Yaron (2017) and Villani et al. (2018) found that boys are more positive than girls. Dündar and Akçayir (2014) and Cacciamani et al. (2018), however, found no gender difference or experience effect, contrary to their expectations. These inconsistent results do not suggest any gender effect. Grade was not identified as a discriminating factor by Cacciamani et al. (2018). According to Horzum et al. (2014), self-efficacy has a positive influence and anxiety has a negative influence on effort expectancy.

Concerning the topic being learnt, findings revealed that it can impact perceptions: students interviewed by Ferguson (2017) expressed that they miss using paper, especially for mathematics, and Keane et al. (2013) found that tablet use is perceived to be more useful for some learning subjects (e.g., history and geography) than others (e.g., music). Thus, students may have different perceptions of tablets according to the learning context.

Attitude and General Perception Factors

As mentioned previously, there is no clear theoretical distinction between the concepts of attitudes and general perception. Thus, we will retain the concept of attitudes regardless of the term used in the studies. As presented in the Appendix, some studies focused on attitude determinants, while others compared these attitudes according to learner-related characteristics such as experience with technology, gender, or age.

Most model-based studies aimed to investigate the relationships between the model components, especially the factors influencing attitudes (e.g., Ifenthaler and Schweinbenz 2016; van Deursen et al. 2016. Students' attitude toward tablet use was positively predicted by the participants' effort and performance expectancy (Ifenthaler and Schweinbenz 2016; Horzum et al. 2014; van Deursen et al. (2016) but not by social influence (Ifenthaler and Schweinbenz 2016; van Deursen et al. 2016. The researchers assumed that the overall positive expectancy and novelty effect might have neutralized the expected social influence. Courtois et al. (2014) and Montrieux et al. (2014) longitudinally investigated the evolutionary nature of the acceptance process over a 6-month period. Courtois et al. (2014) and Montrieux et al. (2014) found that overall, the impact of factors influencing attitudes (perceived usefulness, perceived ease of use, status, and perceived enjoyment) is rather stable. Furthermore, perceived enjoyment was the strongest attitude factor throughout the study conducted by Montrieux et al. (2014). Courtois et al. (2014) also found that a positive attitude before tablet adoption gives rise to the development of a stronger perception of behavioral control.

Regarding the effects of learner characteristics on attitude, experience, age, and gender were investigated by the studies. Experience appears as a factor with both positive and negative impacts according to the nature of the experience. Experience with tablets was associated with better perceptions in several studies (Ferguson 2017; Ozdamli and Tavukcu 2016; Pruet et al. 2015), but whereas other studies stated that while perceptions are very high when students start using the tablet PCs, they decrease after a period of use because of bugs and negative experiences encountered (Montrieux et al. 2014; Pamuk et al. 2013). Finally, Tay (2016) did not find any significant change in perceptions over 2 years of use. Concerning students' age, younger students are more positive than older students (e.g., Ferguson 2017; Montrieux et al. 2017; Soffer and Yaron 2017). For gender effects, once again results are inconsistent. Two studies failed to find any difference between males and females (Montrieux et al. 2017; Pruet et al. 2015); two found that girls were more positive than boys (Görhan et al. 2014; Hyppa-

Martin et al. 2016), whereas three came to the opposite conclusion (Ferguson 2017; Ozdamli and Tavukcu 2016; Soffer and Yaron 2017).

Some use-related factors were also studied (i.e., factors related to context and type of use). Contrary to their expectations, some researchers found that frequency of use is not a discriminating factor of perceptions (Çukurbaşi et al. 2016) or satisfaction to use tablets (Kim and Jang 2015). Other factors are specific to educational situations, such as teachers' attitudes or their role in the classroom. In that line, Montrieux et al. (2017) compared three different classroom scripts. In one scenario, learning activities were situated only at the classroom level, with strong teacher control. Under this condition, tablets were used as digital books only. In another scenario, learning activities were balanced between group (collaborative) and classroom levels (teacher-led interventions). In the last scenario, learning activities occurred mainly at the group level and the teacher offered minimal guidance. Under these two conditions, students received learning material adapted to the opportunities of tablet devices. Qualitative and quantitative results show that students' perceptions toward tablets were more positive in the first two scenarios than in the last one, indicating that students did not appreciate when learning was not structured by the teacher. The authors concluded that the role of teachers is very important in technology-enhanced learning. This result can be compared to those obtained by Tay (2016) and Kontkanen et al. (2017), who highlighted the need for teachers to develop their skills for better teaching (and learning) experiences. Finally, Gokcearslan (2017) questioned the relations between self-directed learning with technology and the level of acceptance of tablets. He found that the more students are self-directed, the more positive are their attitudes.

The collaborative aspects of tablets use were investigated by two studies. Fokides and Mastrokoukou (2018) showed that students liked using tablets in a collaborative way. Lin et al. (2012) compared two modalities of collaborative use: some groups involved four students working together with only one tablet (1:m). Others involved four students working together with one tablet per student (1:1). Results showed that the 1:m condition resulted in lower perceptions toward tablet use and collaborative learning. Thus, the modalities of collaboration in the use of tablets may also affect students' perceptions.

Attitude and general theoretical factors are presented in Table 3.

Factors of Intention and Actual Use of Tablets in School Context

In acceptance models, users' perceptions are thought to determine intention to use and actual use of technologies. Thus, some of the model-based studies assessed the relationship between perceptions and students' intention and actual use of tablets for learning. The perceptions studied in these studies were attitudes (Courtois et al. 2014; Ifenthaler and Schweinbenz 2016; Montrieux et al. 2014), effort expectancy (Cacciamani et al. 2018), and perceived usefulness or performance expectancy (Cacciamani et al. 2018; Ifenthaler and Schweinbenz 2016). Moreover, because they considered that high school is a specific context, Cacciamani et al. (2018) added another factor to their experiment: empowerment in learning. This refers to the feeling that tablet use may sustain the learning process at school. Although the definition seems akin to performance expectancy (or perceived usefulness), items are more focused on academic tasks. The use was systematically assessed by self-reported measures. Furthermore, Cacciamani et al. (2018) made the distinction between learning usage, which refers to the use of tablets to perform learning tasks, and communicative usage, which refers to the use of tablets to communicate about school matters.

Table 3 Attitude factors

Factor studied	Positively predictive of or related to attitude	Negatively predictive of or related to attitude	Not predictive of or not related to attitude
Performance expectancy and perceived usefulness	Courtois et al. (2014) Ifenthaler and Schweinbenz (2016) Horzum et al. (2014) Montrieux et al. (2014) van Deursen et al. (2016)		
Effort expectancy and perceived ease of use	Courtois et al. (2014) Horzum et al. (2014) Ifenthaler and Schweinbenz (2016) Montrieux et al. (2014) van Deursen et al. (2016)		
Social influence			Ifenthaler and Schweinbenz (2016) van Deursen et al. (2016)
Experience	Pruet et al. (2015) Ferguson (2017) Ozdamli and Tavukcu (2016)	Montrieux et al. (2014) Pamuk et al. (2013)	Tay (2016) van Deursen et al. (2016)
Interest			van Deursen et al. (2016)
Status	Courtois et al. (2014)		

Regarding the findings, attitude positively predicts behavioral intention to use tablets (Ifenthaler and Schweinbenz 2016), especially when focusing on pre-adoption expectations (Courtois et al. 2014). However, when focusing on use after 6 months, the effect of attitude disappears (Courtois et al. 2014; Montrieux et al. 2014). Performance expectancy predicts behavioral intentions (Ifenthaler and Schweinbenz 2016) and learning use, but not communicative use (Cacciamani et al. 2018). Nevertheless, the empowerment in learning predicts both communicative and learning uses (Cacciamani et al. 2018). Effort expectancy was not identified as influencing behavioral use in the only study that examined this relation (Cacciamani et al. 2018).

Overall, model-based studies focused more on the relationship between affective variables and intention or actual use. These variables are subjective norm (Courtois et al. 2014; Ifenthaler and Schweinbenz 2016; Montrieux et al. 2014), self-efficacy (Ifenthaler and Schweinbenz 2016; Zubković et al. 2016), perceived behavioral control (Courtois et al. 2014), and affects toward tablets (Cacciamani et al. 2018). Subjective norm is defined as the perception that most people who are important to a person think he/she should or should not perform the behavior concerned. This perception does not directly relate to tablets, but to people in the learners' educational environments. It positively predicts intention and use in a fluctuating way. Ifenthaler and Schweinbenz (2016) failed to find any significant influence of subjective norm on intention after 10 months of use. In longitudinal studies, there was a strong significant effect after 2 months of use, but this effect decreased after 6 months of use (Courtois et al. 2014; Montrieux et al. 2014). Thus, subjective norm seems to affect intentions

or the actual tablet use only in the early stages of tablet adoption. The effect of subjective norm may also be task-dependent: Cacciamani et al. (2018) found that support conditions (a concept akin to subjective norm) affect the learning use of tablets, but not communicative use. Courtois et al. (2014) explained that 3 months' post-adoption, implementation yielded some problems (crashes, down time, usability issues, difficulties of use) and teachers had to motivate students to persist and overcome these problems. These encouragements may have reinforced the influence of subjective norm on actual use.

Contrary to the acceptance model's predictions, Ifenthaler and Schweinbenz (2016) did not find any relationship between perception of one's own ability to perform a task with a tablet (i.e., self-efficacy) and intention to use a tablet. Zubković et al. (2016) found that fifth grade students who are going to use a tablet show higher self-efficacy in ICT use than students who have decided not to use a tablet. There is no such difference, however, between older tablet users and nonusers. Thus, self-efficacy could influence intention to use tablets for learning only at some stages of adoption. In the same vein, Courtois et al. (2014) investigated the longitudinal role of perceived behavioral control, a construct very close to self-efficacy (e.g., Ajzen 1991). They found that perceived behavioral control positively explains actual use only in the second wave of measurements, but not before adoption or after 6 months of use. Another explanation may be that the impact of self-efficacy varies according to the task. Cacciamani et al. (2018) assessed another construct from social cognitive theory, affects toward tablet, and found that it predicts communicative use of tablet but not learning use. Thus, affective and motivational variables may predict some academic uses but not all.

Among the no-model-based studies, only Sommerich et al. (2007) studied self-reported tablet use. They found that females were more likely to use tablets for homework than males. Females were also more likely to communicate with their teacher and reported less discomfort than males, as mentioned previously. These results are in line with the UTAUT model that predicts that gender is a moderator between perceptions and actual use of technology (Venkatesh et al. 2003). The factors explaining intention and actual use of tablets in a school context are summarized in Table 4.

Discussion and Recommendations

The examination of students' perceptions of learning tools, particularly for innovative tools, helps to predict how students will or will not adopt these tools in their learning activities. Because perceptions contribute to the acceptance of learning tools, we conducted a detailed review of perceptions of the use of tablets for learning in primary and secondary schools to identify the nature of the perceptions and their determinants. By analyzing 41 studies from 2000 to 2018, convergent results were observed concerning perceptions, but limitations to these positive perceptions were also identified. Moreover, this critical review highlighted different theoretical and methodological limits to the studies.

Positive Perceptions of Tablets and Their Determinants

Overall, the results showed that students have rather good perceptions of tablets. Tablets tend to be perceived by students as easy to use (low effort expectancy), adapted to learning needs (medium to good performance expectancy), and received a positive attitude. Nevertheless, a closer look shows that this general result needs to be nuanced.

Table 4 Factors explaining intention and actual use of tablets in a school context

Factors studied		Positively predictive of or related to intention	Not predictive of or related to intention or use	Variations throughout use
Students' perceptions	Attitude	Ifenthaler and Schweinbenz (2016)	Courtois et al. (2014) Montrieux et al. (2014)	Positively predictive after 3 months of use; not predictive after 6 months of use (Courtois et al. 2014; Montrieux et al. 2014)
	Performance expectancy	Ifenthaler and Schweinbenz (2016) Gokcearslan (2017)		
	Effort expectancy		Cacciamani et al. (2018)	
	Subjective norm		Ifenthaler and Schweinbenz (2016)	Not predictive before adoption, predictive after 2 months of use, decreases after 6 months of use (Courtois et al. 2014; Montrieux et al. 2014)
Other factors	Self-efficacy or perceived behavioral control	Zubković et al. (2016) (for younger students)	Ifenthaler and Schweinbenz (2016) Zubković et al. (2016) (for older students)	Positive effect only after 3 months of use (not after 6) (Courtois et al. 2014)
	Gender	Females are more likely to use tablets for homework and communication than boys (Sommerich et al. 2007)		

Some limitations have been emphasized, particularly in qualitative studies. Perceived ease of use can be hampered by some use conditions and is related to the technical characteristics of the tool. Firstly, ease of use is task-dependent: although reading on tablets (Dündar and Akçayir 2012), seeking information on the Internet, or managing materials (e.g., Kontkanen et al. 2017) is perceived as easy to do, students report that tablets are harder to use for other tasks requiring production of texts. For example, writing with a tablet appears to be an issue (e.g., Soykan 2015). However, the advent of new technologies such as digital pens can overcome these difficulties (e.g., Yanikoglu et al. 2017). In some cases, students prefer to use traditional tools such as books or paper and pencil. Then, technical issues experienced with tablets were revealed and impacted perceptions. Much negative feedback has been reported by students concerning technical difficulties encountered (bugs, freezing), which can lead to the loss of learning documents (e.g., Dündar and Akçayir 2014). More generally, it causes loss of time and interrupts learning. Finally, tablets are considered problematic by some students because of physical discomfort after prolonged use of the tool (eye pain, headache, etc.) or visual fatigue (e.g., Soffer and Yaron 2017).

The picture is quite similar regarding performance expectancy. Overall, results from model-based studies show that performance expectancy scores range from medium to high, indicating that students think the tablet is a useful tool for studying. Once again, qualitative feedback gives a more detailed view of students' perceptions. On the one hand, students generally consider that tablets facilitate learning and make courses more fun and pleasant (e.g., Soykan 2015). New resources are available and enrich the course content (e.g., Huang et al. 2017). As a tablet is usually a personal tool, the ability to customize the device and learning tasks is also appreciated (e.g., Prince 2017). On the other hand, these advantages are not shared by all students. Some students think that tablets do not help them to study and learn (e.g., Kontkanen et al. 2017). Others consider that it does not foster interest for courses: on the contrary, they perceive tablets at school as a source of distraction and judge that tablets can negatively affect social relationships (e.g., Duran and Aytaç 2016). In summary, the findings highlight the fact that perceptions are complex, sometimes ambivalent and may differ according to students and learning contexts.

The complex picture of students' perceptions of tablets raises the issue of the determinants of these perceptions. We identified two types of determinants in the current study: learner-related factors and use-related factors. Studies showed consistent effects for some factors, but the effects for others remain inconsistent. While age seems to be a stable factor, with younger students being more positive than their older counterparts (e.g., Soffer and Yaron 2017), other learner-related factors such as gender (e.g., Hyppa-Martin et al. 2016; Ferguson 2017) or prior experience with technology (e.g., Pruet et al. 2015; Tay 2016) present inconsistent effects.

Use-related factors were less empirically studied, but some studies suggested that the experience and role of teachers when using tablets in the classroom might influence students' perceptions (Montrieux et al. 2017; Tay 2016). Qualitative comments also emphasize the need for the teacher to be competent (e.g., Kontkanen et al. 2017). The nature of the learning tasks must also be considered: in Kontkanen et al. (2017), learners advised teachers to carefully design the learning task, feeling that tablet use seems to be artificial or useless for learning. More generally, students think that tablets are not equally useful and easy to use for all tasks and materials. The variability of learning situations in the considered studies could explain why some results are inconsistent.

According to the acceptance models, perceptions toward a technology may affect its adoption and uses. Results from the model-based studies in this review, however, do not confirm all the predicted relations. This may be explained by the evolutionary nature of the relationship between perceptions and behavioral intentions as found by Courtois et al. (2014) or Montrieux et al. (2014). Furthermore, school is a specific context in which the proposed tasks can widely vary. The considered model-based studies failed to task variability into account, with the exception of Cacciamani et al. (2018) who distinguished learning and communicative uses. They found that some factors can predict one category of use but not the other (e.g., perceived usefulness predicts learning but not communicative use). Most acceptance questionnaires do not distinguish the tasks, and items assessing perceptions of using a tool are formulated in a general way, avoiding the nature of the learning tasks. The students' qualitative comments provided more context-sensitive information about their perceptions, stressing the complementary nature of qualitative and quantitative measures to assess students' perceptions.

Complementarity of Quantitative and Qualitative Methods

The review included both quantitative and qualitative studies and highlighted the variability of the applied methodologies adopted in the studies. Studies using quantitative methods relied on clearly identified acceptance models, while those using qualitative methods mostly consisted of descriptive analyses or explorative investigations taking into account different features of the educational contexts.

As shown in the perception-related findings, the results from the different types of studies display true complementarity. The quantitative methods provide reliable data about the level of perceptions and more generalizable findings because they were collected from large samples of students. However, this type of study focuses on specific factors based on predictions according to the models. Qualitative methods obviously fail to provide highly generalizable results, but they provide a more detailed understanding of the perceptions and the conditions affecting these perceptions. Moreover, as Ferguson (2017) noted, open questions lead to more negative comments than closed questions delivered by written survey. One explanation may be that whereas closed questions, widely used in the quantitative studies, are limited to the set of alternatives being proposed, open questions allow the respondent to express himself/herself without being influenced (e.g., Reja et al. 2003). Thus, feedback may be closer to students' experiences. Furthermore, closed surveys question students without distinguishing specific uses, whereas, as mentioned before, students' perceptions seem to be highly dependent on situational characteristics such as learning task or teachers' skills and role. Thus, quantitative and qualitative methods in research into perceptions of learning tools are complementary, painting a general picture of students' perceptions and their determinants.

Limits and Further Research

Variability of the Theoretical Constructs and Their Measurement

Considering the different studies taken into account in this review, only a minority (32%) relied on clearly identified theoretical frameworks. The lack of theoretical framework

presents different limits. Firstly, it weakens the validity and interpretation of the construct. For instance, many studies investigated students' opinions, but the weakness of the conceptual definition of this construct limited the understanding of the results. Secondly, the comparison between these studies and the identification of the convergent findings is complex due to the lack of a common theoretical background. Finally, the lack of theoretical models does not support the use of common assessment methods and can limit the validity of the interpretation.

Studies using theoretical models offer more possibilities to compare findings and to achieve deeper interpretation. Nevertheless, even though they used questionnaires measuring specific constructs relying on the model used, further work is required to more deeply examine some concepts, their meaning, and their measurement. For instance, the attitude construct is particularly complex and different definitions exist in psychology (Maio et al. 2018). Therefore, further research is needed to examine new dimensions of the perceptions by using measures related to the chosen definition of the construct. Moreover, we noticed that researchers used a great variability of questionnaires from several sources (see the description of applied methodologies). Furthermore, some of them were adapted to students' grade or context of use. Thus, the same constructs were assessed with different scales. As discussed earlier in the paper, quantitative methods provide reliable data concerning the level of perceptions and more generalizable findings. However, in this review, the lack of unified theoretical constructs and measurements in model-based studies reduces results comparison or generalization possibilities. On the other hand, a broad range of studies (68% of the considered studies) did not fall within theoretical frameworks. Some of them aimed to investigate factors influencing perceptions, but 44% of the studies remained at a descriptive level. There is a strong need for further studies focusing on more explicative aspects and relying on well-defined theoretical frameworks. Moreover, these choices should be made considering the kind of task performed by students.

Investigating the Impact of Types of Use and Learning Tasks on Perceptions

To date, the studies conducted on tablets in primary and secondary education have focused either on the learning benefits of tablets or on the perceptions and acceptance of tablets. Future investigations should be conducted on the relationships between learning and perceptions. The perceptions of tablets can rely on subjective norms, personal expectations, personal culture, and values. Perceptions are, however, widely constructed from one's own learning experiences with tablets. The studies that considered students' previous experience with tablets usually referred to general use out of the educational context. It is important to consider the nature of the learning tasks that are performed with the tablets and what learning tasks students previously experienced. Most of the studies reviewed (80%), however, did not focus on a specific task, or even on a specific context of tablet use. This was a strong limitation given that previous studies have shown the importance of taking into account the tasks performed by students. For example, for higher education students, Amadieu et al. (2016) found that the perceptions of tablets became more positive after experiencing a reading–comprehension task of a multimedia document, while they became more negative after experiencing a writing task with the built-in digital keyboard. In this review, only Cacciamani et al. (2018), Lin et al. (2012), and Montrieux et al. (2017) considered different types of use. Therefore, these

results stress that previous experiences with tablets in educational contexts may impact perceptions of tablets and that perceptions may be different for one student according to the task considered. Another consequence of assessing perceptions in a general way is that student feedback relies more on technological considerations than on pedagogical applications, sometimes tending to consider that technology is the main determinant of learning. In addition, model-based studies in this review are mainly techno-centered as they do not focus on the context of use. Although technological aspects are important to analyze, assessing how pedagogical uses impact perceptions is central—and little studied.

Upcoming studies should examine both teacher and learner activities with tablets in the classroom and determine how the different types of activity contribute to the development of tablet perceptions. The TTF model (Chang 2010) could be a relevant model for assessing the match between the task and technology characteristics that can help to determine users' performance, tablet uses, tablet perceptions, and tablet adoption. Wu and Chen (2017) tested the prediction of the task–technology fit model on perceptions of educational technology and confirmed it predicted perceived usefulness and perceived ease of use. Future research should define a theoretical framework of acceptance and perceptions of educational technology integrating the conventional models of acceptance and the TTF model.

Another way to be more learner-centered could be to integrate motivational and learning models into the analysis of students' perceptions. We noted some attempts in this review: for example, Gokcearslan (2017) found a link between self-directed learning and attitudes toward tablets. Soffer and Yaron (2017) found that the more students experienced ease of use with a tablet, the more they perceived themselves as engaged in learning. Nevertheless, many questions remain. For example, motivational theories established that the task value is a key component of students' engagement and academic outcomes (e.g., Eccles 1983). Nothing is known, however, about the relationship between task perception and tablet perceptions. Subsequent research should assess learners' engagement in learning tasks with tablets rather than only assessing perceptions. To determine the impact of tablet engagement in learning, subjective and objective measures can be used (Henrie et al. 2015). Investigating perceptions and engagement should contribute to our understanding of true adaptation to tablets by students and not only their acceptance based on measured perceptions. Thus, the acceptance model should be more closely articulated with motivation models in learning. On the other hand, focusing more on the task could allow articulation of acceptance models with specific learning models. In this review, there is a lack of focus on theoretical learning models. For example, a collective tablet-based task could be related to socioconstructivist approaches; a task performed autonomously in a complex learning environment could be related to self-regulated learning theories. Thus, further studies should assess the relationships between acceptance, motivational, and learning models in order to be more learner-centric.

Additionally, the studies reported in this review that investigated perception dynamics over the year emphasized the importance of considering how perceptions evolve over uses in the classroom. The period of assessment in these studies, however, was relatively short (one semester). In general, the studies considered in this review focused mainly on early stage of adoption. There is a need to understand how perceptions and their impact on behavioral use evolve over a longer period.

Finally, one of the main affordances of mobile devices like tablets is their mobility. Sommerich et al. (2007) found that girls were more likely to use tablets at home than males, but no other study focused on students' pedagogical uses of tablets outside the classroom. The location issue is critical for educational implications: there is a need to determine whether perceptions of use outside the classroom are similar to those found in class.

Educational Implications for Better Integration of Tablets in Education

The conclusions from the analysis of the different studies provide useful information for more efficiently integrating tablets into educational contexts and for meeting the needs of students. Firstly, the studies showed that tablets are better suited to viewing tasks (reading, searching for information, viewing multimedia or Internet documents), recording tasks (audio and video recording), and exercises or communication tasks. In contrast, tablets are less well-suited to major writing tasks with the digital keyboard; in this case, tablets are usually negatively perceived. Then, the role of teachers and guidance appears very important to convey a positive experience for students with tablets. While some teachers might assume that tablets promote autonomy for students, the findings tend more to show that students have to be accompanied and guided by teachers. In the same vein, intensive tablet use in the classroom can lead students to experience visual fatigue due to the backlit screen.

In summary, investigations of the pedagogical designs of tasks and resources with tablets should be continued. Facilitating learning and enhancing the students' experience should contribute to more relevant education based on digital tools.

Limitations of the Review

As discussed earlier in the article about the criticism of methods used in some of the studies examined, this review attempted to extract concepts comprising students' perceptions from the different studies. The heterogeneity of the studies regarding the theoretical framework and methods rendered extraction occasionally difficult. The manner in which the review interpreted the results differed too much from the framework of acceptance presented in the introduction. This work provided an organized understanding of perceptions that allowed the identification of convergent findings and inconsistent results. The greater the use of shared models of acceptance and perceptions by future studies, the more the findings will be comparable. In that case, our knowledge of how students perceive educational technology should be widely enriched.

This literature review focused on tablet technology because their integration in education is currently increasing. This spreading technology raises new issues such as mobile learning issues or the place of tablets in the classroom, combined with other pedagogical resources. The conclusions are restricted to tablets. Technological developments are, however, leading to some overlap. For instance, tablets are increasingly close to smartphone technology thanks to multitouch interaction systems and to the increasing size of smartphone screens, but also to hybrid personal computers proposing ever more multitouch interaction. Thus, the findings of the literature concerned only tablets, but they should be considered as potentially informative about perceptions of new technology tools for education even though specific perceptions exist according to the studied tools.

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Appendix

Table 5 Characteristics of the selected studies

Author and year	Purpose of the studies	Theoretical aim	Population studied	Number of participants	Tool	Duration of use before data collection	Tasks performed with tablet	Quantitative/ qualitative method	Data collection method	Country
Cacciamani et al. (2018)	Assessing the relationships between model components (effect of PU, PEU, affects, support conditions, empowerment in learning on learning and communicative use) according to frequency of use, gender, and grade	To assess UTAUT and TAM models	Secondary students	296	Unreported	1 year	Various	Quantitative	Survey—closed questions	Italy
Ciampa (2014)	Identification of students' experiences and perceptions associated with tablet use	Descriptive	Primary students	24	Unreported	5 months	Various	Qualitative	Interviews	Canada
Clarke and Abbott (2016)	Identification of students' experiences andperceptions associated with tablet use	Descriptive	Primary students	27	iPad	5 months	Various	Qualitative	Interviews	Ireland
Courtois et al. (2014)	Assessing the evolution of the relationships between model components (attitude, subjective norm, perceived behavioral control, behavioral intention, and actual use)	To assess TPB model	Secondary students	351	iPad	6 months	Various	Quantitative	Survey—closed questions	Belgium
Çukurbaşi et al. (2016)	Assessing factors that explain variance of model components (PEU, PU, attitude, behavioral intention) according to gender, tablet ownership, technology education, and schools	To assess TAM model	Secondary students	2023	Unreported	Unreported	Various	Quantitative	Survey—closed questions	Turkey

Table 5 (continued)

Author and year	Purpose of the studies	Theoretical aim	Population studied	Number of participants	Tool	Duration of use before data collection	Tasks performed with tablet	Quantitative/ qualitative method	Data collection method	Country
Dündar and Akçayir (2012)	Identification of students' experiences and perceptions associated with tablet use	Descriptive	Primary students	10	iPad	One (first) use	One controlled reading task	Qualitative	Interviews	Turkey
Dündar and Akçayir (2014)	Comparison of attitudes toward the use of tablet computers (PEU, PU, affects toward computer) according to gender and experience	To assess TAM model	Secondary students	206	Android tablet	6 months	Various	Mixed	Survey—closed and open questions	Turkey
Duran and Aytaç (2016)	Identify students' experiences and perceptions associated with tablet use	Descriptive	Secondary students	1439	Unreported	Unreported	Various	Qualitative	Survey—closed and open questions	Turkey
Fekonja-Peklaj and Marjanovič-Umek (2015)	Identify students' experiences and perceptions associated with tablet use	Descriptive	Primary students	12	Unreported	6 months	Various	Qualitative	Interviews	Slovenia
Ferguson (2017)	Comparison of students' experiences and perceptions associated with tablets use according to gender and grade	Explicative-descriptive	Primary and secondary students	676	iPad	8 or 20 months of use	Various	Mixed	Survey—closed and open questions	USA
Fokides and Mastrokoukou (2018)	Assessing students' perceptions toward the use of tablets for collaborative learning task	Descriptive	Primary students	75	Unreported	Four 2-hsessions	Collaborative information seeking and exercises on specific app in biology courses	Qualitative	Survey—closed and open questions	Greece
Gokcearslan (2017)	Assessing the relationship between the level of acceptance of tablets (PU, PEU, attitude, and behavioral intention) and the level of self-directed learning with technology;	To assess TAM1 model	Secondary students	414	Android tablet	Unreported	Various	Mixed	Survey—closed and open questions	Turkey

Table 5 (continued)

Author and year	Purpose of the studies	Theoretical aim	Population studied	Number of participants	Tool	Duration of use before data collection	Tasks performed with tablet	Quantitative/ qualitative method	Data collection method	Country
	comparison according to gender									
Görhan et al. (2014)	Comparison of students' experiences and perceptions associated with tablet use according to gender, grade, and experience	Explicative-descriptive	Primary and secondary students	414	Unreported	Unreported	Various	Quantitative	Survey—closed questions	Turkey
Horzum et al. (2014)	Assessing the relationships between model components (PU, PEU, attitude, intention) and anxiety and readiness for educational usage of tablet	To assess TAM1 model	Secondary students	1130	Unreported	Unreported		Quantitative	Survey—closed questions	Turkey
Huang et al. (2017)	Assessing perceived usefulness, ease of use, and satisfaction and behavioral intentions after using the tablet for academic tasks	Descriptive	Secondary students	58	Tablet	(unreported) + virtual pen for tablet	6 weeks of use	Individual exercises on specific app in English courses	Mixed	Survey—closed questions Interviews China
Hwang et al. (2015)	Assessing students' perceptions (PEU, PU, and behavioral intention)	Descriptive	Primary students	20	Asus Transformer Pads	3 weeks (20 min by week)	Individual exercises on specific app in mathematics courses	Qualitative	Survey—closed questions + interview	Taiwan
Hyppa-Martin et al. (2016)	Comparison of students' experiences and perceptions associated with tablets according to gender	Explicative-descriptive	Primary students	115	iPad	One (first) use	Test of an augmentative and alternative communication system	Quantitative	Survey—closed questions	USA
Ifenthaler and Schweinbenz (2016)	Assessing the relationships between model components (effort expectancy, performance expectancy, social	To assess UTAUT, TAM, and TRA models	Secondary students	120	iPad	10 months	Various	Quantitative	Survey—closed questions	Germany

Table 5 (continued)

Author and year	Purpose of the studies	Theoretical aim	Population studied	Number of participants	Tool	Duration of use before data collection	Tasks performed with tablet	Quantitative/ qualitative method	Data collection method	Country
	influence, attitude toward tablet, self-efficacy, facilitating conditions, behavioral intention, actual use)									
Kaman and Ertem (2018)	Identify students' experiences and perceptions associated with tablet use	Descriptive	Primary students	15	Unreported	14 weeks of use (1 use by week)	Reading task	Qualitative	Semistructured interview	Turkey
Keane et al. (2013)	Identification of students' experiences and perceptions associated with tablet use	Descriptive	Secondary students	51	iPad	Several years	Various	Qualitative	Survey—closed and open questions Interviews	Australia
Kim and Jang (2015)	Assessing the relationships between PU, PEU, satisfaction, deepened experiences through tablet use, beliefs about the future, and self-efficacy	To create a structural research model	Primary students	277	Samsung Galaxy Note 10.1 (Android)	Unreported	Various	Quantitative	Survey—closed questions	Korea
Kontkanen et al. (2017)	Identify students' experiences and perceptions associated with tablet use	Descriptive	Secondary students	84	iPad	2 years	Various	Qualitative	Open questions (formulation of advice based on the TPACK framework)	Finland
Lin (2014)	Comparison of perceived usefulness, ease of use, and satisfaction after the use of tablet or laptop	To assess TAM2 model	Secondary students	82	iPad	10 weeks of use	Individual documents consultation and exercises on specific app in English courses	Mixed	Survey—closed and open questions	Taiwan
Lin et al. (2012)	Comparison of perceptions according to modalities of collaborative use of tablet (1:1 or 1:m)	Explicative-descriptive	Primary students	64	Unreported	One use	Collaborative concept mapping on	Mixed	Survey—closed questions Interviews	Taiwan

Table 5 (continued)

Author and year	Purpose of the studies	Theoretical aim	Population studied	Number of participants	Tool	Duration of use before data collection	Tasks performed with tablet	Quantitative/ qualitative method	Data collection method	Country
							social studies lesson			
Ling (2016)	Comparison of students' experiences and perceptions associated with tablet use according to gender, ethnicity, and experience	Explicative-descriptive	Secondary students	404	iPad	6 months	Various	Qualitative	Survey—closed questions	USA
Montrieux et al. (2014)	Assessing the evolution of the relationships between model components (attitude, subjective norm, perceived behavioral control, PU, PEU, perceived enjoyment, status, behavioral intention, and actual use)	To assess TPB model	Secondary students	351	iPad	6 months	Various	Quantitative	Survey—closed questions	Belgium
Montrieux et al. (2017)	Comparison of students' experiences and perceptions associated with tablet use according to the nature of use (electronic book, guided and not-guided inquiry-based learning) and gender, age, and academic track	Explicative-descriptive	Secondary students	139	iPads	2 years	Digital book or inquiry learning	Mixed	Survey—closed and open questions	Belgium
Norqvist (2016)	Assessing whether tablets are integrated into learning in students' opinion	Descriptive	Secondary students	23	Unreported	Unreported	Various	Qualitative	Interview (based on the theory of group cognition)	Denmark
Ozdamli and Tavukcu (2016)	Comparison of students' attitude before and after tablet use and according to gender	Explicative-descriptive	Secondary students	319	iPad	6 months	Various	Quantitative	Survey—closed questions	Cyprus
		Descriptive		918	Unreported	6 months	Various	Qualitative		Turkey

Table 5 (continued)

Author and year	Purpose of the studies	Theoretical aim	Population studied	Number of participants	Tool	Duration of use before data collection	Tasks performed with tablet	Quantitative/ qualitative method	Data collection method	Country
Pamuk et al. (2013)	Identification of students' experiences and perceptions associated with tablet use		Secondary students						Survey—closed questions Interviews	
Prince (2017)	Identification of students' experiences and perceptions associated with tablet use	Descriptive	Primary students	8	iPad	1 year	Various	Qualitative	Interviews	Europe
Pruet et al. (2015)	Comparison of students' experiences and perceptions associated with tablets according to experience	Explicative-descriptive	Primary students	213	Android	Unreported	Various	Quantitative	Survey—closed questions	Thailand
Shadiev et al. (2017)	Identification of students' experiences and perceptions associated with tablet use	Descriptive	Secondary students	57	Asus transform-er Pads	7 weeks	Various tasks in English course	Qualitative	Survey—closed questions + interview	Taiwan
Soffer and Yaron (2017)	Comparison of students' experiences and perceptions associated with tablet use according to gender and grade	Explicative-descriptive	Secondary students	427	iPad	1 year	Various	Mixed	Survey—closed and open questions	Israel
Sommerich et al. (2007)	Identification of student's experiences and physical discomfort associated with tablet use	Descriptive	Secondary students	106	Unreported	1 year	Various	Qualitative	Survey—closed questions	USA
Soykan (2015)	Identification of students' experiences and perceptions associated with tablet use	Descriptive	Secondary students	319	iPad	18 weeks	Various	Qualitative	Interviews	Cyprus
Tay (2016)	Comparison of students' experiences and perceptions associated with tablet use according to grade and experience	Explicative-descriptive	Secondary students	92	iPad	1 year	Various	Mixed	Survey—closed questions Interviews	USA
				139	Unreported	Unreported	Various	Quantitative		Netherlands

Table 5 (continued)

Author and year	Purpose of the studies	Theoretical aim	Population studied	Number of participants	Tool	Duration of use before data collection	Tasks performed with tablet	Quantitative/ qualitative method	Data collection method	Country
van Deursen et al. (2016)	Assessing the relationships between model components (influence of PU, PEU, social influence, experience, independence, and interest on attitude)	To assess UTAUT and TAM models	Primary students						Survey—closed questions	
Villani et al. (2018)	Assessing the relationships between model components (effect of PU, PEU, affects, support conditions, empowerment in learning on learning, and communicative use) according to frequency of use, gender, and grade	To assess UTAUT and TAM models	Secondary students	296	Unreported	1 year	Various	Quantitative	Survey—closed questions	Italy
Yanikoglu et al. (2017)	Identification of students' experiences and perceptions associated with tablet use and digital pen (2 evaluations)	Descriptive	Primary students	20 and 24	ASUS tablet	Unreported	Various (using digital pen)	Qualitative	Interview	Turkey
Zubković et al. (2016)	Comparison of attitudes toward the use of tablet computers regarding the decision to use iPad and the experience of using iPads in the classroom	To assess TAM2 model	Primary and secondary students	109	iPad	1 to 2 years	Various	Quantitative	Survey—closed questions	Croatia

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