Best of The Netherlands: Reinforcing Accounting

Reinforcing Accounting: A Case Study on using M-Learning in a Technology-Enhanced Bachelor Course

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Abstract: In this study we investigate the use of an interactive mobile application aimed to engage students, stimulate reinforcement of the learned material, and thereby increase performance in a large scale undergraduate Accounting course. Via the app, students are prompted to answer questions connected to the course content throughout the course. The design combines several experimental conditions to investigate optimal implementation in terms of usage and the relation with course grade. Initial results show that presenting students with the possibility to compare their performance to peers stimulates student engagement and there is a positive relation between course grades and total number of completed prompts.

Introduction

The past decades, a complex of related factors (e.g., rapid changes in the labor market (and the resulting demands on the workforce), decrease in the half-life of knowledge, increased mobility, rapid ICT development, increase in student numbers, increase in internationalization) led to an increased demand for Higher Education (HE) to become more flexible, responsive, and student-centered (c.f., Gaebel, Zhang, Bunescu, & Stoeber, 2018). For example, increasing student numbers in HE, especially in the domains social sciences, journalism, information, business, administration or law (EUROSTAT, 2018) poses a challenge to provide individual feedback, which is perceived as essential for learning (Hattie, 2007). These challenges are no different for Business and Management education (BME). Moreover, BME is specifically called to more efficiently and effectively educate the future industry leaders (Ayling, Price, Tucker, & Vellner, 2015), which, in the wake of the last economic crisis, is especially true for quantitative areas such as accounting (Cameron, et. al., 2015).

Accounting is a central field taught in any business and management Bachelor curriculum, and it faces yet an additional challenge to engage large groups of students and help them truly understand the systematic build of accounting: it is often perceived as trivial and boring (Stivers & Onifade, 2014). By combining insights from cognitive psychology on improving education with the affordances of ICT in the form of mobile learning, the current study aims to improve a large-scale Bachelor level accounting course in terms of student engagement and performance.

Enhancing Accounting Education

A shared understanding of the three main educational paradigms (behaviorism, cognitivism and constructivism) is that learning is a persistent change in human performance or performance potential through interaction with the environment (Driscoll, 1994). Effective learning occurs in context, is active, social, and reflective (Driscoll, 2002), to which more passive ways of providing education, like the traditional lecture, are less beneficial. For example, a robust meta-analysis by Freeman et al. (2014) on the effectiveness of lecturing in science convincingly shows '...average examination scores improved by about 6% in active learning sections, and that students in classes with traditional lecturing were 1.5 times more likely to fail than were students in classes with active learning.' (p. 8410). This is supported by studies in other disciplines like physics and medicine indicating that active learning leads to better results, less dropout, higher passing rates and student-satisfaction (e.g., Deslauriers, Schelew, & Wieman, 2011; Schmidt, Wagener, Smeets, Keemink, & van der Molen, 2015).

Though the lecture still has a prominent role when teaching large groups (most likely to contain the expense of delivery), recent years show an increase in pedagogical approaches that can remediate the challenge of scale such as flipped classroom and blended learning, mostly enhanced by the affordances of technology (DeLozier & Rhodes, 2016; Spanjers, et al., 2015; Gaebel, et al., 2018). However, choosing the ´right´ pedagogical approach to accommodate large scale teaching is difficult as flipped classroom, blended learning, and technology-enhanced learning are umbrella terms encompassing a wide variety of implementations (DeLozier & Rhodes, 2016; Spanjers, et al., 2015, Kirkwood & Price, 2014). Even though Accounting as a field has one of the most prolific histories in educational research (Arbaugh & Hwang, 2015; Arbaugh, Asarta, Hwang, Fornaciari, Bento, & Dean, 2017), an elaborate analysis of 20 years of research published in 299 issues of six journals on accounting education (Apostolou, Dorminey, Hassell, & Rebele, 2017) showed the focus to be as diverse as curriculum issues (28 %), content (14 %), educational technology (10 %), students (31 %), and faculty (17 %). Nonetheless, broadening our scope to the learning sciences provides insights that can help to improve educational quality, even in a large scale context.

Building on insights provided by Dunlosky, Rawson, Marsh, Nathan, and Willingham (2013) on the most effective common techniques for learning and instruction, Roediger III and Pyc (2012) recommend three general principles. First, distributed practice, or spacing learning over time, enhances the integration of newly learned knowledge and skills into existing schemata and thereby long term retention. Second, retrieval practice (self-testing) stimulates durable learning. Both techniques can be implemented using aids such as flashcards. The third and last recommended technique is explanatory questioning in the form of self-explanation or elaborative interrogation (asking questions like e.g., 'Why?'; 'Which elements of what I read are new?'; 'How does this new topic relate to the previous?'). All three techniques are active approaches to studying that students can incorporate themselves or be prompted to. However, the latter requires students to be able to steer their own learning, for which offering a clear structure and autonomy support are crucial factors. As our context is set in large scale accounting education where students enjoy much freedom in planning their studies and class attendance is not mandatory, we were looking for a way to enhance student engagement and stimulate performance that fit these conditions as well as the target audience.

Mobile Learning

As a significant part of students' learning processes in our context takes place outside the classroom, we aimed to find technology to apply the techniques that Roediger III and Pyc (2012) recommend in- and out of class. A possible solution that fits the requirements mentioned above is to incorporate mobile learning or m-learning. Though little accounting education research focuses on the implementation of m-learning, the use of 'personal electronic devices' such as smartphones for learning is widespread, has been found to fit current societal needs, and enhances student motivation as well as satisfaction with learning content (Jeno, Ardachi, Grytnes, Vandvik, & Deci, 2018; Sabah, 2016). It is important to realize that technology such as m-learning by itself are not a panacea but foremost a means to an end of which its effectiveness is determined by multiple factors including context and content. Therefore, and as brought forward by Kirkwood and Price (2014), the most relevant question is how technology can be implemented in a way that it enhances learning. Nonetheless, several factors that determine students' intention to use m-learning when it is offered are well researched. Taking a Technology Acceptance Model

(Davis, 1989) approach, a meta-analysis by Sabah (2016) shows that, next to perceived ease of use and perceived usefulness, the intention to use m-learning strongly relates to social influences in the form of peer perception (especially for younger students). First and foremost, we searched for a mobile applications that fit our needs, which was found in the form of Mindmarker; a mobile app aimed to reinforce learning by regularly prompting students with questions and allows for comparison to peers via a leaderboard.

The Present Study

The current study took place in a large scale Financial Accounting course as part of the third year Bachelor curriculum of a large business school in Western Europe. The Mindmarker app was used as a technological enhancement of the course. Further details regarding the specific design and implementation are provided below.

The effectiveness of the enhancement was evaluated by taking a multi-method approach combining course evaluations, student performance, and app usage data. The evaluation was aimed at the following aspects:

- How do students use the app? More specifically, does the timing of the prompts, the opportunity to compare one's performance to peers and the use of an interleaved learning approach (i.e., weekly prompts including questions on multiple topics) as opposed to a blocked learning approach (i.e., weekly prompts including questions on a single topic) matter for completion level (as defined by the total number of mindmarkers completed)?
- How is training with mindmarker prompts related to the course grade? More specifically, does the timing of the prompts, the opportunity to compare one's performance to peers and the use of an interleaved learning approach (i.e., weekly prompts including questions on multiple topics) as opposed to a blocked learning approach (i.e., weekly prompts including questions on a single topic) matter for the course grade?

Method

Tool Description

Mindmarker is an online training reinforcement tool in the form of a mobile app that activates learners by sending prompts at predetermined times during and/or after a formal training program. A prompt (or mindmarker) can be anything from a reminder to a question regarding course content, by itself or presented in a real-life context. By combining this main feature with a leaderboard containing statistics on one's usage and performance compared to others, it empowers a learner to practice meaningfully, reflect on, and steer, their learning process.

Participants and Design

In total, approximately 1000 students participated in the course. One week before the start of the course, the course coordinators sent a message via the university's general learning management system informing students about the Mindmarker app and details related to its use in the course. To encourage collaboration, all the students in the course were randomly allocated to a Mindmarker team but all students could fill in their answers individually in the Mindmarker app. In total there were 237 Mindmarker teams and most of them had four students each. Occasionally, teams with five members were allowed to accommodate late enrollments in the course. Via the app the students would receive weekly quizzes with three multiple-choice questions and an open question. To motivate students to engage with the app, they were informed that some questions were taken from previous exams. Students were advised to answer the Mindmarker quiz questions correctly and fast as both aspects would allow teams to collect points. Furthermore, the course coordinators offered a surprise prize (e.g., a boat ride around a local river) for the team with the highest score at the end of the course. The course coordinators also specifically mentioned that using the app was voluntary, it did not count for the grade of the course, and students could always decide to stop using it. Students received login details via their individual emails.

The experimental design involved three conditions: the prompt-day condition (i.e., the teams receive the quiz before the lecture and workshop, after the lecture but before the workshop and after the lecture and workshop), the interleaved learning condition (i.e., interleaved learning versus blocked learning) and the leaderboard condition (i.e., with leaderboard versus no leaderboard). In total there were 12 distinct experimental groups. There were eight quizzes in total spanning eight course weeks. Each quiz contained three multiple-choice questions and one open question (e.g., “Why is the lower cost or net realizable value used to value inventories?”), hence each quiz contained four mindmarkers. The quiz questions referred to eight financial accounting topics: financial statements; inventory; property, plant and equipment; intangibles; investments; liabilities; equity and financial statement analysis. The quizzes were sent at the same time of the day for all groups. In the interleaved learning condition students received quizzes with questions from different topics. For example, the interleaved learning experimental groups would receive a quiz with two multiple-choice questions from topic one and one multiple-choice question from topic four as in table 1. The open questions were the same for the interleaved learning condition and the blocked learning condition.

MC question from	Week 1	Week 2	Week 3	Week 4
Topic	1	2	3	4
Topic	1	2	3	4
Topic	4	1	2	3

Table 1: Allocation of MC questions for the first four weeks under the interleaved learning condition

The leader board was sent via a separate mindmarker message to all the students in the “with leaderboard” condition. More specifically, the following information was presented to the students in the “with leaderboard” condition: a ranking with the winning team on top of the ranking, the team number and the total points of the team.

Results

Tool Usage

Figure 1 presents the number of students that used the app over the eight week period. Although the app was introduced in the course with the goal of having students rehearse financial accounting topics regularly between the weeks, the data shows a sharp drop in the use of the app after the first week of the course. The number 361 shows the total number of students that initially self-enrolled to use the app but some never actually used it. Not even the presence of a midterm exam after week four or the presence of an exam after week eight managed to increase the use of the app. From these descriptives it cannot be disentangled weather the characteristics of the app (e.g., ease of use), the characteristics of the questions (e.g., difficulty of questions, perceived usefulness of the questions as an exam study aid) or the topic itself (e.g., financial accounting topics) caused the sharp drop in the number of students using the app.

Next, it is interesting to see if the experimental conditions influenced the use of the app. A descriptive analysis of completed mindmarkers divided per prompt-day, per interleaved learning and per leaderboard condition (Figure 2.) indicates that the day when mindmarkers are sent to students or weather the questions contained interleaved practice or blocked learning practice does not matter for the completion level of the mindmarkers. Conversely, it appears that presenting students with a leaderboard where they can see how their team is doing compared to peers seems to slightly improve the completion level of the mindmarkers.

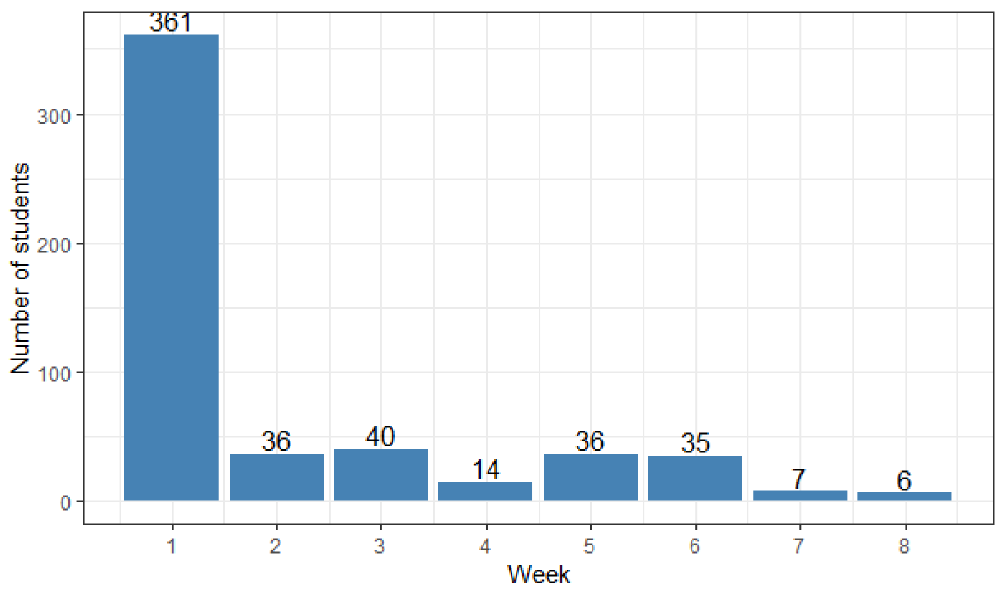

Figure 1: Number of students per week

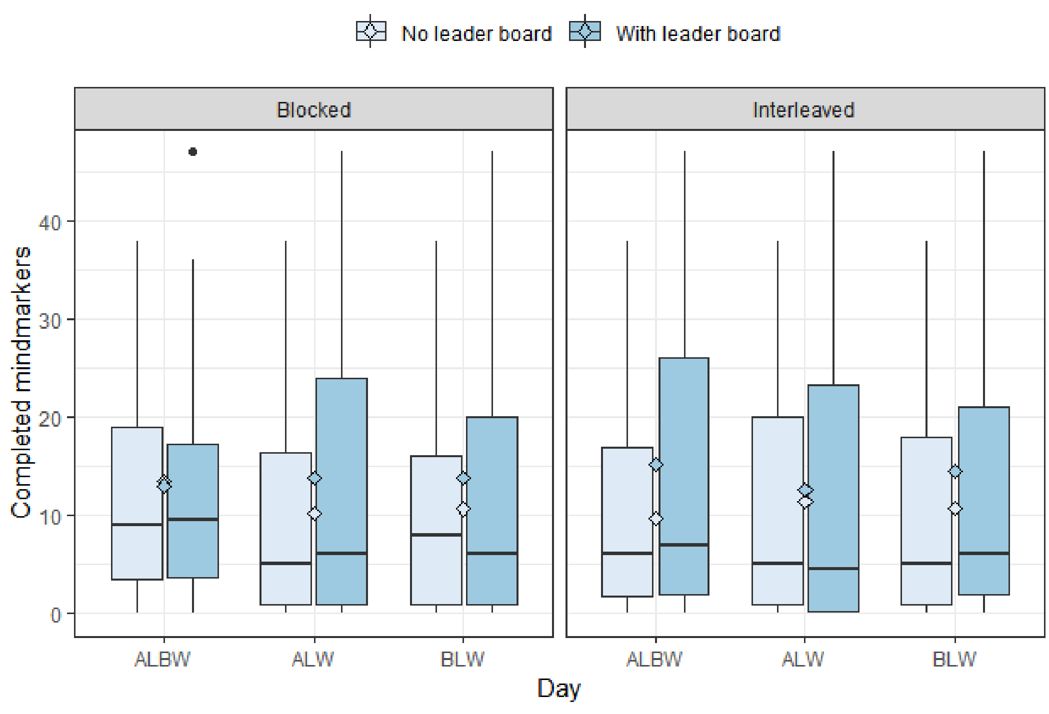

Figure 2: Completed Mindmarkers for the three conditions: the prompt-day condition (i.e., the teams receive the quiz before the lecture and workshop - BLW, after the lecture but before the workshop - ALBW - and after the lecture and workshop - ALW), the interleaved learning condition (i.e., interleaved learning versus blocked learning) and the leaderboard condition (i.e., with leaderboard versus no leaderboard)

Relation to the Course Grade

Figure 3 presents a positive correlation between course grades and the total number of completed mindmarkers. The descriptive results indicate that students who complete more mindmakers have higher course grades. In terms of magnitude, the regression coefficient is 0.02 ($t = 4.20$). If a student completed ten mindmarkers, his course grade would increase from an average of 6.6 to a 6.8 (on a scale from 1 to 10), while if the student would have completed all the 32 mindmarkers, his course grade would increase from an average of 6.6 to approximately 7.2. Of course, the big disadvantage of this correlation analysis is that it is missing information on the prior performance of students as it is likely that more motivated students would both complete more mindmarkers and score higher grades.

The descriptive statistics of the grades for each experimental condition combination are presented in table 2. Although no distinct pattern is emerging from the descriptives statistics, a visual analysis of the results shows that students who practice with interleaved learning have slightly higher grades than participants that experience blocked practice and students that received the mindmarkers after the lecture but before the workshops have on average higher grades than the other two groups of students, that received the mindmarkers before the lecture and workshops or after the lectures and workshops. Students that received interleaved mindmarkers and a leaderboard had a slightly higher average grade that students with blocked practice and no leaderboard. Untabulated t-test and anova results show no statistical significance difference between any of the groups.

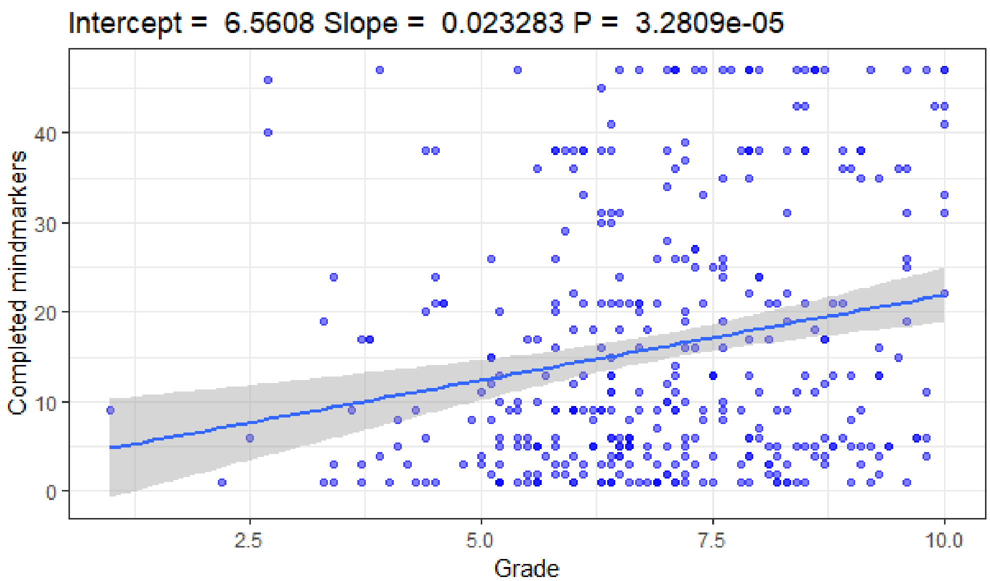

Figure 3: Correlation between course grades and completed mindmarkers

Group	Leaderboard	Interleaved	Prompt	Count	Mean *(SD)*	Range
1	Yes	No	ALBW	33	7.4 *(1.4)*	4.4 - 9.6
2	Yes	Yes	ALBW	32	7.0 *(1.6)*	3.8 - 10
3	Yes	No	ALW	26	6.6 *(1.5)*	3.3 - 9.4
4	Yes	Yes	ALW	30	7.0 *(1.5)*	2.2 - 9.0
5	Yes	No	BLW	38	6.7 *(1.9)*	1.0 - 9.6
6	Yes	Yes	BLW	37	6.9 *(1.4)*	3.6 - 9.6
7	No	No	ALBW	35	6.5 *(1.6)*	2.5 - 9.8
8	No	Yes	ALBW	45	7.2 *(1.9)*	2.7 - 10
9	No	No	ALW	31	6.9 *(1.7)*	2.7 - 10
10	No	Yes	ALW	24	6.9 *(1.8)*	3.8 - 10
11	No	No	BLW	26	6.8 *(1.4)*	3.7 - 9.9
12	No	Yes	BLW	27	7.2 *(1.6)*	4.2 - 10

Table 2: Descriptive statistics of the grades for the three conditions: the prompt-day condition (i.e., the teams receive the quiz before the lecture and workshop - BLW, after the lecture but before the workshop - ALBW - and

after the lecture and workshop - ALW), the interleaved learning condition (i.e., interleaved learning versus blocked learning) and the leaderboard condition (i.e., with leaderboard versus no leaderboard).

Conclusion and Discussion

The Mindmarker app was introduced in a large scale accounting course with the purpose of encouraging students to practice with course topics regularly rather than engaging with the topic just before the exam. Enhancing the course with an app was seen as a suitable intervention that would also allow the course instructors to engage the students that were not regularly frequenting the large scale lectures. The questions included in the app (the mindmarkers) were purposefully few (four mindmarkers per week) as to not discourage students from using the app. Several experimental conditions were designed to investigate optimal implementation in terms of usage and the relation with course grade. Although not conclusive, initial results show that students should be presented with a leaderboard as this relative performance evaluation artifact motivates them to complete more mindmarkers. Additionally, students that received mindmarkers that employ an interleaved learning approach where questions from different topics are mixed do benefit slightly more in terms of grade than students that received mindmarkers with blocked practice. As such, if the app is used to deliver reinforcement on three topics on three separate delivery moments then the first mindmarker delivered should include questions from topics one, two and three instead of only questions from topic one. The positive correlation between course grades and total number of completed mindmarkes indicates that it is beneficial to receive four weekly questions via the Mindmarker app in a course that spans over eight weeks.

The current study could have benefited from a broader but invasive data collection that would contain student demographic and past performance data. This would allow for the formulation of a clearer conclusion on the actual effect of the mindmarkers on course grades. Supplementary, questionnaire data on the app user experience is missing in the current study but such information could clarify if the app characteristics, the topic characteristics or the questions characteristics influence the use of the app. Unfortunately, despite running the current study in a large scale course, the voluntary use of the app dictated by the ethical considerations of the study, does not allow us to draw conclusions on a bigger sample as the majority of students did not use the app. Still, this can constitute a result in and of itself as it shows that mobile enhancements of courses are not always successful with students of large scale courses.

References

Apostolou, B., Dorminey, J.W., Hassell, J.M., & Rebele, J.E. (2017). Accounting education literature review (2017), *Journal of Accounting Education,* 43, 1-23.

Ayling, A., Price, M., Tucker, B., & Vellner, T. (2015). *Business Education Jam: Envisioning the Future.* Questrom School of Business, Boston, MA..

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.

DeLozier, S.J., & Rhodes, M.G. (2016). Flipped Classrooms: a Review of Key Ideas and Recommendations for Practice. *Educational Psychology Review*, 29(1), 141-151.

DesLauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large-enrollment physics class. *Science*, 332, 862-864.

Driscoll, M. P. (1994). *Psychology of learning for instruction*. Needham, Ma: Allyn & Bacon.

Driscoll, M. P. (2002). How people learn (and what technology might have to do with It). ERIC Digest, Syracuse, NY.

Dunlosky, J., Rawson, K.A., Marsh, E.J., Nathan, M.J., & Willingham, D.T. (2013). Improving Students' Learning With Effective Learning Techniques: Promising Directions From Cognitive and Educational Psychology. *Psychological Science in the Public Interest*, 14(1), 4–58.

EUROSTAT (2018). *Tertiary Education Statistics*. Brussels, Belgium.

Freeman, S., Eddy, S.L., McDonough, M., Smith, M.K., Okoroafor, N., Jordt, H., & Wenderoth, M.P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23), 8410-8415.

Gaebel, M., Zhang, T., Bunescu, L., & Stoeber, H. (2018). *Trends 2018: Learning and teaching in the European Higher Education Area*. European University Association (EUA), Brussels, Belgium.

Hattie, J., & Timperley, H. (2007). The Power of Feedback. *Review of Educational Research*, 77(1), 81-112.

Jeno, L.M., Grytnes, J-A., Vandvik, V., Deci, E.L. (2018). The effects of m-learning on motivation, achievement and well-being: A Self-Determination Theory approach. *British Journal of Educational Technology*, 50(2), 669-683.

Kirkwood, Adrian and Price, Linda (2014). Technology-enhanced learning and teaching in higher education: what is ‘enhanced’ and how do we know? A critical literature review. *Learning, Media and Technology*, 39(1), 6–36.

Orphanides, A. G. (2012). Challenges in European higher education. *Higher Learning Research Communications*, 2(2), 3-7.

Roediger III, H.L., & Pyc, M.A. (2012). Inexpensive techniques to improve education: Applying cognitive psychology to enhance educational practice, *Journal of Applied Research in Memory and Cognition*, 1(4), 242-248.

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory. basic psychological needs in motivation, development, and wellness*. New York: The Guilford Press.

Schmidt, H.G., Wagener, S.L., Smeets, G.A.C.M., Keemink, L.M., & van der Molen, H.T. (2015). On the Use and Misuse of Lectures in Higher Education. *Health Professions Education*, 1(1), 12-18.

Spanjers, I.A.E., Könings, K.D., Leppink J., Verstegen, D.M.L., de Jong, N., Czabanowska, K., & van Merriënboer, J.J.G. (2015). The promised land of blended learning: Quizzes as a Moderator. *Educational Research Review*, 15, 59-74.

Stivers, B. P., & Onifade, E. (2014). Student Perceptions of Introductory Accounting and the Accounting Profession. *Academy of Educational Leadership Journal*, 18(3), 49-59.