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Why Are Plickers an Interesting Pedagogy Alternative for Accounting Educators? A Reflection on Distinct Types of Student Response Systems

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Abstract

Plickers are a relatively new educational technology that can assist the teaching and learning processes and this study seeks to answer the following question: why are plickers an interesting pedagogy alternative for accounting educators? To do so, I develop a section to detail plickers' features and functionality. Subsequently, I compare plickers and other types of student response systems (SRS) in terms of technology, financial, and utilization issues. Next, I present prior research on plickers, discussing with prior literature. Then, I conclude that plickers have important advantages over other types of SRSs that may influence relevantly educational institutions' and faculty's decision to adopt one or another model of SRS. The answer for the proposed question, implications for practice, and suggestions for future studies are provided at the final section of the paper.

Keywords: Plicker, Clicker, Student response system, Educational technology, Accounting education.

Por que os Plickers são uma Alternativa Pedagógica Interessante para os Educadores Contábeis? Uma Reflexão sobre Distintos Tipos de Sistemas de Resposta do Estudante

Resumo

Os plickers são uma tecnologia educacional relativamente nova que podem assistir os processes de ensino e aprendizagem e este estudo procura responder a seguinte questão: por que os plickers são uma alternativa pedagógica interessante para educadores contábeis? Para tanto, desenvolvo uma seção para detalhar as características e funcionalidade dos plickers. Subsequentemente, comparo os plickers e outros tipos de sistemas de resposta do estudante (SREs) em termos de questões tecnológicas, financeiras e de utilização. Na sequência, apresento pesquisas prévias sobre os plickers, discutindo com a literatura prévia. Desta forma, concluo que os plickers têm importantes vantagens sobre outros tipos de SREs que podem influenciar relevantemente a decisão das instituições de ensino e corpo docente à adotarem um ou outro modelo de SRE. A resposta para a questão proposta, as implicações para a prática e sugestões para futuros estudos são fornecidas na seção final do artigo.

Palavras-chave: Plicker, Clicker, Sistema de resposta do estudante, Tecnologia educacional, Educação contábil.

1 Introduction

Plickers represent a relatively new educational technology that enables faculty to engage students during the classes. It is a recent type of student response system (SRS), very alike to clickers and other audience response systems in general. Main difference from previous SRSs is *the way* educators employ it though. However, as other types of SRS, it is plausible to presume that plickers have similar effects on students' attendance, satisfaction, motivation, interactivity, and performance. Plickers generate instant visual feedback as well.

Educators should consider utilizing plickers since it is a user-friendly, low-cost, and mobile tool, besides its potential benefits to the learning process. It means that plickers do not demand faculty or student training to be used. According to Watty, McKay, and Ngo (2016), faculty capacity constitutes a barrier to use technology. Once plickers are easy to use, this aspect is no longer an obstacle. In addition, plickers are a low-cost resource because it utilizes the instructor's mobile device (e.g. cell phone, phablets, tablets, etc.) and QR-code cards that could be printed and reused. Then, both faculty and educational institutions can afford it. Finally, plickers are also an interesting alternative pedagogy tool because its mobility. QR-code cards and mobile phones can easily be moved from one place to another. It allows educators to employ plickers across distinct courses and classrooms.

As new generations of students expect more visual stimulus (Sprague & Dahl, 2010) and are often characterized as being fast-paced and multitasking (Lea, 2008), plickers can help bringing interactivity to the classroom. For instance, use of plickers may encourage discussions on relevant topics of accounting. Complementarily, students sometimes find that accounting education process is boring and demotivating (Gaviria, Arango, & Valencia, 2015). In reaction to this scenario, accounting educators could adopt plickers to make learning more fun (Premuroso, Tong, & Beed, 2011). Research suggests that previous types of SRS make class more fun (Caldwell, 2007; Chatham & Davidson, 2011; Cunningham, 2008; Eng, Lea, & Cai, 2013; Kay & LeSage, 2009; Mula & Kavanagh, 2009; Rana, Dwivedi, & Al-Khowaiter, 2016; Segovia, 2008) and I presume that plickers can produce the same results, as suggested by Wuttiprom, Toeddhanya, Buachoom, and Wuttisela's (2017) findings.

Besides the key points about plickers considered in this introductory discussion, the main objective of this study is to respond to the following question: Why are plickers an interesting pedagogy alternative for accounting educators? I believe that debating on interactive technologies, particularly the affordable, mobile, and user-friendly ones, which is the case of plickers, is crucial to enhance any education process. This is not different for accounting. Here, I seek to show detailed differences among types of SRS, focusing primarily on plickers.

This study seeks to contribute to accounting education literature and practice in three directions. First, I would like to call attention to plicker technology because accounting educators do not largely know it, especially in Brazil. Then, its potential benefits are being ignored. Second, I extend Carnaghan, Edmonds, Lechner, and Olds's (2011) discussion by comparing plickers and other types of SRS. Plickers were not considered in Carnaghan et al.'s (2011) literature review because it is a more recent technology. Third, to the best of my knowledge, there is no published work in accounting

education approaching the plicker topic so far. Then, it constitutes a research opportunity to test empirically how this recent technology can assist accounting education processes.

The remainder of this paper is structured as follows. Section 2 presents literature review on plickers' functionality and features. Section 3 brings the comparison between plickers and other types of SRS, focusing on technology, financial, and utilization issues. Section 4 discusses general benefits for faculty and student learning based on preliminary findings. Finally, section 5 concludes and provides suggestions for future research.

2 Plicker's functionality and features

Plicker is a recent type of SRS and an important feature is its simplicity (Wood, Brown, & Grayson, 2017). Plickers consist of QR-code cards that are scanned by instructor's mobile device. Figure 1 shows an example of it. QR-codes are printed in paper that can be plasticized or laminated to increase its durability, as Krause, O'Neil, and Dauenhauer (2017) and McCargo (2017) report. According to Howell, Tseng, and Colorado-Resa (2017), 63 distinct plicker cards are available to be printed currently. Reusing QR-code cards is a good practice to avoid paper waste. Faculty should keep this is mind. Detecting QR-code is the main objective of plicker software/app and this is probably the most important process that faculty must ensure when using plickers. Otherwise, plicker activity may not be developed appropriately.

Each plicker card has a different QR-code to avoid response conflict and this is fundamental when instructor is analyzing the students' answers. Each side of plicker card has a letter (A, B, C, and D) to represent the response to the questions. To get a valid response, students must hold up the QR-code cards until instructor's device scans it. Top of the card indicates the chosen alternative. For instance, in Figure 1, the answer is D. Plicker cards also have a number attached to them. This allows faculty to associate students to the plicker cards and then collect more specific data. In Figure 1, the number is 3 (three), which could represent "Anna," for example.

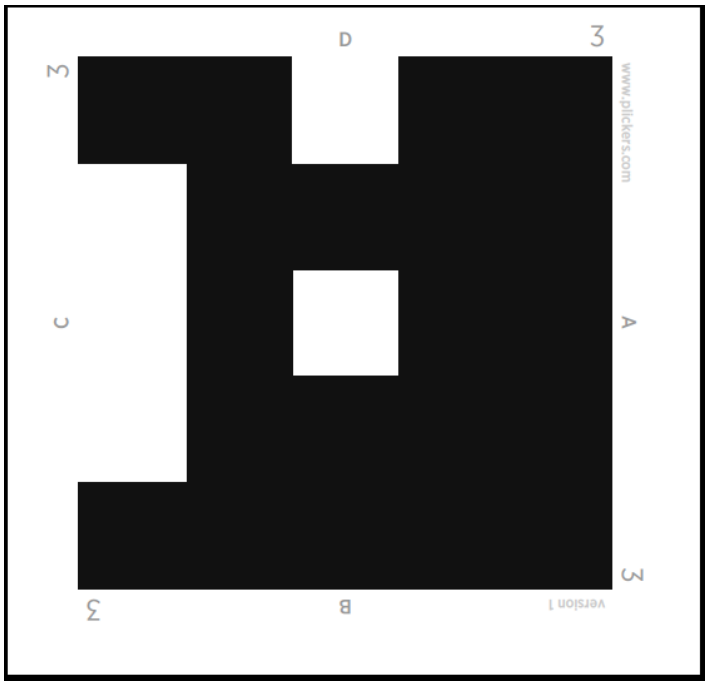

Figure 1. Plicker card
Source: Google images.

The general functionality of plickers does not differ relevantly from other types of SRS. First, professor exposes a multiple-choice question and then students think about it and raise their QR-code cards in a determined position according to their chosen alternative (Howell et al., 2017). Each position represents an alternative for the question, as mentioned previously. After these steps, plicker software/app captures students' answers and provides immediate feedback in graphic forms, usually histograms. This process repeats as questions are asked. Albeit plickers can be used in an offline mode, it is recommended that faculty's mobile phones be connected to the internet for immediate data synchronization and to maximize their usefulness (Krause et al., 2017). Additionally, it is encouraged to use a personal computer attached to a multimedia projector to display the response histograms and to support the activity in general. Figure 2 provides better visualization of how plickers work in the classroom.

Figure 2. Plickers in the classroom.
Source: Google images.

It is possible to observe that each student is raising his/her QR-code card in a certain position. Card position is important here because it represents the response choices. Students must hold up their cards until plicker software/app scans them. In Figure 2, I note that distinct alternatives to a question were chosen. Because the process is not entirely electronic, plickers cannot be employed in distance education. It may also have some difficulties in capturing students' answers in large lecture halls since there might be juxtaposition of cards due to the large number of students one in front to another. Plickers may still be a good alternative in small and medium classrooms though.

Plickers are also an inclusive pedagogic tool since it permits that all students participate actively in class at the same time. This would be very difficult to achieve without a response system. Then, plickers may reduce demotivation because students have to pay attention to respond questions correctly and they do not have time to sleep or be distracted. It becomes clear to the instructor who is paying attention to the class when plickers are used.

Basically, plicker is a pedagogical tool that can promote different academic activities from traditional education methods (e.g. reading and memorization), as well as to

assess students' performance on a regular basis. The answer for the question "Why are plickers an interesting pedagogy alternative for accounting educators?" is provided over the following sections when I discuss some similarities and differences between plickers and other types of SRS and present some prior studies on the topic.

3 Plickers vs. other types of student response systems

Comparisons between plickers and other types of SRS are based on technology, financial, and utilization issues. Before adopting a certain type of SRS, comparisons are important to provide information for education institutions and instructors to make better decisions.

3.1 Technology issues

Carnaghan et al. (2011) describe three electronic models of SRS: infrared-based (IR-based SRS), radio frequency-based (RF-based SRS), and telephony-/web-based (web-based SRS). Electronic SRSs utilize alphanumeric devices ("clickers", "response pads", "handsets") or mobile phones to answer questions (Carnaghan et al., 2011). IR-based and RF-based SRSs have a receiver which captures students' responses through IR signal or RF frequency. These three types are based on a full electronic process. Both instructor and students use technology to expose questions and to transmit answers. On the other hand, plickers remind a more remote and simple type of SRS, described by Edmonds & Edmonds (2008). In the late 1960s, the first SRSs consisted of index cards and a projector (Edmonds & Edmonds, 2008). Index cards were colored and each color represented a response. Students had to raise their colored cards according to the desired choice. Plickers have very similar response system, as described previously. However, plicker is a "one-way" technology resource. Only the educator uses his/her electronic device to identify students' answers. Thus, plickers are less dependent on technology than electronic models of SRSs. This may be an advantage because it is easier to make one electronic device work than each of the students' devices. Moreover, Krause et al. (2017) report that plickers can work with or without internet, as well as can be easily used inside or outside the classroom. These features make plickers a very interesting alternative for the current existing types of SRS.

IR-based and RF-based SRSs require specific response pads to work. Each provider has a particular model and this cannot be utilized in conjunction with SRSs from distinct providers (Carnaghan et al., 2011). For example, iClicker's handsets (https://www.iclicker.com) will not work with Poll Everywhere's receiver (https://www.polleverywhere.com). Web-based SRS is more flexible in this sense. Students use their own mobile devices (e.g. cell phones) to answer the questions. No response pad purchase is needed. However, connection to the internet may be a problem in this case. Education institutions (instructors) must provide a strong wi-fi signal over the campus (classroom) for students to connect their cell phones. Otherwise, academic activities with web-based SRSs might not be well conducted. For this reason, plickers have an advantage over prior versions of SRS because they use printed cards. Besides that, Carnaghan et al. (2011) and Duncan (2006) report that sometimes calling to technical support services is necessary for electronic SRS models. As plickers use only one device, technical support is dispensable. However, instructor's mobile device must be connected to the internet, then an adequate wi-fi signal is still required.

Because IR-based, RF-based, and web-based SRSs use personal devices, instructors need to establish a bring your own device (BYOD) policy. Clickers and mobile devices are small and similar to a TV remote control (Caldwell, 2007; Rana et al., 2016), making them easy to be lost or forgotten (Dallaire, 2011). For instance, Dallaire (2011) surveyed 151 psychology students and found that 57% of them declared that forgetting to bring the handsets to class is main obstacle to use SRS. Thus, BYOD policy may help students to avoid forgetting their devices that would otherwise prevent some students to participate in class. On the other hand, plicker cards are easy to be managed and can easily be moved from one place to another. Educator can distribute the QR-code cards to students and at the final of each class students give them back. It is arguably that alphanumeric devices can be lent and returned as well (Caldwell, 2007), however, this is not valid for web-based SRS since no one would let the instructor keeps the devices or would purchase an additional cell phone just to use it for SRS activity. In this sense, IR-based SRS, RF-based SRS and plickers have a slightly advantage over web-based SRS when it comes to devices' logistics.

Another aspect is that clickers' and cell phones' batteries should be charged. It would be a serious concern if some clickers stop working in the middle of the SRS quizzes, especially if instructor is using SRS to attribute course grade. Although this seems less relevant, students must pay attention to this detail. When plickers are employed though, no battery is needed, except for the instructor's device's.

Some concerns emerge from technology usage and need to be considered in order to avoid further problems with SRS activity. If technology challenges overcome the benefits for student learning, instructors must rethink SRS use. Here, I tried to evidence some relevant features of each type of SRS to provide more information for educators to make a better decision to adopt or discard SRS. Table 1 brings the summary of technology issues.

Table 1. Summary of technology issues among types of SRS

Technology issues	**Plicker**	**IR-based SRS**	**RF-based SRS**	**Web-based SRS**
Connection	Internet/Scan	Infrared signal	Radio frequency	Internet/Web
Response device	QR-code cards	Clickers	Clickers	Cell phones/Tablets
Dependency on technology	Low	High	High	High
Device's compatibility	Yes	No	No	Yes
Internet/Wi-fi signal	Yes (1 device)/No*	No	No	Yes
Technical support	Dispensable	Sometimes	Sometimes	Sometimes
BYOD policy	No need	Yes/No**	Yes/No**	Yes
Battery	No	Yes	Yes	Yes

*It depends on whether faculty want to use plicker in online or offline mode.
**If students purchase the clickers BYOD is necessary, otherwise it is dispensable.

3.2 Financial issues

Financial issues represent a relevant threat to educational technology because they may impair its usability and in many times are deciding factors to use or not technology. In an era where education institutions' budgets have strong constraints, which is the case of Brazil and might be the case of some other countries, research on low-cost educational resources associated with effective outcomes becomes even more fundamental. I believe this is the case of plickers. As mentioned previously, plickers consist of QR-code cards and a mobile device to scan them. Plicker software/app is free and the cards can be printed in 63 different ways (Howell et al., 2017) and laminated to improve their life span (Krause et

al., 2017). Then, cost of plickers is near zero, especially when all the cards are being used by different classes over a significant period.

One of the main complaints about electronic SRSs, specifically for IR-based and RF-based SRS models, is the cost of devices and it definitely represents a barrier to their use (Caldwell, 2007; Carnaghan et al., 2011; Jones, Henderson, & Sealover, 2009; Kay & LeSage, 2009; Rana et al., 2016; Zhu, 2007). IR-based and RF-based SRSs require alphanumeric devices which purchase depends on the academic policy established by the education institution. Some institutions (e.g. West Virginia University) buy the clickers and lend to the students (Caldwell, 2007; Mula & Kavanagh, 2009), but others demand students to purchase them. Clicker's acquisition by students is likely to affect their acceptance and satisfaction with technology (Dallaire, 2011). Therefore, instructors have to ensure that clickers will be used in a regular basis before buying them, otherwise students may not see value regarding the use of response pads and then consider the purchase a waste of financial resource (Zhu, 2007). Despite the recent decrease in the clickers' price, it can still be a significant investment for education institutions or students (Blasco-Arcas, Buil, Hernández-Ortega, & Sese 2013; Rana et al., 2016). Some recommendations for saving money are provided by Carnaghan et al. (2011) and Zhu (2007).

Web-based SRSs do not demand any purchase of response pads as they use students' own mobile devices. On the other hand, web-based developers/providers may require a registration fee to allow students to utilize the web system. For instance, iClicker has multiple types of subscription (https://www.iclicker.com/pricing), varying in value and period. However, there are free web-based SRSs as well. Kahoot! (https://kahoot.com) is a totally free SRS and represents a better option for educational institutions or teachers which budget is limited. Free web-based SRSs has a cost near zero, because they basically need internet connection. The more students use it, the less is its cost. In IR-based and RF-based SRSs this is not necessarily true, because each of handsets has an individual cost, either for the education institution or for the student. Thus, from a financial standpoint, plickers and web-based SRS are alike and have advantage over IR-based and RF-based SRS types.

By confronting plicker's and clicker's financial costs, I believe that financial issues are not a deciding factor for plickers and web-based SRS to be employed in the learning process since they are cheap. Also, they represent a better choice for institutions and faculty that have constrained budgets. IR-based and RF-based are more expensive and for this reason they should be considered after plickers and web-based SRSs. A final consideration about web-based SRS must be emphasized though. As internet connection is a crucial factor for this type of SRS to work, financial investments should be applied to provide strong wi-fi signals or other means of internet connection over the campus or classrooms. Nevertheless, I still think that plickers and web-based SRS are the best options institutions and teacher have for polling academic activities. Besides, they are more modern and probably will last more than previous versions of SRS. Carnaghan et al. (2011), for example, note that IR-based SRSs are already obsolete. Ultimately, a summary of financial issues is shown in Table 2.

Table 2. Summary of financial issues among types of SRS

Financial issues	**Plicker**	**IR-based SRS**	**RF-based SRS**	**Web-based SRS**
Response pads' purchase	No need	Need	Need	No need
Free software	Yes	No	No	Yes/No**
Investment in internet	Yes/No*	No	No	Yes

*It depends on whether faculty want to use plickers in online or offline mode.

**It depends on the SRS provider.

3.3 Utilization issues

Some important utilization issues may impact institutions' and faculty's decision to adopt one or another type of SRS. IR-based SRSs require a direct line between the receiver and clickers (Caldwell, 2007). Similarly, proximity and a direct line between the QR-code cards and instructor's mobile device are also necessary for plickers to work properly. These features impose two fundamental constraints for IR-based SRS and plickers that should be taken in consideration: (i) they may not be adequate for large classrooms; and (ii) they cannot be employed in distance education. Certainly, these limitations impair the usefulness of these technologies, but they may still be relevant pedagogy resources in face-to-face education. In turn, RF-based SRSs do not demand a direct line because responses are transmitted to the receiver through radio frequency. Carnaghan et al. (2011) report that RF-based SRSs supports up to 2000 transmitters and 300 feet distant from the receiver. Then, RF-based SRS are appropriate to both small and large classrooms. Still, Eng et al. (2013) highlight that radio frequency can be adjusted to avoid interference among multiple classrooms where RF-based SRSs are being utilized. Despite these benefits, this model cannot be used in distance education. Lastly, web-based SRSs do not need a direct line between the software and the students' mobile phones and they also can be employed in distance education, making them the best alternative from a use perspective.

Students' cheating behavior is another relevant concern faculty face in the educational process and may distort learning evaluations. Discussions on types of SRS contribute to find effective pedagogy methods and distinct ways to use technology in order to prevent such undesirable behavior. Some studies show concerns with student cheating when SRS is employed (Carnaghan et al., 2011; Duncan, 2006; Jones et al., 2009). A common cheating behavior is the practice of looking at other students' handsets to copy their responses (Carnaghan et al., 2011; Jones et al., 2009). In this respect, none of types of SRS are immune, however, students' audience are more visual to instructor when plickers are used because students need to raise their cards. For electronic SRSs, Jones et al. (2009) suggest that faculty ask students to put their response devices on their desks or other place where they can be seen. But, no matter what strategy instructors adopt to prevent student cheating, it is recommended that at the beginning of the semester faculty talk to students and be clear about cheating practice and its consequences.

Students seem to like SRS because it provides anonymity when answering questions. This point is relevant because it prevents students to be embarrassed or to be scared about being judged by their peers as they answer questions wrongly (Beekes, 2006, 2009; Fies & Marshall, 2006; Kay & LeSage, 2009). Therefore, students' identity is protected and it may make students more comfortable to participate through SRS. Plickers have a slightly lower level of anonymity than electronic versions of SRS since students raise their cards in a certain position, making visible to others. In this regard, electronic SRSs provide more anonymity but at the same time can be used to cheat more frequently. Elliott (2003) reports her case on using SRS in the anonymous mode and it could be interesting to encourage students' participation without the feeling of being monitored, which is a challenge for student involvement (Kay & LeSage, 2009). Either way, both plickers and electronic SRSs offer reasonable levels of anonymity that may attract students to use them. Accounting educators can take advantage of this characteristic to poll students about accounting choice issues or sensitive and professional ethical questions.

Literature shows that clickers may encourage active learning, higher interactivity, and involvement (Carnaghan & Webb, 2007; Edmonds & Edmonds, 2008; Eng et al., 2013; Kay & LeSage, 2009; Lea, 2008), and this may be true for plickers as well, although more research is still necessary. These aspects can combat passive learning, traditional teaching methods, and boring classroom environments that new generations of students complain about. It is arguably that there will always be a few students disinterested in learning, and they probably will raise their plicker cards without purpose. Definitely, it is not an expected behavior and may jeopardize the general active learning environment. However, I must highlight that this is not a particular issue of plickers, but all teaching methods. Despite that, plicker has potential to make students interested in learning by making them participate through a "no one left behind" policy, which may produce a sense of fairness because every student, either shy or spontaneous, has the opportunity to give their opinions and answers by promoting polling or debating activities. In this sense, plickers and electronic SRSs are very similar.

Finally, after reviewing some important utilization issues faculty may face when using SRS, I provide an overview through Table 3. Plickers indeed have some disadvantages in relation to electronic SRSs, such as their use in large classrooms or in distance education. But up to 63 QR-code cards can be printed (Krause et al., 2017), which is a reasonable number of students faculty can manage through the use of plickers. Moreover, plickers seem to be similar in terms of potential benefits. Active engagement can be promoted by polling and discussing activities, as well as make every student participate in class. This aspect alone would be a strong reason to consider plickers as an alternative pedagogy tool.

Table 3. Summary of utilization issues among types of SRS

Utilization issues	Plicker	IR-based SRS	RF-based SRS	Web-based SRS
Direct line	Yes	Yes	No	No
Distance education	No	No	No	Yes
Small classrooms	Adequate	Adequate	Adequate	Adequate
Medium classrooms	Adequate	Adequate	Adequate	Adequate
Large classrooms	Adequate/Not adequate*	Adequate/Not adequate*	Adequate	Adequate
Cheating	Not immune	Not immune	Not immune	Not immune
Level of anonymity	Medium	High	High	High
Active learning	Yes	Yes	Yes	Yes
"No one left behind" policy	Yes	Yes	Yes	Yes

*It depends on how students' seats are organized.

4 Previous research on plickers

Plicker literature is still to be developed, even though some published studies and conference papers can be found. For example, Thomas, López-Fernández, Llamas-Salguero, Martín-Lobo, & Pradas (2016) analyzed the relationship between knowledge, participation and creativity when plickers are used. A sample of 60 high school students was submitted to the analysis. Pearson's correlation matrix showed a positive association between creativity and participation (coeff. = .369; $p < .01$). It suggests that plickers help students to become creative through participation. Thomas et al. (2016) also found a positive strong correlation between participation and knowledge (coeff. = .903; $p < .01$). It indicates that plickers help students to participate in class, and then knowledge is

improved. Another potential explanation is that plickers help students to gain knowledge and then they feel more comfortable to participate. These findings suggest that plickers have positive impact on students' participation and related aspects. However, the results should be observed with cautious since they are based on students' perception. Then, Carnaghan and Webb (2007) suggest that studies should find ways to objectively measure the constructs. It may help analyzing empirical data in a more neutral perspective, generating more robust evidence.

Wood et al. (2017) investigated the faculty's and students' perception on the use of plickers. From the faculty's perspective, plickers modified the classroom mood, especially in the first session. It was fast-paced and excited. In addition, plickers encouraged students to assume an interactive and heads up posture toward the instructor. However, responses are typically poor in the initial quizzes (Wood et al., 2017). I emphasize that faculty's perspective should be analyzed cautiously and critically since no evidence, either quantitative or qualitative, was shown in the article. Wood et al. (2017) also administered surveys to capture students' perspective. It was found that plickers strongly increase students' involvement (63%) and learning (66%). Beckert, Fauth, and Olsen (2009), Eng et al. (2013), Lea (2008) and Yourstone, Kraye, and Albaum (2008) also found an improvement on students' participation and involvement, but they tested clickers instead. Complementarily, 60% of the students would recommend plickers for other instructors to employ them in their classes. This is consistent with Beckert et al.'s (2009), Premuroso et al.'s (2011), and Stowell's (2015) results. However, it seems that plickers have a little impact on previous preparation for class (62% of the students reported that plickers slightly encourage). Despite that, 83% of the students prefer plickers over paper quizzes and 60% prefer plickers over clickers. However, only 9% prefer plickers over other quizz methods. These findings support that plickers are an interesting alternative pedagogy comparatively to other types of SRS.

Wuttiprom et al. (2017) developed a study focused on the analysis of plicker usage in conjunction with peer instruction (PI) at Ratchathani University, Thailand. First year undergraduate students of Chemistry (n = 50) and Engineering (n = 119) constituted the sample of the study. Results showed that students' average scores improved after PI for both Chemistry and Engineering students. It suggests that plickers are an adequate educational resource to mediate the relationship between students' performance and PI. This result is congruent with Marshall and Varnon's (2012). Students also reported that plickers make class more fun and enjoyable. This finding is consistent with prior clicker literature (Carnaghan et al., 2011; Carnaghan & Webb, 2007; Chatham & Davidson, 2011; Cunningham, 2008, 2011; Edmonds & Edmonds, 2008; Eng et al., 2013; Lea, 2008; Marshall & Varnon, 2012; Mula & Kavanagh, 2009; Premuroso et al., 2011). At this point, both clicker and plicker research shows convergent evidence.

McCargo's (2017) master's thesis was based on an examination of the effects of plickers on academic engagement behavior of high school students. An ABCBC design was employed to analyze the effects of the intervention. The B phases represented the opportunity to respond intervention while the C phases were the periods in which plickers were used. Tau U was employed as an analysis procedure because it allows to observe the effect size that accounts for nonoverlap across intervention stages (Parker, Vannest, Davis, & Sauber, 2011). Regarding the plicker usage results, visual analysis indicated no association with students' disruptive behavior. McCargo (2017) also investigated the perception of high school teachers in terms of the "use of Plickers® as a socially valid method for addressing student behavior." (p. 47). Mixed results were found, but the main complaint was the time spent to prepare the activity. This is consistent with clicker

literature as well (Carnaghan et al., 2011; Kay & LeSage, 2009; Sprague & Dahl, 2010) and it seems to be valid for plickers, even though Howell et al. (2017) report that "it is easy to add class sections, students rosters, and MCQs to the Web site." (p. 145).

Krause et al. (2017) examined plickers as a formative assessment tool for K-12 and physical education teacher education (PETE) professionals. The study is basically a descriptive one that provides some considerations on the usage of plickers in K-12 physical education. Particularly, Krause et al. (2017) provide examples on how plickers can be employed to develop four domains of learning: psychomotor, cognitive, affective, and general. Regarding plickers usage in PETE programs, an important observation that deserves to be highlighted is that the use of plickers "is a great way to get PETE students involved in both the technology and assessment processes" (Krause et al., 2017, p. 36). This might be extended to other faculty training programs.

I was not able to find any conference paper or published article about plicker in accounting education literature so far. Majority of the literature is concentrated on clickers (Beekes, 2006, 2009; Carnaghan et al., 2011; Carnaghan & Webb, 2007; Chatham & Davidson, 2011; Chui, Martin, & Pike, 2013; Cunningham, 2008, 2011, Edmonds & Edmonds, 2008, 2010; Eng et al., 2013; Marshall & Varnon, 2012; Mula & Kavanagh, 2009; Segovia, 2006, 2008). Thus, to the best of my knowledge, plickers are still an important and opportune research topic to be investigated. Despite that, preliminary results, such as found by Wood et al. (2017) and Wuttiprom et al. (2017), are encouraging to the extent to which they support positive effects of plickers usage in the teaching and learning processes. Some limitations and challenges pointed out by McCargo (2017) should be equally considered when adopting plickers though.

5 Concluding remarks

This study aimed to offer a reflection upon plickers as an alternative pedagogy technology for accounting educators. To the best of my knowledge, plicker has not been considered as a topic by accounting researchers as no published work was found. This means that relevant discussions and research are opportune in the sense of increasing our understanding about plickers and how they can assist both accounting students and faculty to have a more fluent educational process.

To respond to the question "why are plickers an interesting pedagogy alternative for accounting educators?" I base my answer on four arguments. The first one is related to the technology issues. Plickers can be used with or without internet connection (Krause et al., 2017) and are less dependent on technology than other types of SRS. Therefore, it is easier to make them work. Also, technical support, BYOD policy, and batteries are unnecessary when plickers are being used while electronic SRSs will need these aspects at some point. Second, plickers have advantage over other types of SRS in terms of financial issues. Plickers are generally cheaper than IR-based and RF-based SRSs as no response pad needs to be purchased. It is similar to the web-based SRS, but investment in internet connection (wi-fi signal) is a serious concern for web-based SRS once it is a *sine qua non* condition for them to work while plickers can work without internet connection. Then plickers still have a slightly advantage. Third, even though plickers cannot be employed in distance education or would be inappropriate for large classrooms, they have very similar potential benefits that clickers offer. And fourth, preliminary evidence in plickers found by the existing literature so far supports similar effects also found for previous versions of SRS. Plickers help students to participate and get more involved in classes (Thomas et al., 2016; Wood et al., 2017), as well as serve to mediate student learning and other teaching methods

(Wuttiprom et al., 2017). Finally, plickers are as flexible as clickers in terms of utilization in different levels of education, as Krause et al. (2017) show.

Regarding implications for practice, preliminary findings on the use of plickers suggest that it increases students' performance when utilized with PI (Wuttiprom et al., 2017). Student involvement and learning were also found to be enhanced (Wood et al., 2017). Still, a weaker evidence support that students prepare themselves for class. Based on this evidence, accounting instructors can use plickers to generate more involvement and interactivity in face-to-face education. These results are consistent with clicker literature, but plickers would be more interesting because they are less dependent on technology and have lower financial costs than prior versions of SRSs (e.g. RF-based SRS). On the other hand, if compared to web-based SRS, plicker could not be employed in distance education. This might reduce plickers' usefulness, but it can still be an effective pedagogy tool inside the classroom.

For future studies, I recommend the analysis of the mediate effects of plickers on the relationship between students and teaching methods. Wuttiprom et al. (2017), for instance, utilized plickers with PI. Marshall and Varnon (2012) conducted a similar study with PI and clickers. Other teaching methods can be assisted by plickers, such as think-pair-share or problem-based learning. Plickers can be utilized in multiple ways and the observation on how they mediate learning and teaching methods is important to deliver content effectively. Therefore, research is needed in this sense. Another relevant analysis has to do with the quality of the use of plickers. Experimental studies on SRS have been conducted (Carnaghan & Webb, 2007; Chui et al., 2013; Edmonds & Edmonds, 2008), measuring the presence or absence of SRS in a binary way (usually 1 for SRS and 0 for No SRS). However, little attention is paid to the discussion about the quality of the SRS usage as a major focus is on students' final performance. Some questions emerge from this context: for how long should SRS be used over a semester? Is there an optimum length for SRS quizzes to last? Is binary measurement the best proxy to be used or there are degrees of quality of SRS usage? Thus, an in-depth discussion about SRS utilization remains missing. By providing a step-by-step process of plickers usage rather than a binary measurement, instructors would be able to reproduce it easier. Therefore, I encourage discussions on quality of plicker use and the full disclosure of how plickers were used in research.

Ultimately, I hope that I could have provided some insights for accounting educators' decisions to utilize or discard plickers as an alternative pedagogy resource to the existing response systems. Although I am favorable about using plickers because of their potential benefits to both faculty and students, I acknowledge that limitations and challenges do exist and should be taken in consideration.

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Final note:

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