

**ASSESSING THE IMPACT OF MOBILE APPLICATIONS ON EDUCATIONAL COURSE
ASSESSMENT: A QUASI-EXPERIMENTAL STUDY**

Mr. Keyur Popat

Research Scholar, Atmiya University, Rajkot, Gujarat

Dr. Amit Rajdev

Associate Professor, Faculty of Management, RK University, Rajkot, Gujarat

Abstract:

In response to the emergence of new technologies, such as mobile applications, universities are recognizing the need to reconsider their educational strategies. While previous studies have primarily focused on the impact of mobile applications on student engagement in the classroom, limited research has been conducted on how these applications affect student assessment. This study utilizes a quasi-experimental approach to investigate the correlation between student assessment and the utilization of a mobile application. Two groups of students, a control group and an experimental group, were assessed during the same academic semester under the instruction of the same lecturer. The relationship was evaluated through two analyses: a t-test and a difference-in-differences analysis. Contrary to general expectations, the results indicate that there is no significant difference in assessment scores between the two groups. However, students demonstrated a positive attitude towards engaging with the mobile application. Although the use of mobile applications in classrooms has increased, this research suggests that they should be regarded as a supplementary tool to traditional education rather than a replacement for it.

Keywords: Higher Education, Google Classroom, Assessment, Student Response Systems, Teaching and Learning, M-learning, Mobile Application

1. Introduction:

Universities are currently grappling with the need to reconsider their educational strategies in response to the emergence of new technologies (Lucena, 2016; Riaz and Rodríguez, 2016). Among these technologies, mobile technology is increasingly being adopted in educational institutions, especially in higher education, with high expectations (see Balta et al., 2017). Mobile applications such as Google Classroom, Google Form, Flint.com, Socrative.com, remind.com, and Kahoot are prime examples. It exemplify the use of mobile technology, also known as m-learning development (Kokina and Juras, 2017; Onodipe, 2017; Zou and Lambert, 2017). These applications are employed in universities as Student Response Systems (SRS) (Lim, 2017; Onodipe, 2017; Zou and Lambert, 2017), "clickers" (Guarascio et al., 2017), and online homework platforms (Balta et al., 2017).

Numerous studies (e.g., Fotaris et al., 2016; Guarascio et al., 2017; Lim, 2017; Onodipe, 2017; Wuthisatian and Thanetsunthorn, 2019) have focused on assessing the impact of SRS usage on student engagement, with most of them revealing an increase in classroom motivation. However, there has been limited research investigating the relationship between the use of mobile applications and assessment. Arain et al. (2018), for instance, compared students' final exam scores between an experimental and a control group. Introducing such new technologies in the classroom necessitates additional efforts beyond traditional teaching methods (Savec et al., 2018; Sefo et al., 2017). Hence, it is crucial to analyze whether these new technologies result in improved student assessment outcomes. The present research aims to evaluate the effect of an SRS on assessment through a quasi-experimental study.

The structure of this paper is as follows: Sections 2 and 3 provide an overview of the main literature in this field; Section 4 outlines the context and design of the quasi-experiment; Section 5 presents the primary results;

Section 6 offers a discussion of the findings, and Section 7 presents the conclusions.

2. Literature Review:

The design and implementation of new teaching methodologies in universities are directly linked to the characteristics of students (Lim, 2017). Today's students largely belong to the Millennial generation, digital natives with multitasking abilities (Picault, 2019; Varela-Candamio et al., 2014). Millennials are constantly immersed in technology, seek immediate feedback (Montenery et al., 2013), and maintain continuous digital connectivity (Lim, 2017; Manning et al., 2017). Additionally, student engagement tends to decline as they progress to higher education levels (Anderson et al., 2019). The use of mobile learning (m-learning) applications, such as Student Response Systems (SRS), fosters increased student engagement (Guarascio et al., 2017; Kokina and Juras, 2017; Wuthisatian and Thanetsunthorn, 2019). These applications provide alternative means for students to express themselves beyond traditional SRS methods like oral question-and-answer reports or pen-and-paper questionnaires (Zou and Lambert, 2017).

Several SRS applications, including Socrative.com, remind.com, and Kahoot.it, have gained popularity (Kokina and Juras, 2017; Onodipe, 2017; Zou and Lambert, 2017). Socrative, in particular, has been widely accepted and utilized by teachers (Balta et al., 2017; Haintz and Ebner, 2014; Kokina and Juras, 2017). Socrative like google classroom serves as an SRS that facilitates engagement, assessment, and personalized learning experiences. Educators can employ formative assessments through quizzes, quick question polls, exit tickets, and space races using the Socrative Teacher app. The platform allows teachers to instantly grade, aggregate, and visualizes results, aiding in identifying opportunities for further instruction. Teachers create a Socrative Teacher account, while students can connect to their unique room via the Socrative app on various devices such as smartphones, tablets, and laptops (Balta et al., 2017).

Studies such as Guarascio et al. (2017) conducted surveys to compare student preferences for Socrative and traditional SRS methods, with students favoring Socrative due to its ability to enhance their classroom participation. Kokina and Juras (2017) also reported similar positive results for m-learning applications. Additionally, Zou and Lambert (2017) emphasized the positive reception of Socrative, as well as Today's Meet and Google Drive, in the classroom. However, these studies did not incorporate a control group for comparison. Fotaris et al. (2016) compared students and instructors over two consecutive years, utilizing m-learning technologies in one year but not the other, and found that the gamified approach mixed with m-technology applications motivated and enriched both students and instructors.

While previous examples demonstrate the positive effects of m-learning applications on engagement, there is limited research examining the relationship between m-learning applications and assessment. Quasi-experiments, which compare experimental/treatment groups with control groups, offer a means to evaluate this connection (Handley et al., 2018). Common methods to reduce bias in quasi-experiments include partially random assignment to treatment and control groups and ensuring the groups have similar characteristics before the experiment, minimizing differences in group composition. Golenhofen et al. (2019) attempted to measure the effect of an SRS (eMed-App) on assessment but did not include a control group. In a quasi-experiment by Arain et al. (2018), which employed a single-difference method, positive effects on assessment were observed when using a mobile learning app (Darsgah) in a Communication Skills course for engineers.

3. Linking Course Delivery and Assessment:

The elements of a course - learning outcomes, course delivery, and assessment - must align and be consistent with each other (Norton, 2009). Learning outcomes define the intended achievements of students (Prøitz,

2010), while course delivery encompasses various instructional techniques, such as lectures, active learning, and instructional technology (Felder and Brent, 2003; Lozano et al., 2015). Assessment is closely tied to predetermined learning objectives and the effective delivery of the course (Combs et al., 2008; Streveler et al., 2012). Changes in course delivery can potentially impact assessment outcomes (Balta et al., 2017).

Its main purposes include pedagogy, evaluating student knowledge and skills, standardization, and certifying achievement levels (Norton, 2009). Assessment involves reasoning about students' knowledge, abilities, and accomplishments based on their responses and performances in specific contexts (Mislevy et al., 2003). The assessment cycle involves the administrator and the participant, encompassing processes such as activity selection, presentation, response processing, and summary scoring (Almond et al., 2002). This paper specifically focuses on the connection between course delivery and assessment, particularly in relation to changes made in the course delivery and its potential impact on assessment outcomes.

4. Method:

The introductory course for Master of Business Administration students typically includes the learning of Fundamentals of Quantitative Techniques, which can be challenging due to the use of unfamiliar vocabulary and tools like mathematics, statistics and graphics. Teaching of the subject like this, in particular, relies on analytical models that require strong mathematical, statistical and analytical skills (Barnett, 2009). Traditional teaching methods often struggle to engage students, especially in subjects with a high level of difficulty (Fotaris et al., 2016). To address these challenges, a new course delivery approach was designed and implemented in an experimental group to observe its impact on assessment outcomes. The study was conducted during the second semester of the 2020-2021 academic year with students. The course was divided into two sections. Each section was taught by different instructors, and the examinations were conducted separately.

4.1. Course Objectives, Delivery, and Assessment

The course was structured with the four learning outcomes. The course covered fundamental concepts of Quantitative Techniques of Business Management, including correlation, regression, descriptive analysis and probability. The instructional sessions consisted of both theoretical and practical classes, involved traditional lectures.

Table 1: Learning Outcomes.

Learning Outcomes (LO):	Description:
LO 1:	To be familiar and able to discuss the general principles of Fundamental of Quantitative Techniques.
LO 2:	To understand the concept of Quantitative Analysis and its general features and principles.
LO 3:	To be aware of the links between Quantitative Methods and Business Statistical Analysis.
LO 4:	To be able to work with advance techniques, graphics and analytical texts related to topics taught during the course.

The practical classes aimed at enhancing student engagement and participation. In the morning group, interactions were emphasized as learner-content and learner-instructor. Meanwhile, the afternoon group utilized additional learner-instructor (providing instructions), and learner-interface with feedback. The

morning group followed a traditional approach, whereas the afternoon group employed Google Classroom an interactive learning platform.

Table 2: Interactions Types.

Class type	Control Group (FN)	Experimental Group (AN)
Theoretical classes	learner-instructor learner-content	learner-instructor learner-content
Practical classes	+ learner-learner (peer learnings)	+ instructor (just giving instructions) learner-interface interaction: Google Classroom

During the practical classes, students in both groups practiced multiple-choice questions to prepare for the final exam. While the questions were the same for both groups, different techniques were employed to cater to their respective learning environments. At the end of the semester, students were required to pass a multiple-choice test. Each question consisted of four potential answers, with only one being correct.

4.2. Experimental Design and Sample

This study employed a quasi-experimental design to assess the impact of a mobile learning (m-learning) application on students' performance in assessments. It is aimed to isolate the effects of using this new technology and employed the "double-difference" method to evaluate the instructional value added by the intervention. On the first day of class, a pre-test was conducted comprising eight questions related to key subject topics, such as Probability, Measures of Central Tendency, and Level of Data Measurement. The primary objective of this pre-test was to establish the average scores of the students before the course began.

Group assignments were based on students' last names. Switching between groups during the course was not permitted. The "treatment" or intervention involved using the Google Classroom platform and utilized an interactive response device to answer questions during practical classes. On the last day, both groups completed a simulation of the final exam, consisting of eight questions, following the same format as the actual final exam. The students were not informed in advance that they would be taking this mid-term exam.

Table 3 Part I. Quantitative, ICTs and time distribution.

Q. 1	I liked learning issues related with Macroeconomics.
Q. 2	I have regularly attended the theoretical classes in the Principles of Economics.
Q. 3	I like using new technologies (computer, mobile phone, etc.).
Q. 4	I believe that new technologies facilitate my learning.
Q. 5	I like using new technologies in the classroom.
Q. 6	We use new technologies (computer, Power Point, mobile phone, etc.) in other subjects in the classroom.
Q. 7	Time distribution: Indicate the hours you dedicate per week to the following activities: Social networks, Doing sport, Sleeping, Going out with friends, Doing private study (outside of class)

Additionally, all students completed a survey comprising two parts. The first part, completed by the entire

sample, focused on statements related to Quantitative Techniques, ICTs, and time distribution. Participants expressed their level of agreement or disagreement with each statement using a 5-point Likert scale, with 1 indicating strong disagreement and 5 indicating strong agreement. The primary objectives of this survey were to identify differences between the control and experimental groups and to understand their attitudes towards the topics under investigation.

Table 4 Part II. Google Classroom Questions

Q. 1	I liked Google Classroom. (Balta et al., 2017)
Q. 2	Google Classroom tool helps in learning material. (Kokina and Juras, 2017)
Q. 3	The usage of Google Classroom tool motivates me in my learning. (Lim, 2017)
Q. 4	The usage of Google Classroom tool encourages focusing. (Lim, 2017)
Q. 5	Google Classroom tool encourages to participation (Kokina and Juras, 2017)
Q. 6	Google Classroom is more fun than traditional methods (Zou Lambert, 2017)
Q. 7	Google Classroom is more stressful than traditional methods (Zou Lambert, 2017)
Q. 8	Satisfied with the usage of Google Classroom tool in my classroom. (Lim, 2017)
Q.9	Socrative should be used when teaching other subjects also. (Balta et al., 2017)

The second part of the survey focused solely on the experimental group and focus on Google Classroom-related questions. These questions were derived similar from previous literatures.

The final sample consisted of 80 students, who met the criteria to ensure consistency across all tests in both groups like enrolment in the course for the first time, agreement to take the pre-test, attendance of practical lessons, completion of the mid-term exam, participation in the survey, and completion of the final test. Consequently, the sample comprised a control group (CG) of 42 students (24 females) attending morning classes and an experimental group (EG) of 38 students (19 females) attending afternoon classes. There were no significant differences observed in the demographic characteristics of interest between these two groups.

4.3. Data Analysis

The data analysis involved several quantitative techniques: Firstly, a t-test for Equality of Means was conducted to identify statistically significant differences in the pre-test, mid-term review, and final test scores between the two groups. Secondly, a difference-in-differences (DD) analysis, also known as the "double-difference" method, was performed. This analysis compared the changes in results over time between the experimental and control groups to estimate the impact of the treatment, which in this case was the use of Google Classroom as a Student Response System (SRS). By applying the DD analysis, the initial differences in results between the two groups at the beginning of the course were taken into account and eliminated (White and Sabarwal, 2014; Pomeranz, 2011). Lastly, a complementary analysis was conducted using the survey results to examine. This analysis aimed to gain insights into their attitudes and opinions regarding these topics.

4.4. Limitations of the Methods: Reliability and Validity

This research is subject to certain limitations that need to be acknowledged. When designing a quasi-experimental study with students, several barriers may arise. Firstly, it is crucial to ensure that the research is designed to minimize potential biases by incorporating a control group and an experimental group, while also maintaining equitable treatment of students. To address this, average scores were measured for both groups

before the course began to prevent comparisons between heterogeneous groups. The quasi-experiment was specifically designed to isolate the effects of using the new technology and solely test the value added by the instructional intervention.

Multiple-choice questions were utilized in all tests to obtain objective results. While this approach provides objectivity, a more comprehensive evaluation method could provide additional insights into students' actual skills and knowledge. The lecturer's attitude towards the m-learning application may influence the students' perception and engagement with this new learning method. Some challenges were encountered in using online platform, such as issues with Wi-Fi connectivity and limited storage space on mobile phones to download the application. However, these obstacles were addressed by providing alternative solutions, such as lending laptops to students.

5. Results

5.1. T-test:

A T-test for Equality of Means was conducted to compare the average scores of the experimental and control groups in the pre-test, mid-term exam, and final exam. The classification variable for both groups was group membership, and the scores of each group in each test were compared to identify any potential differences in their marks. Prior to the t-test, a Levene's test was conducted, which indicated that the assumption of homogeneous variances could be made. In the pre-test, the mean score for the control group was 4.189, on the other hand, the experimental group had a mean score of 4.589. According to the analysis, there were no significant differences at a 95% confidence level. This suggests that initially, both groups had a similar level of knowledge about the topics they were going to study.

Similarly, there were no significant differences between the average scores of the control and experimental groups in the mid-term exam. However, in the final exam, the mean score for the control group was 4.122, while the experimental group had a mean score of 3.540. In this case, the differences were statistically significant at a 99% confidence level (Sig.=0.008).

Table 5: Part I T-test for equality of means.

	Group	N	Mean	SD	T	Sig.	DF	Dif.
Pre Test	CG	42	4.189	1.200	-1.441	0.150	78	-0.400
	EG	38	4.589	1.535				
Mid Test	CG	42	4.587	1.555	0.225	0.829	78	0.335
	EG	38	4.252	1.551				
Final	CG	42	4.122	1.348	2.727	0.007	78	0.582
	EG	38	3.540	1.168				

(*CG=Control group; EG=Experimental Group.)

5.2. Difference-in-differences (DD) analysis:

By applying the DD method using data from the pre-test and the mid-term test, it was observed that the morning group (CG) showed an improvement in their average score by 0.4, while the afternoon group (EG) remained unchanged. Considering the results at the starting point and the mid-term, the DD value was -0.735. (-0.337 - 0.398).

Table 6: Difference-in-Differences (DD) Analysis between the Pre-test and Mid test

Means	Pre-test	Final test	Change
EG	4.589	4.252	- 0.337
CG	4.189	4.587	0.398
Differences	D = 0.400	D = - 0.335	DD = - 0.735

Upon applying the DD method using data from the pre-test and the final test, it was observed that the control group remained stagnant, while the experimental group's average score worsened by 1.15. The average scores of the CG in the pre-test, the DD analysis in this case is considering the results at the starting point and the final test, the DD value was -1.116.

Table 7: Difference-in-Differences (DD) Analysis between the Pre-test and Final test

Means	Pre-test	Final test	Change
EG	4.589	3.540	- 1.049
CG	4.189	4.122	0.067
Differences	D = 0.400	D = - 0.582	DD = - 1.116

5.3. Survey results

5.3.1. Part I. General opinions

The aim of the general questions was to compare attitudes towards ICT (Information and Communication Technology) and Quantitative Analysis in both the CG and EG, ensuring that the only distinguishing factor was the use of Google Classroom by the experimental group. There were no significant differences in their mean opinions regarding Quantitative Techniques, ICT, and the use of ICT in the classroom. The assumption of homogeneous variances could be made based on the Levene's test for Equality of Variances. Moreover, there were no differences in time distribution, including studying outside the class. Overall, students in both groups had positive opinions about these topics and spent a considerable amount of time on social networks.

Table 8: Part II T-test for equality of means.

Question	Group	N	Mean	SD	T	Sig.	DF	Dif.
Q. 1	CG	42	3.98	0.638	0.495	0.4752	78	-0.14
	EG	38	4.12	0.670				
Q. 2	CG	42	4.24	0.821	1.171	0.2819	78	-0.18
	EG	38	4.42	0.674				
Q. 3	CG	42	4.45	0.813	0.011	0.9229	78	0.02
	EG	38	4.43	0.751				
Q. 4	CG	42	4.20	0.877	0.069	0.7950	78	-0.01
	EG	38	4.21	0.788				
Q. 5	CG	42	4.18	0.999	1.272	0.2569	78	0.18
	EG	38	4.00	0.768				

Q. 6	CG	42	3.73	0.985	0.112	0.7328	78	0.05
	EG	38	3.68	0.753				
Q. 7	CG	42	4.21	0.923	0.751	0.123	78	0.21
	EG	38	4.00	0.755				

5.3.2. Part II. Google Classroom - Student Response System (SRS).

Following table presents the key findings from the students' responses regarding Student Response System (SRS). The instrument demonstrated high internal consistency, as indicated by the Cronbach's alpha value ($\alpha=0.811$). Upon analyzing the results, the experimental group had the highest mean scores (above 4) in questions Q.5, Q.6, Q.8, and Q.9. Students believed that Student Response System (SRS) enhanced participation in the classroom (mean score of 4.19) and found it more enjoyable than traditional methods (mean score of 4.23). They expressed satisfaction with the use of Student Response System (SRS). (mean score of 4.19) and believed it should be implemented in other subjects as well (mean score of 4.03). Questions related to Student Response System (SRS) contribution to learning Q.2, engagement (Q.3), and focus (Q.4) received moderately high mean scores (3.98, 3.87, and 3.66, respectively). Students agreed that Student Response System (SRS) was less stressful than traditional methods like pen-and-paper questionnaires.

Table 9 : Part II Student Response System (SRS) – Google Classroom

		Mean	SD
Q. 1	I liked Google Classroom.	4.01	0.677
Q. 2	Google Classroom tool helps in learning material.	3.99	0.666
Q. 3	The usage of Google Classroom tool motivates me in my learning.	3.87	0.865
Q. 4	The usage of Google Classroom tool encourages focusing.	3.66	0.957
Q. 5	Google Classroom tool encourages to participation	4.19	0.845
Q. 6	Google Classroom is more fun than traditional methods	4.23	0.811
Q. 7	Google Classroom is more stressful than traditional methods	2.14	1.157
Q. 8	Satisfied with the usage of Google Classroom tool in my classroom.	4.19	0.518
Q.9	Google Classroom should be used when teaching other subjects also.	4.03	0.933

6. Discussion

The current student population in Higher Education Institutions is predominantly, who are recognized as digital natives and adept multitaskers. Students are accustomed to a faster-paced lifestyle and have easy access to information compared to previous generations. However, it has been observed that student engagement tends to decline as they progress to higher levels of education (Anderson et al., 2019). These two phenomena present challenges that necessitate instructors to adapt their teaching methods (Picault, 2019).

One approach to address these challenges is the integration of new technologies, such as educational apps and media, into the teaching process (Montenery et al., 2013; Picault, 2019). Higher Education Institutions have invested in mobile learning applications, including Student Response Systems (SRS), as a means to deliver course content innovatively and cater to the needs of current generation.

These applications have demonstrated an increase in student engagement. However, the impact of these technologies on student assessment has not been extensively explored. This study aims to examine the relationship between assessment and the use of mobile technologies, specifically SRS, in the classroom. Contrary to general expectations, the results of this research indicate that mobile learning applications do not yield positive effects on short-term assessment, aligning with the findings of Chui et al. (2013) and Harmon and Tomolonis (2019). However, the study reveals positive attitudes towards engaging with new technologies, incorporating technologies in the classroom, and favouring Google Classroom, a specific SRS platform (Guarascio et al., 2017; Lim, 2017; Zou and Lambert, 2017). Students expressed that Google Classroom made learning enjoyable, improved engagement, and facilitated focus on assigned tasks. Additionally, students emphasized that Google Classroom was less stressful compared to traditional methods like pen-and-paper questionnaires, contrasting with the findings of Zou and Lambert (2017).

7. Conclusion:

The findings of this study suggest that the anticipated benefits of mobile learning technologies may be overstated, as no positive effects on student assessment were observed when using Google Classroom. However, it is important to highlight that mobile learning applications do enhance student engagement, which can contribute to more effective content delivery for the new generation of students. Instructors should continue to adapt traditional teaching methods to accommodate the characteristics, such as incorporating mobile applications. However, it is crucial to view these technologies as supplementary tools rather than replacements for traditional education. Further research should be conducted to examine whether these results hold true in different contexts, such as other academic disciplines, and to assess the long-term impact as a student response system on assessment outcomes. Additionally, exploring more sophisticated assessment designs could provide insights into evaluating students' skills effectively.

References:

- Anderson, R.C., Graham, M., Kennedy, P., Nelson, N., Stoolmiller, M., Baker, S.K., Fien, H. (2019). Student agency at the crux: mitigating disengagement in middle and high school. *Contemporary Educational Psychology*, 56, 205-217.
<https://doi.org/10.1016/j.cedpsych.2018.12.005>.
- Picault, J. (2019). The economics instructor's toolbox. *International Review of Economics Education*, 30, 100154. <https://doi.org/10.1016/j.iree.2019.01.001>.
- University of A Coruna. (2018). Degree in Law. Retrieved from <http://estudios.udc.es/en/study/start/612G01V01/2018>.
- Savec, V.F., Hrast, Š., Šuligoj, V., Avsec, S. (2018). The innovative use of ICT in STEM teacher training programmes at the University of Ljubljana. *World Transactions on Engineering and Technology Education*, 16(4), 421-427.
- Zou, D., Lambert, J. (2017). Feedback methods for student voice in the digital age. *British Journal of Educational Technology*, 48(5), 1081-1091.
<https://doi.org/10.1111/bjet.12522>.
- Onodipe, G.O. (2017). Engaging and empowering dual enrollment students: a principles of economics

course example. In *Empowering Learners With Mobile Open-Access Learning Initiatives* (pp. 1-6). <https://doi.org/10.4018/978-1-5225-2584-4.ch058>.

Riaza, B.G., Rodríguez, A.I. (2016). Students' perception of the integration of mobile devices as learning tools in pre-primary and primary teacher training degrees. *International Journal of Human Capital and Information Technology Professionals*, 7(2), 19-35. <https://doi.org/10.4018/IJHCITP.2016040102>.

Lucena, S. (2016). Culturas digitais e tecnologias móveis na educação. *Educação em Revista*, (59), 277-290. <https://doi.org/10.1590/0104-4060.43689>.

Fotaris, P., Mastoras, T., Leinfellner, R., Rosunally, Y. (2016). Climbing Up the Leaderboard: An Empirical Study of Applying Gamification Techniques to a Computer Programming Class. *Electronic Journal of e-Learning*, 14(2), 94-110. <https://doi.org/10.1007/s11528-016-0070-3>.

Danesh, A., Baily, A., Whisenand, T. (2015). Technology and Instructor-Interface Interaction in Distance Education. *International Journal of Research in Business and Social Science*, 6 (2), 29-47.

Lozano, R., Ceulemans, K., Scarff Seatter, C. (2015). Teaching organisational change management for sustainability: Designing and delivering a course at the University of Leeds to better prepare future sustainability change agents. *Journal of Cleaner Production*, 106, 205-215. <https://doi.org/10.1016/j.jclepro.2014.03.031>.

White, H., Sabarwal, S. (2014). *Diseño Y Métodos Cuasiexperimentales 8. Sinopsis Metodológicas. Sinopsis de La Evaluación de Impacto N°*, pp. 1-16. Retrieved from <https://www.unicef-irc.org/publications/pdf/MB8ES.pdf>.

Haintz, C., Ebner, M. (2014). Developing a web-based question-driven audience. *Journal of Universal Computer Science*, 20 (1), 39-56.

Chui, L., Martin, K., Pike, B. (2013). A quasi-experimental assessment of interactive student response systems on student confidence, effort, and course performance. *Journal of Accounting Education*, 31(1), 17-30. <https://doi.org/10.1016/j.jaccedu.2013.01.002>.

Montenery, S.M., Walker, M., Sorensen, E., Thompson, R., Kirklin, D., White, R., Ross, C. (2013). Millennial generation student nurses' perceptions of the impact of multiple technologies on learning. *Nursing Education Perspectives*, 34(6), 405-409. <https://doi.org/10.5480/10-451>.

Sinha, N., Khreisat, L., Sharma, K. (2009). Learner-interface interaction for technology-enhanced active learning. *Innovate: Journal of Online Education*, 5(3), Article 3.

Barnett, L. (2009). Key aspects of teaching and learning in economics. In K. S. Fry & S. M. H. Ketteridge (Eds.), *A Handbook for Teaching and Learning in Higher Education* (pp. 405-423). Routledge.

Combs, K.L., Gibson, S.K., Hays, J.M., Saly, J., Wendt, J.T. (2008). Enhancing curriculum and delivery: linking assessment to learning objectives. *Assessment & Evaluation in Higher Education*, 33(1), 87-102.
<https://doi.org/10.1080/02602930601122985>.

Mattheos, N., Lic, O. (2004). Information Technology and Interaction in Learning Studies of Applications in Academic Oral Health Education. PhD. diss., University of Malmö.

Almond, R.G., Steinberg, L.S., Mislevy, R.J. (2002). Enhancing the design and delivery of assessment systems: a four-process architecture. *Journal of Technology, Learning & Assessment*, 1(5), 1-64.

Vrasidas, C. (2000). Constructivism versus objectivism: implications for interaction, course design, and evaluation in distance education. *International Journal of Educational Telecommunications*, 6(4), 339-362.
<https://doi.org/10.1080/0031383890330103>.