Active Learning with Smartphones in the Learning Environment to Access Search Engines, Respond Surveys with QR Code, and Make Videos

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Resumo

The purpose of this work is to discuss the experience and results of employing active learning methods using smartphones in three different financial courses during three semesters. Smartphones connected to the internet enable research with search engines (e.g. Google, Yahoo!, Bing) and access to an online survey generator (e.g. SurveyMonkey), which allows online testing on the learning content. Furthermore, smartphones may produce high-quality videos that can be uploaded to a social network (e.g. YouTube). These technological developments change the relationship between learners and tutors and support new learning techniques. Such procedures require tutors to act as a facilitator interacting with the learners, who should be seen as active participants in an unrestrained debate where they should be encouraged to present ideas, to produce innovative work, and even to suggest improvements to the learning methodologies, what did happen during the development of the techniques presented in this work. Thus, the presented techniques, references, and results of questionnaires may improve the set of theoretical conceptions and actions on how to improve the learning environment and the relationship amid this environment with a group of learners.

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Key-words and expressions: teaching-learning methods. learning strategies. active learning. peer instruction. smartphones.

1   Introduction – motivation to this work

The process of obtaining, retaining, and recalling information and concepts can - and should - be carried out with great motivation, albeit with effort. As explained and exemplified in this work, rather than passively receiving knowledge exposed and discussed by lecturers, speakers, or teachers, active learning techniques are indeed more effective for knowledge retention and ultimate retrieval. This is due to the effective transfer of the information initially captured by the limited short-term memory into the long-term memory, whose storage capacity may be expanded with appropriate training within a suitable context and mind-set.

This work presents and discusses results of employing three active learning methodologies in three different undergraduate courses during three semesters in a business school in Brazil, which in 2018 was ranked "5" by ENAD/INEP and "5 stars" by "*Guia do Estudante*"/Grupo Abril, the highest possible position. The significant differences of the profiles of the learners attending the three courses enhance the usefulness of the results that do point out the relevance of the interaction between a "*tutor*" and the group of "*learners*".

The terms "*tutor*" and "*learners*" will be used throughout this work instead of "*teacher*" and "*students*" (and eventually "*participants*" in either a conference or an audience), given that such nomenclature emphasizes the mind-set that should prevail in the "learning environment" (traditionally known as "classroom") and that actually everyone is always learning, although the scope of learning may be different. In addition, "*teaching is inseparable from learning*" as described by Gilbert Highet (1989), who discusses teaching methods among which "*tutoring*", which fits the approach of active learning methodologies.

2   Theoretical Background

Learning may be understood as "*picking up new knowledge or skills and being able to apply them later*", according to Brown et al. (2014, chapter 3, page 47). Such goal demands an appropriate learning environment where tutors may convey both knowledge and learning methods so that learners are able to educate themselves, ultimately with the aid of tutors. This section briefly contrast traditional learning with active learning, explaining additionally why and how three active learning methods should be adopted using smartphones.

2.1 On active learning

Traditional learning required students to always attend classes, to pay attention to the teachers in the classroom, and to do what they are told to do amid an environment with fear of obtaining low grades, failing exams or even suffering corporal punishment (Wikipedia, 2019). It is disputable, whether traditional learning would be effective not only to transfer knowledge, but also to develop healthy human character and sound relationships, including respect for human rights and human dignity.

An alternative learning procedure implying that learners should select the most appropriate learning strategies for them and take control of the learning process with the assistance of a tutor is actually not new. The Greek philosopher Socrates did apply active learning techniques with his learners, as mentioned in the book by Highet (1989) on "*the art of teaching*". In this book, the author describes the procedure of "*tutoring*" by stating that it "*is the most difficult, the least common, and the most thorough way to teach*" (Highet, 1989, chapter III, page 108), although "*this system is far the best kind of education*" (Highet, 1989, chapter III, page 109).

Changes in and improvements to traditional learning are feasible with and actually result from technological innovation. Indeed technology progress enables the adoption of more personal and even "*tailor-made*" education, which is actually the goal of "*tutoring*". Face-to-face meetings should become even more interactive with the use of tools resulting from technological development to actively share knowledge. This fact is a further indication that the so-called "*traditional lectures*" may become "*discussion meetings*" with the use of questionnaires (picking up responses from participants in the so-called audience).

Active learning is a methodology to engage learners (rather than disciplined students) in the learning process in such a way that they become interested in the subjects to be learned and are also able to overcome the challenges of the learning process, which is described in depth by Brown et al. (2014), Carey (2015), and Foer (2011). Additionally, a lively and interactive environment should increase the pleasure of tutors to carry out their activities. Extensive information on active learning and teaching methodologies is freely available, such as: files prepared by the Professional Development Service for Teachers (2019) and an introductory description on "active learning" delivered by Wikipedia (2019).

There are several active learning methods, such as: storytelling (Xavier, 2015, and also Palacios and Terenzzo, 2016), debating scenes of videos or films together with Socratic questions (Henriques de Brito, 2018, and Brandão, 2009), and using games (Prensky, 2007). Beyond understanding the learning process so as to identify and develop more effective methodologies, another challenge faced by research is to measure the results, such as discussed by Vincent-Lancrin, S., et al. (2019) in the OECD publication: "*Measuring Innovation in Education 2019: What Has Changed in the Classroom?*". Such reports contribute to introduce and modify learning methodologies. Thus, the focus of the following work is to report actual experience combined with data about three new active learning techniques using smartphones that are being used in three different courses since 2018.

2.2 Active learning using smartphones

A smartphone is more than just a mobile phone: it is actually a potent multi-purpose mobile wireless computing device with both a touchscreen interface and voice recognition, which comfortably fits on human's palm hand and is equipped to access internet, send and receive text, voice and e-mail messages, run downloaded applications (such as text editors, spreadsheets, and games), capture and process images (such as barcodes and QR Codes), take pictures, record and reproduce videos, and store information. Smartphones became increasingly popular in the 2010s after technological developments improving functionalities and increased competition reducing prices, according to historical facts (Wikipedia, 2019).

The introduction of smartphones triggered a revolution in the society, including in business

schools. At first, the handle of smartphones was forbidden inside several places, such as banks and classrooms. By the time of writing this article in May 2019, laws and rules strictly forbidding the use of mobile phones inside those places could still be enforced. Nevertheless, banks developed application software (app) that clients can and may assess in the premises of banks. Such use may even be mandatory, when an "*app*" supplies a code to access account information and enable banking transactions inside the branches, albeit infringing the law. Analogously, learners employ smartphones in three different undergraduate courses in a business school in Brazil, as described in this article, despite placards in all classrooms in the building (as shown in Figure 1) recalling that the use of smartphones together with smoking, eating and drinking is forbidden.

Figure 1   Picture of a sign banning the use of smartphones in the classroom

Instead of rejecting smartphones and complying with the directive displayed in Figure 1, smartphones are deemed a useful active learning tool in at least three different courses in a business school, as reported in this work. Therefore, learners - incited by a tutor with the support of faculty members - are in fact breaking a rule when using smartphones inside "*learning environments*". Likewise, the ban of smartphones is being unofficially overruled inside bank branches just a couple of years after being introduced. These facts do evidence that applications using smartphones in banks and classrooms is indeed a "*paradigm shift*", and, hence, there is a "*revolution*", as explained by Kuhn (2012) in a book released in 1962.

Thus, another goal of this article, even if only with an adjoining purpose, is to discuss the model presented by Thomas Kuhn, who thoroughly discusses the term "*paradigm*" and the expression "*paradigm change*" in his most known book: "*The Structure of Scientific Revolutions*". Kuhn presents and deepens the idea of the existence of "*paradigms*" in science and, at the same time, explains the emergence of "*new paradigms*", which challenge existing "*paradigms*" defined simply as "*accepted model or pattern*" (Kuhn, 2012, chapter III, pg. 23).

The idea that a "*revolution*" questions the usefulness of a previously established "*paradigm*" and replaces it with a "*new paradigm*" is the core of Kuhn's work, once scientific revolutions "*are the tradition-shattering complements to the tradition-bound activity of normal science*" (Kuhn, 2012, pg. 6) in such a way that "*scientific revolutions are here taken to be those non-cumulative developmental episodes in which an older paradigm is replaced in whole or in part by an incompatible new one*" (Kuhn, 2012, chapter IX, pg. 92).

Even though Kuhn focus basically on natural sciences rather than addressing issues of social scientists, the approach and contribution of the present work can also be analysed within the understanding that a paradigm prevails until there is a paradigm change. In the case of the present work, the paradigm is that the use of mobile devices, including tablets and specially smartphones, would be harmful in the classroom because both learners and lecturers would be vulnerable to distractions, which would jeopardize the learning process. Thus, the goal of the paradigm to ban mobile devices from the classroom would be to promote a learning environment with total concentration and no distractions in order to ensure a more effective learning process.

Nevertheless, the development of the fields of education, scientific research, and cognitive behaviour occur with the possibility of experiments (analogous to those conducted by natural scientists). A planed experiment may assess and check if a new practice, applying a new technology in a learning environment (and, hence, challenging an existing paradigm), may successfully replace traditional procedures to acquire, build, and retain information, knowledge, and wisdom. The "*paradigm shift*" within the learning environment results from the availability of a ground-breaking technological device – the smartphones, which were invented and started to be sold for only a couple of years (as previously explained) and whose applications are still being discovered and developed. Discoveries and especially inventions are certainly "*sources of destructive-constructive paradigm changes*" (Kuhn, 2012, chapter VII, pg. 66). Moreover, developments in the field of education that acknowledge that distractions and forgetting are not harmful during the learning process (Brown et al., 2014) should override the idea that smartphones must be banned from the learning environment for eventually distracting both learners and lecturers. There are indeed several possibilities to use smartphones in the learning environment, as explained further in the following sections.

2.3   Search engine usefulness as an active learning tool

Lecturers' current role in a face-to-face "*classroom*" setting should be to trigger curiosity, nurture debate, and foster investigation in a friendly and interactive way. Therefore, tutors may ask the audience some specific information about the topic being presented. Such questions may be useful either to stir curiosity or to check learners' awareness and their previous knowledge. The goal of stirring curiosity may even be to ask the learners to find information using search engines. A tutor may constantly use search engine to retrieve data and news, to illustrate a concept or a fact discussed in the "*learning environment*", to reinforce the relevance of a topic, or to emphasize the notoriety of terms and expressions.

The tutor should also not feel obliged to know precisely all the information related to a certain area of expertise, because this attitude is not even necessary, given the current information overload, the frequent changes, and updates. Under this context, the tutor should rather give the example to the learners that when someone is uncertain about a specific topic, it is fair, possible, and better to research using the smartphone connected to the internet. By selecting suitable keywords, a Google search may list a series of news or facts that may confirm, correct, or just exemplify a content dealt in the learning environment. Already a link to a webpage with selected head titles may be sufficient to fulfil the mentioned purpose. Thus, the use of search engines should also be employed to develop the ability to insert "appropriate" keywords into the search engine fields in order to assess information, after being able to filter which links may be appropriate to supply precise and useful information.

Using search engines may be ranked as active learning, because:

♦ It offers a way of accessing information and, hence, learning autonomously
♦ It develops human interaction with a machine in an intelligent way, whereas robotics development strive the opposite (i.e. to make machine interact with the physical environment in ways it seems intelligent)
♦ Learners may learn how and when to ask for input, instead of receiving all the information precisely, beforehand, or on time

Given that the search engines (Google, Yahoo!, Bing) may be useful for digital marketing, business schools should bring awareness on how these websites can be employed to promote business. In the field of digital marketing, the book by Kotler et. al. (2017, chapter 11, page 154) brings the following statement: "*it becomes imperative for marketers to reach out and engage customers through smartphones apps*". The same conjecture holds for tutors and learners with the understanding that tutors actually do somehow sell ideas to learners.

2.4   Questions with interactive assessment: The QR Code Learning Method

It may be challenging to receive from all learners in a learning environment an immediate and precise feedback on whether some concepts are known or were understood. Some learners may be shy and not willing to speak, ask, or openly share their thoughts and ideas. Fortunately there is a way to assess whether the activities are actually benefiting the learners: the use of questions with interactive assessment in a learning environment.

A thorough step-by-step procedure to formulate and apply surveys during presentations and to immediately discuss the results with the audience was outlined and explained by Henriques de Brito (2018), without however presenting any data to evidence or measure the usefulness of the suggested procedure, which might be summarized by the following stages:

i.   Formulate a multiple-choice question.
ii.   Create a survey with the website tool "SurveyMonkey" or "Google Forms".
iii.   Obtain a QR Code image and insert it in a slide prepared with Microsoft Power Point
iv.   Display the slide amid the power point presentation, asking the audience to access and answer the question using a QR Code reader app installed in their smartphones.
v.   Show the aggregated results collected by the "SurveyMonkey" (or "Google Forms") website, debating the alternatives by emphasizing what is correct, wrong or omitted.
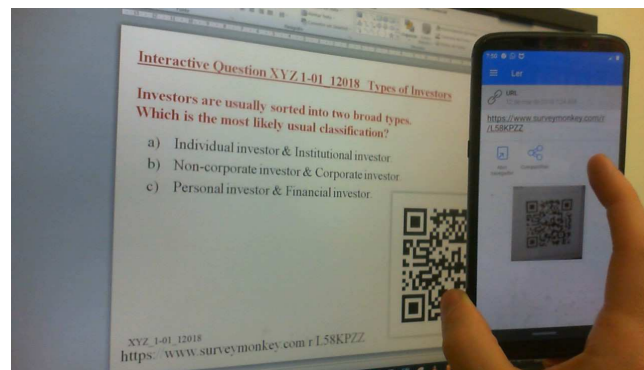

Figure 2   Smartphone after reading a QR Code from a Microsoft Power Point slide

Figure 2 shows a Microsoft Power Point slide in the computer and a smartphone which was used to read the QR Code. The link shown in the smartphone is related to the QR Code shown in the slide, being the same as the link typed at the bottom of the slide.
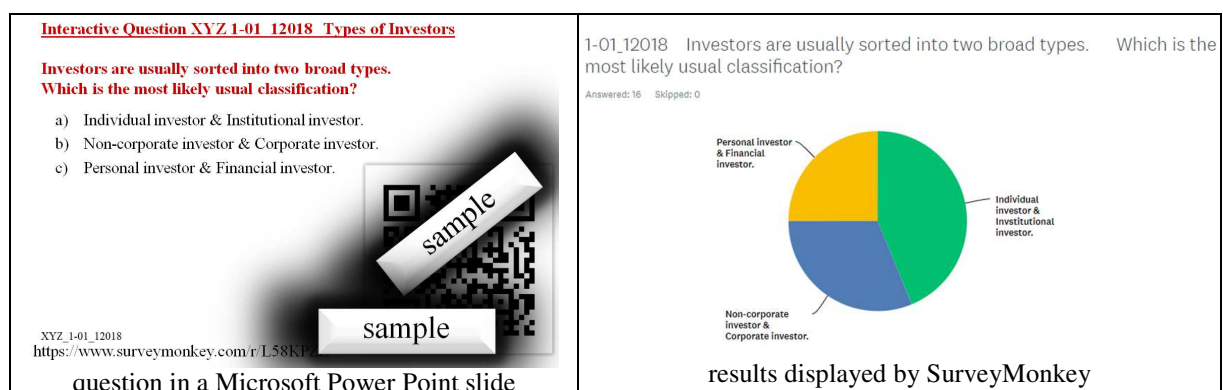

| question in a Microsoft Power Point slide | results displayed by SurveyMonkey |

Figure 3   Slide of a survey using QR Code with the results of the related query

Figure 3 brings an example of the aggregated results collected by SurveyMonkey website. The question with the QR Code is shown in the slide in the left of Figure 3 and the selected answers are presented with the chart prepared by the SurveyMonkey website (Figure 3, right). The expected answer is "a" and the chart in the right of Figure 3 clearly discloses that the

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group did not grasp the expected way of classifying investors. Furthermore, the quite even distribution of the answers among the alternatives also indicates that the wording of the three alternatives was adequate by not giving any hint of which alternative could be right or wrong.

The results with the question in Figure 3 bring an example of how the procedure described above may also help tutors to communicate better with a group of learners. Tutors may suffer the "*curse of knowledge*", which is the tendency to underestimate the difficulties that other people may have to understand and master what a tutor already knows (Brown et al., 2014, page 115). The "*curse of knowledge*" could impel tutors to disclose the answer to the questions by spontaneously saying "*it is obvious that the answer is (a)*" or "*clearly the correct answer is (a)*". These kinds of statements would make learners who selected the wrong alternatives feel that they might really be "*incompetent*". During all debates, no participant should ever be ashamed of having foolish thoughts, gibberish ideas or saying nonsense.

Once learners do acquire knowledge with facts but also with their feelings, any harassment dismissing their qualifications is indeed counterproductive in a learning environment, even if it is not a public vexation. Therefore, displaying the results sorted by SurveyMonkey website makes everyone see the performance of the group, which might hamper an involuntary harassment, as explained above. Moreover, the tutor may understand that the concept must be better explained. Anyhow, learners should feel comfortable to make mistakes. Nobody should actually aim "*errorless learning*", because errors are indeed "*an integral part of striving one's mastery over new material*" and may even aid learning (Brown et al., 2014, chapter 4). Errors are not learned when corrective and friendly feedback is promptly given and justified.

Tutors should speak calmly, with easy terms, and eventually with incremental steps the reasons for accepting or rejecting each alternative. Moreover, the information to be learned is better retained when there is an unambiguous meaning, an articulated context, or a mental framework. Therefore, tutors should provide narratives when both explaining the correct alternative and rejecting all other multiple-choice alternatives, besides stressing the reason and the relevance of the best alternative. Whenever possible, using additional sketches, drawings or images effectively contributes to fix knowledge, such as when adopting the "*mind map technique*" described by Buzan (2018). Polite and proper humor may also help the learning process by relaxing and spacing the transmission of new information.

The QR Code Learning Method may comprise different styles of questions and using different styles is actually recommended considering the effectiveness of variable practice for cognitive learning skills. The most common style requires selecting the most (or least) likely alternative. Another style of question consists in showing two or three statements, requiring the selection of the correct group of statements, if any. A more elaborated style of question requires the learner to identify if there is a cause and effect link between two given statements, which can be wrong nonetheless.

Eric Mazur (1997) was also concerned with interactive teaching in large, heterogeneous classes and he developed the idea of the "*Peer Instruction*" Learning Model. In his guide applied to undergraduate classes on physics, which may be considered a landmark in education, Mazur (1997) explains that when the lecture is interspersed with short tests, the tutor gets answers that provide immediate feedback on student understanding, "*The new lecture format elicits far more questions from the students than I have ever encountered before. Often these questions are very to the point and profound, and I usually attempt to address as many of them as I can*" and "*in effect, they are teaching me how to teach.*" (Mazur, 1997, chapter 4, page 28).

Mazur also explains in the guide to "*Peer Instruction*" that "*tallying the answers can be accomplished in a variety of ways, depending on setting and purpose: 1. Show of hands. ... 2. Scanning forms. ... 3. Handheld computers*". Besides discussing advantages and pitfalls of the first two ways of tallying the answers, Mazur reports that the main advantage of the system

with "*Handheld computers*" is that "*analysis of the results is available immediately. In addition, student information (such as name and seat location) is available to the instructor, making large classes more personal; the system can also handle numerical and nonmultiple-choice questions; and sharing these hand-held computers enhances student interaction. Potential drawbacks are that the system requires a certain amount of capital investment and that it adds complexity to the lecture*" (Mazur, 1997, chapter 2, page 17). More than 20 years later, the "*Handheld computers*" are nowadays the smartphones (which did not exist in 1997) and such technological development eliminated the "*amount of capital investment*" and removed the "*complexity to the lecture*".

Interestingly, while Mazur considers that with "*Handheld computers*" an additional advantage is that "*student information (such as name and seat location) is available to the instructor, making large classes more personal*", Mazur's comments that the main drawback of "*show of hands*" is "*a loss of accuracy, in part because some students may hesitate to raise their hands*". Thus, the fear of identification could prevent learners from spontaneously giving an answer, unless they are really obliged to do so. If learners are forced to do something, fear may again affect learners' ability to answer questions. Thus, fear of being identified or fear of making a mistake is counterproductive when learning. To avoid upspring fear, the learning process must be separated from the examination with grades. There is indeed a difference between testing in order to show the learner his or her development and testing to award a grade with repercussion in the final average and eventually making a person pass or fail the course. Section 4.4 discuss exams following activities with The QR Code Learning Method.

Likewise adopting Mazur's "*Peer Instruction*" learning model (Mazur, 1997, chapter 3), collaboration from learners is essential to the successful use of The QR Code Learning Method using smartphones in the learning environment. Thus, learners must be convinced that the new format will be effective, which requires the tutor to motivate learners early on.

Addressing the question on how much work is required to change to that "new" ["Peer Instruction"] lecture format, Mazur states that: "*teaching in the new format requires less preparation and effort than a traditional lecture because part of the lecture period is taken up by the student discussions*" (Mazur, 1997, chapter 6, page 41). The same comment holds for the tutors with The QR Code Learning Method. Once the questions are set, the process with The QR Code Learning Method flows, although time is required to prepare the questions and insert them in the SurveyMonkey website and in the slides together with the QR Code.

Unlike The "*Peer Instruction*" Learning Model suggested by Eric Mazur, who would expect learners to study beforehand reading assignments, The QR Code Learning Method did not required such attitude from the learners, although it would be desirable. Thus, after being introduced to the topic, the learners under The QR Code Learning Method would answer to the questions during the class and would check their results together with the group a couple of minutes later. The QR Code surveys make learners recall or retrieve information recently stored, which enhances learning. Nevertheless, The QR Code Learning Method may be useful to check reading assignments. The class may however not do the homework with the previously sent QR Code questions, as it happened in March 2019, when an e-mail with several questions was sent to two different classes. The learners were asked to answer those questions outside the learning environment and register their answer using the QR Code, as if they were in the learning environment. There was no enforcement and no control on who would deliver the homework. Besides the fact that the response to the homework was very low, actually as expected, learners informally reported lack of time due to long working hours in internships and employments, and loss of time with transport commuting and traffic jams. These reasons suggest that learners expect that the bulk of the content to be learned should happen during the hours in the business school rather than elsewhere. Thus, learners wish to improve the efficiency of the learning process in the learning environment in the business

school so as to minimize the work to be done elsewhere. Additionally, three facts shed also light to the unfavourable procedure of working out the answer later with the learners.

Firstly, those learners who did not do the homework were not able to follow the discussions of the answers and, hence, they visibly stayed in the classroom without benefitting from the comments, since they did not have the time even to read and think about the correct answers. An uninterrupted presentation of the answers to several questions made an interactive procedure become an extension of a common lecture.

Secondly, the samples of the answers had a clear bias toward those learners who enjoyed the subject and had been willing to carry out the assigned homework. Consequently, the surveys did not assess, address, and motivate those learners who were less tempted to learn and retain information on the course. Thus, the questions sent as homework were not indeed able to fulfil the goal of the methodology to embrace all types of learners and present an unbiased, real-time portrayal of how the group was learning the concepts that were tested.

Last but not least, some learners who diligently did the homework reported during the presentation of the results that they were not being able to actually remember which answer they selected a couple of days before. Worse, some learners would even try during the presentation to figure out if they gave a wrong answer, instead of just concentrating themselves in which would be the suitable answer and, hence, joining the debate on why the other alternatives were unsuitable. Thus, even for those learners who were diligent, a later debate of a batch of questions assigned as homework was also not adequate.

The facts above show that the use of surveys with data collection with QR Code should be carried out as originally conceived and described here, i.e., one multiple-choice question at a time, interleaved with the lecture, and each correct answer must be delivered and discussed some minutes after the responses were collected by the learners who were following the class.

The QR Code Learning Method may be ranked as active learning, because:

- Learners are not obliged to answer and they are not identified and, hence, they know that they have the control over the learning process and that it is up to them to learn
- There is no punishment for mistakes which will be impartially and politely explained
- Learners may carry out the activities in pairs or in small groups instead staying alone
- Learners will be curious about what would be the correct answer and, hence, will actively pay attention to the explanation, ultimately willing to agree or disagree
- Learners will understand how the other learners answered and will by themselves be able to rank their improvement
- There is fun and pleasure in the process of using smartphone as a gadget

Although The QR Code Learning Method seems to apparently be effective, no evidence or data was yet presented to sustain if the learners appreciated and considered useful the introduction of this procedure in the courses. Therefore, it was necessary to investigate at least qualitatively and even quantitatively if this suggested procedure could in the end really be classified as an effective active learning method. The results are presented in a section 4.

2.5 *Using smartphones to produce videos*

A workshop conceived by Nascimento et al. (2018) within the EnEPQ2018 Conference promoted by ANPAD in 26 May 2018 in Porto Alegre, Brazil asked participants to produce a 1-minute video in a very short period of time using the camera embedded in smartphones, similar to what the Brazilian TV network Rede Globo de Televisão was asking their viewers with the project "*O Brasil que eu quero*" ["*The Brazil that I want*"]. According to Rede Globo de Televisão (2018), during 7 months, more than 50 thousand vídeos were sent from 99,5% of the Brazilian towns. Thus, this way of producing videos is not difficult, albeit quite new. Several publications describe how to make videos, such as Willoughby (2017) and Lies, Little White e Matt Thrift (2018). Software to edit a video for free is legally and easily obtained.

In the following semesters, after the EnEPQ2018 conference, learners in three different courses in the business school received a teamwork assignment to deliver a written report and to produce an up-to 3-minute video, both about a specific topic related to the course syllabus. The new assignment was embraced by the learners, also because they knew that some companies were starting to require videos when applying for internships or jobs.

Video making together with writing a report may be ranked as active learning, because:

- Learners choose a topic of their interest to research, analyze and report
- Learners have freedom to decide how the work will be divided within the group
- Learners will define a script, produce and edit a video
- Learners will get a feedback on their video, specially by looking at the video of other groups, when they wish, as long as they wish, and even repeatedly.
- Learners realize by themselves that the report and the video convey information in a different way, even if the content is basically the same
- Learners are encouraged to innovate, respecting inevitable guidelines, described by the assignment and related to content, size of the report, and duration of the video

Likewise The QR Code Learning Method, once the rules to produce both the report and the video are written and the students acknowledge understanding the rules, the process flows. Compared to assessing the performance of a live group presentation, the tutor should award a grade to a video with more comfort and even fairness among different groups, since each video may be seen more than once, unlike a Microsoft Power Point presentation. The tutor will always be able to justify with more ease an assigned grade, if the group disagree with the grade, by simply watching again the video together with the frustrated group. This procedure may engender less conflict than discussing what each person could eventually remember from how a live group presentation unfolded in the past. Results of this task are in a section 4.

3   Sampling Methodology

Data on the opinions of the learners about the implementation of the active learning methods were collected from learners in three consecutive semesters. Three groups with absolutely different profiles were enrolled in three entirely different courses on finance (referred as "FIR", "PFC", and "SFM") under the responsibility of the same tutor. While the elective cross-disciplinary course "SFM" was held in English with multicultural participants with different backgrounds and citizenships, the required courses FIR and PFC were held in Portuguese and the learners were basically Brazilians, either aiming a degree in international relations (the "FIR" group) or in business (the "PFC" group).

This section describes briefly the sampling procedure employed to evaluate the acceptance of both The QR Code Learning Method and the teamwork with the video. There was no formal assessment on the use of search engines in the learning environment. Section 4 presents the results and discussions.

3.1   Questionnaires on the acceptance of The QR Code Learning Method

The learners were asked to judge how proper or applicable were five statements. In the same sheet, there was also space for additional written comments. A translated version into English was provided for learners enrolled in the course that was not in Portuguese. Care was taken to apply the same structure and especially to keep the same meaning.

In the day of the first exam in the middle of each semester, the learners were asked to anonymously answer the questionnaires immediately before receiving the exam questions. In such a presumably stressful moment for the learners, there was an opportunity to collect the highest number of answers to the questionnaires (in average 63 replies in each semester) and also to somehow allow the impact of perceived level of preparation to take the exam upon the

answers to the questionnaires, since insecurity may convert into insatisfaction. Such impact was investigated by asking the three different groups in the first semester 2018 to answer the same questionnaire one month later, after the first exam and the disclosure of the grades.

When contrasting results from questionnaires answered in different semesters by learners enrolled in the same course, the analysed replies are those given by a broad turnout in the most stressful moment, i.e. straight before the beginning of the first exam of the course. These moments will be referred as 12018 and 22018 (first and second semester in the year 2018 respectively) and 12019 (first semester in the year 2019).

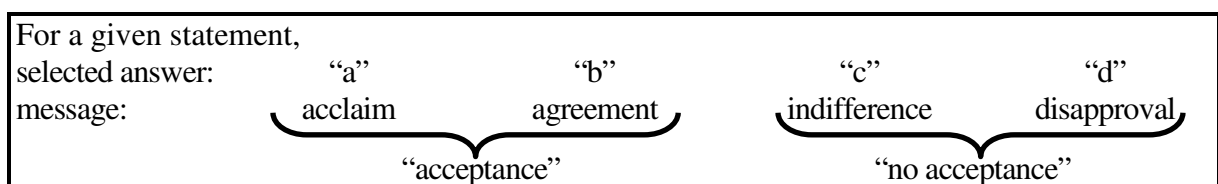### 3.2 *Obtaining feedback on the experience of producing videos in a teamwork*

The groups started to produce videos in the second semester in the year 2018 together with a written report. The assessment of the video experience occurred with a question in the exam, which also asked to list the members of the group. The question in the individual, written exam for each group of learners was: "*describe BRIEFLY one aspect and one challenge related to producing the video*". The goal of such question was to obtain a feedback on the opportunities and challenges to make the videos, besides being also a way to verify who indeed did participate together with the group. In the first semester 2019, there was a also multiple-choice question to quantify how the learners perceived as being beneficial the production of the video instead of an usual presentation with Microsoft Power Point slides.

4 Results and Discussions

This section brings results with discussions. The majority of the evidences are on the effectiveness of The QR Code Learning Method. Nevertheless, there is data evidencing the appropriateness of asking groups to produce videos together with written reports. There are also comments on the use of search engines as an useful active learning tool. Last but not least, this sections ends with notes on how these active learning techniques affect exams.

4.1 *Evidence on the effectiveness of The QR Code Learning Method*

Section 3 mentioned the use of questionnaires to assess the effectiveness of The QR Code Learning Method. For each statement, there were four possible alternatives (from "a" to "d"), allowing two different levels of acceptance ("a" and "b") or denial ("c" or "d") in order to deliberately oblige the learners to decide whether to either agree or disagree with the statement. Figure 4 display how the "degree of acceptance" for a statement was obtained.

For a given statement,

| selected answer: | "a" | "b" | "c" | "d" |
| message: | acclaim | agreement | indifference | disapproval |

"acceptance" "no acceptance"

The quantity of answers given to each item is used to compute:

$$\text{the degree of acceptance} = (\#a + \#b - \#c - \#d) / \#t$$

where "#a" is the quantity of answers given to "a" (for example) and "#t" is the total number of answers
the degree of acceptance ranges from -100% (if all answers select "d") to +100% (if all answers select "a").
Source: Authors

Figure 4   Sketch of the procedure to quantify the degree of acceptance

Without knowing how their answers would be computed, the learners were asked to analyse three statements on the utility of The QR Code Learning Method and two specific statements on the implementation of that method. These statements were mixed when listed in the questionnaire so as not to induce any answer. However, these two groups of statements are ordered separatedly in Table 1 with the results of the degree of acceptance.

Given that the degree of acceptance is a number which can range from -100% (if all answers select "d") to +100% (if all answers select "a"), all the positive and high results in Table 1 are a clear evidence that The QR Code Learning Method was considered to be useful and implemented adequately in all different groups during three semesters in a row.

Table 1   Degree of acceptance of The QR Code Learning Method in three courses

statements	FIR			PFC			SFM		
	FIR-12019	FIR-22018	FIR-12018	PFC-12019	PFC-22018	PFC-12018	SFM-12019	SFM-22018	SFM-12018
1	85%	100%	100%	48%	69%	87%	75%	80%	100%
2	54%	33%	87%	48%	8%	29%	75%	60%	44%
3	85%	78%	100%	65%	38%	61%	67%	53%	67%
4	54%	56%	100%	83%	85%	87%	92%	100%	67%
5	85%	78%	87%	74%	54%	61%	75%	47%	44%

Three statements on the utility of The QR Code Learning Method are:
1) The process of absorbing new information within the subject using surveys likely improved.
2) The interest in the topics of the subject DUE TO the use of surveys likely improved.
3) The study of this subject with the use of surveys likely improved.
Two specific statements on the implementation of The QR Code Learning Method
4) The quantity of questions at each meeting ("class") in average was likely suitable.
5) The wording (sentence style and terms employed) of the questions was likely good.
Source: Authors

Table 2 presents data to analyse how the results might change if the learners reply the same questionnaire immediately before and about four weeks after an exam, when the number of respondents is about 25% lower. The results tend to be higher after the exam, especially for the courses PFC and SFM, once the FIR group has high values in both cases.

Table 2   How the exam afected the degree of acceptance in the first semester 2018

statements	FIR-12018		PFC-12018		SFM-12018	
	exam day	weeks after	exam day	weeks after	exam day	weeks after
1	100%	100%	87%	92%	100%	100%
2	87%	40%	29%	68%	44%	57%
3	100%	100%	61%	84%	67%	86%
4	100%	80%	87%	92%	67%	86%
5	87%	60%	61%	52%	44%	71%

The five statements are the same as those listed with Table 1:
Source: Authors

Typically, more relaxed circumstances may eventually lead to more favorable opinions on both the utility and the implementation of The QR Code Learning Method. Thus, the data shown in Table 1 may reliably and conservatively represent both the utility and the implementation of The QR Code Learning Method.

Basically all questions were conceived in the first semester 2018, although in the following semesters a couple of questions (few) were rephrased and ultimately some new questions were formulated without any abrupt change. The tutor responsible for the three courses reports that the enthousiasm when using the method with the learners was basically the same during all semesters with all groups. Nevertheless, the tutor's excitement could have been "*more apparent*" in the first semester 2018, involuntarily reducing thereafter. The groups may have felt this unconscious behaviour of the tutor, which could explain why the degree of acceptance tended to decay with time, according to Table 1, but always remaining positive.

The high results on the utility of The QR Code Learning Method do evidence that the method consistently improves both the learning of and interest in the subject of the three different courses, besides increasing pleasure to be in a dynamic learning environment and

"*having fun*", as reported by some learners. There is a steady great acceptance with no significant rejection to applying the "new" method. The results are in harmony with the "*Peer Instruction*" findings: "*The convince-your-neighbours discussions break the unavoidable monotony of passive lecturing, and, more important, the students do not merely assimilate the material presented to them; they must think for themselves and put their thoughts into words*". (Mazur, 1997, page 14). The use of surveys improve the study of the subject due to an increase of the available material to study (which in turn will prepare the learner to take the exams). A higher interest in the subject may enhance the willingness to study.

The quantity of surveys per meeting does not really seem to influence satisfaction, since in some groups the number of questions is clearly higher without necessarily increasing satisfaction compared to other groups with less questions per meeting (about two questions). Crucial is the content and the quality of the surveys leading to an useful debate.

The wording (sentence style and terms employed) of the questions was a more disputable issue, since multiple-choice questions can intentionally be misleading but some might involuntarily be awkwardly and clumsily framed. Thus, there were indeed complaints on the way some questions were formulated in Portuguese (FIR and PFC) and in English (the SFM group) too, but the learners accepted that they must get habituated to the fact that multiple choice questions deliberately trigger uncertainty and uneasiness, when employing such words as: "likely" and "usually". The experience in dealing with multiple-choice questions is useful because several tests using such style of questions are required to who wants to become a charterholder or to gain an internship or a job on finance. Therefore, business schools should prepare learners to be familiar with multiple-choice questions.

The use of surveys with QR Code benefits learners	The use of surveys with QR Code benefits tutors
likely higher attention to the concepts & discussions	possibility to emphasize previously presented topics
more material to study in order to take the exam	the surveys may bring new ideas and extra details
shy participants are encouraged to participate	assess how ALL learners are following the debates
interaction with classmates when answering the survey	prepare learners to accept multiple choice exams
self-identification of one's rank in the class	easier to develop exams and to justify the grades

Source: Authors

Figure 5   Main benefits for learners and tutors using The QR Code Learning Method

While Figure 5 brings a summary of the main benefits for learners and tutors using The QR Code Learning Method, below are some lessons from the experience in using this method:

- A tutor may also use a Microsoft PowerPoint slide which has only a big QR Code picture in the screen so that everyone in a big room can capture the QR Code.
- Some learners actually do type the internet address instead of using QR Code, being hence useful that the corresponding internet link is displayed jointly with the QR Code.
- Use only one question for each QR Code.
- Interleave the questions with other activities during a class, avoiding the discussion of a batch of questions (no more than ten), recalling the relevance of the debate.
- The correct alternative should be presented immediately after showing the results of the survey and the failure of all the other alternatives should be explained with care.
- It is not recommended to send (i.e. e-mail) beforehand the questions as homework

Last but not least, learners may later use SurveyMonkey (or Google Forms) for professional activities, because the use of The QR Code Learning Method may stir the curiosity to apply QR Codes in other business activities within a customer-focused company, willing to assess customer needs and satisfaction, to establish supplier demands and complaints, and to help managers understand market trends, for example.

4.2 Evidence on the validity of the teamwork assignment to make videos

In the second semester 2018, learners enrolled in the three courses (FIR, PFC and SFM) wrote several comments on their apparently first experience on producing videos as a teamwork assignment within a course. Nevertheless, the SFM-12019 group will only produce a video at the end of this first semester 2019, while the FIR-12019 and PFC-12019 groups have already produced a video within a work assignment due April 2019. Thus, there is a relevant difference between the group SFM-12019 and the other two groups (FIR-12019 and PFC-12019). The statements collected with the SFM-12019 group actually convey expectations (including fears), whereas the results from all the other groups are influenced by their experience in producing a video. A quantitative assessment occurred only in April 2019, not in the second semester 2018. The results of the degree of acceptance of the benefits of the teamwork to make videos in addition to delivering a report is shown in Table 3 with the degree of acceptance calculated by using the procedure explained with Figure 4.

Table 3   Degree of acceptance for producing videos in a teamwork (April 2019)

	FIR	PFC	SFM
Source: Authors	85%	57%	70%

The results in Table 3 are positive, high, and quite close to those values for statement 1 in Table 1. It is even remarkable to note that the group FIR presents the higher and the group PFC the lower degree of acceptance, albeit these results are from two completely different learning methods. There is again an evidence that active learning methods are praised by learners as being useful.

Even if the learners generally identified benefits in producing videos, including "*learning more*", "*having fun*", "*exchanging ideas*", and "*being prepared for future professional activities*", several learners in the SFM-12019 group frankly expressed in the questionnaires their concerns, even before producing any video, by writing statements such as:

- *There are always some members in a teamwork who do not work.*
- *It is really complicate to meet each other as we live in different places and many of us really have a different schedule.*
- *Some of us do not have the time to carry out the teamwork, since some of us are busy in our jobs or with other academic assigments.*
- *I don´t think everybody has time to record and edit a movie, and a Power Point presentation is produced more quickly.*
- *It´s harder to make a good vídeo than a good presentation.*
- *We need help to produce the video, because I don´t know how to do it, and it could be very hard and time consuming.*

These concerns are not exactly the challenges actually reported by learners in groups that had produced videos (including SFM-22018). Although some issues listed above would be mentioned, the challenges faced by the groups after producing videos were rather:

- *select and establish the relevant content to present within the available, short time.*
- *have the insight on how to expose the ideas in the video.*
- *define a train of thought to present the content and arguments in a short period of time.*
- *prepare and edit a video with creativity (rather than just producing a simple video).*
- *deliver a dinamic and funny video that at the same time conveys information.*
- *how to research and get information to carry out the teamwork.*
- *overcome being shy in front of a camera, also due to the unfamiliarty with this task.*
- *speak naturally, lively, and respecting the division of the task between the members.*
- *understand that the video presents ideas differently than a written report.*
- *more rehearsal before recording the video.*

Therefore, the contrast between the expectations reported by those who will still produce a video and the reality experienced by those who already produced a video shows how this task is really important, because the learners might be surprised with their accomplishment, even if the work is eventually more demanding than a Power Point presentation precisely because producing a video is a new activity, requires a different time management, and triggers creativity and debate between the members of the group.

Some students even reported that they may produce and edit the video by using the web, including recurring to a videoconference, which completely eliminates the argument about "*the difficulty to meet each other as we live in different places and many of us really have a different schedule*". Actually, several learners express in the questionnaires a certain insatisfaction with the result of their video rather than with the assignment. A certain "*guilt*" or "*regret*" for not being able to produce a "*better*" video may explain why the numbers for the degree of acceptance for producing videos in a teamwork were lower than perhaps they should have been, considering the amazing learning accomplishment, as reported above.

4.3 *Evidence on search engine being useful as an active learning tool*

No formal assessment is available on learners' opinion or acceptance about assessing search engines to find websites with information on topics being discussed in the learning environment. However, the process of using Google to find links to sites with content that illustrate an explanation has become so natural and frequent in all groups that spontaneously several learners feel free to directly report information found in websites, even without being explicitly asked. This procedure has also shown to be somehow "*contagious*". After a participant mentions a fact found with a research using either a personal laptop or a smartphone, other learners tend to follow the initiative. Thus, learners do like to use search engines in the learning environment to find information and contribute with ongoing debates.

4.4 *Exams change with The QR Code Learning Method*

The questions used in the learning environment with The QR Code Learning Method may be directly employed in exams, when grades are awarded, recalling the relevance to separate the learning process from the grading process (as discussed in the section 2.4). In order not to have exactly the same questions, small modifications and adjustments are recommended and easily carried out. Nevertheless, the QR Code Learning Method together with other active learning methods should indeed change the way that questions for exams are formulated so as to also capture the discussion related to those questions and issues previously debated.
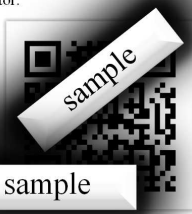

Figure 6   Slide of a survey using QR Code and related questions in an exam

Figure 6 shows examples of exam questions stemming from a single question with QR Code (see Figure 3). The three types of questions shown in Figure 6 require a written answer and make students retrieve more information on the issue than in an ordinary multiple-choice question, but the additional information was presumably debated with the group. Thus, the questions may become harder to answer. Even if the learner may recall verbatim a question with QR Code, she or he will still have to retrieve more information to answer the question.

The grading process may consist of giving a number of points for partially or totally answering each question or filling a blank space (say, 3 points, if perfect; 2 points if acceptable; and 1 point if inaccurate). The sum of all points is then multiplied by a selected factor in order to find the final grade. As an example, if a learner gets 50 points and the factor is 0,15, the final grade is 7,50 (=50*0,15). The tutor may actually adjust the factor to fairly "*fine-tune*" (increase or reduce) the class average. The higher the maximum number of points, the better should be the grade distribution in the class and, hence, the assessment is more fair.

Indeed, with the implementation of this procedure, complaints were basically eliminated, because any student would have great difficulty in arguing that the grading process was not fair and that the exam partially or in whole covered material that was not discussed with the class. Thus, the tutor should grade the exams more quickly and even in a more equitable way.

5   Final messages and thoughts

This work reports three active learning methods which are already being used for being appropriate in a business school willing to develop its learners' skills to carry out their professional activities as a corporate executive, an entrepreneur or self-employed practitioneers. Thus, active learning strives to bolster learning retention and dynamic participation by privileging actively doing rather than passively receiving.

The results gathered and presented in this work are very encouraging to point out that it is indeed feasible and effective to develop active learning activities with mobile devices, including tablets and specially smartphones, in order to acess search engines, join QR Code surveys, and produce videos. This statement overruns the previous established paradigm that would stress that mobile devices would be harmful in a classroom and should be strictly forbidden under all circumstances (Figure 1). However, the reader may agree that "*The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgment leading to that decision involves the comparison of both paradigms with nature and with each other*" (Kuhn, 2012, chapter VIII, pg. 78).

Not only the learning environment but also academic and professional conferences might change with the procedures previously described. There might be no more tolerance for a boring presentation, just replicating what is written in reports and books. Technology can (and should) influence the lecturer's (or speaker's) way of transmitting facts, information, and concepts. The role of the former traditional lecturer or speaker should become the role of a mediator or facilitator of discussions amid an interactive environment.

The effectiveness of employing mobile devices to actively enhance the learning process in the learning environment will likely affect textbooks, recalling Kuhn's prognosis that if "*each scientific revolution alters the historical perspective of the community that experiences it, then that change of perspective should affect the structure of post-revolutionary textbooks and research publications*" (Kuhn, 2012, preface, pg. xliii). Therefore, this work may be useful to motivate other research groups to further investigate the reported findings, suggest other methodologies, applications and material to be used with learners, and disclose if, when, and how active learning with smartphones is effective in other courses and settings (i.e. different countries) and in other fields of knowledge (beyond finance).

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