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The Use of Response Systems in Higher Education during the Covid-19 Pandemic Period

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Abstract

The present article investigates the dimensions of utilization of Response Systems (RSs) in the teaching process. These RSs provide learners with real-time interaction and strengthen their participation. The project is an attempt to record the views of students (N=199) regarding the experience and the impact of their involvement in the use of RSs. In an interdepartmental course taught at the Department of Philosophy and Education of Aristotle University of Thessaloniki during the spring semester of 2020, students used RSs before, during and after the teaching process. Participants were asked to complete an appropriate questionnaire regarding online RSs applications. In this study, we examined how and to what

extent students accepted their involvement in the RSs in the first phase of the Covid-19 pandemic period. The participants, coming from nine University Departments, evaluated positively the integration in RSs teaching. The results showed that more than nine out of ten participants agree that these applications provide new possibilities for strengthening teaching methods through an entertaining experience and the participants have stated that these applications enhance active participation and collaborative learning and engage them actively and pleasantly in a metacognitive function process.

Keywords: Higher Education, Covid-19, Response Systems, E-learning

1. Introduction

1.1 Higher Education and Covid-19

The aspiration of those in charge of educational policy but also of the teachers themselves is the renewal of the methods they use in their teaching and the adoption of adaptable and flexible learning techniques, because according to the prophetic words of John Dewey "If we teach today's students as we taught yesterday's, we rob them of tomorrow." (Kivunja, 2014, p. 107). Educational institutions and curriculum planners monitor developments and progress in technology and with innovative applications try to re-evaluate and redesign teaching methods that will attract the student's attention (Langford & Damsa, 2020; Kearns, 2016; Prensky, 2005).

Undoubtedly, due to the covid-19 virus Digital Media have been used extensively worldwide. The Covid-19 pandemic has prompted university lecturers to develop their digital skills to adapt to online teaching. Teachers had to use distance education. But does this use show that they know how to use digital media pedagogically? How did the pandemic affect the use of RSs?

There are no easy answers to these questions. The Covid-19 pandemic has disrupted teaching in a variety of institutions, especially in higher education (Morris et al., 2021). Electronic learning (e-learning) became the core method of teaching the curriculum during the pandemic (Holubek, 2020). Researchers agree that digital technologies can accelerate the pace and positively affect teaching and learning (Langford & Damsa, 2020; Van der Kleij et al., 2015; Kim et al., 2013; Jimoyiannis & Komis, 2007), while at the same time data from studies show that the use of digital media is sufficiently widespread in Greece and internationally (European Commission, 2018). Especially in the last two decades the teachings that use technologically enhanced learning have increased the learners' interest and dedication (Lim, 2017; Grigoryan, 2018). For higher education institutions a key challenge is to activate, engage creatively and ensure student collaboration in the teaching process. However, evidence shows that student engagement often fails, and this not only does it have a negative impact on quality, evaluation and results, but can also have a detrimental effect on continuing education and on the number of students completing their studies (Bonet & Walters, 2016).

The aim of the educational community is to enable students to actively participate, communicate, collaborate and enjoy learning as an "entertaining" process, in the literal sense of the word (Kim et al., 2021a). According to data from the last decade, more and more RSs

are being developed (Dervan, 2014; Flosason et al., 2015; Hill & Fielden, 2017; Holubek, 2020). In the international literature, RSs are referred to through a variety of terms (Appendix).

One of the ways digital media and especially RSs systems can be utilized in the classroom is through the involvement of learners in a process of formative assessment and feedback, with their consent and active participation (Hargreaves, 2008; Yoon, 2017; Hussein, 2019). Research by Wiliam (2011) and Morris et al., (2021) illustrated that the fundamental importance of a productive formative assessment through timely feedback and discussion of student responses, helps students' progress and improves their metacognitive function.

RSs facilitates teacher-student interaction. Students in many studies highlighted that RSs helped to make learning more interesting, fun and energising (Alharbi & Meccawy, 2020; Mohamad et al.,2019). The interactive questions allowed students to interact with their educators and form a more dialectic relationship (Perera & Hervás-Gómez, 2021). RSs which take place during and after teaching is a very important parameter for effective and deeper learning (Kim, Raza & Seidman, 2019; Van der Kleij et al., 2015). Internet platforms that support RSs and "run" applications such as Socrative and Mentimeter converge in this direction (Langford & Damsa, 2020). The special ease of use, the instantaneous and real-time feedback, as well as the possibility of direct formative evaluation, both individually and at group level, are advantages of these applications (Dervan, 2014). Furthermore, integrating RSs in the teaching process is a way of measuring - without direct grading - the level of conceptual understanding, which also enhances individualized learning (Awedh et al., 2014; Black & Wiliam, 2009).

1.2 Interactive RSs

In general, the pedagogical utilization of technology and especially the RSs aim at increasing the degree of the students´ participation and commitment in situations of increased communication and collaboration (Sun & Hsieh, 2018). Many scholars underline the enhancing of motivation and interactivity in the classroom through the application of personal RSs (Dervan, 2014; Hill & Fielden, 2017; Sun & Hsieh, 2018; Holubek, 2020). A good suggestion with regards the effective activation, as evidenced by the answers of the participants in this RS survey, is the utilization of online RSs through the Socrative and Mentimeter applications (Lin & Lin, 2020; Pryke, 2020). These applications utilize the Real-Time Immediate Response Method, as students actively participate in discussions about the answers given by themselves and their classmates (McDonough & Foote, 2015; Dervan, 2014). In fact, these tools can be a successful way to increase student performance through the services they provide, as the students themselves are actively involved in the learning process (Dakka, 2015).

For this study we selected these software RSs as they provide a range of services which facilitate the creation and the analysis of the questionnaire or quiz. The online applications Socrative (www.socrative.com) and Mentimeter (www.mentimeter.com) can enable teachers to evaluate both the cognitive level of the audience and their views (Lin & Huang, 2018). They provide a wide selection of question types (multiple choice, right-wrong, short answer)

and allow users to respond via smartphone or tablet or other digital devices. Participants can state their true details or appear on the scoreboard anonymously with a username of their choice and see directly the answers given by themselves or their classmates (Pryke, 2020; Holubek, 2020). Comments can be viewed in real time and discussed by participants (X. Lin & C. Lin, 2020).

With a simple command, the software of the applications processes statistical analyses and presents the results in pdf or excel file format. The data from the descriptive statistical analysis can be stored in a default folder on the computer, sent via email to the teacher who designed the teaching or to each student individually. Teachers / researchers discuss the results with other colleagues and with the contribution of the students they complete, comment, review, improve and upgrade the learning process (Hussein, 2019; Pryke, 2020). Learners compare their own answers with those of others. In this way they realize their shortcomings and assess the level of their knowledge in the specific period. Revealing the answers given by other classmates and comparing them with their own answer is a self-assessment experience, which actively and pleasantly engages the learners in a process of metacognitive function (Awedh et al., 2014; Hill & Fielden, 2017).

RSs applications, as highlighted by the processing of the results of other research, are considered by students as useful tools for teaching and learning (Treve, 2021; Gómez-Espina et al., 2019). Several international surveys agree that RSs bring out a large amount of information in an organized and selective manner, leverage image power and enhance metacognitive capacity; however, a reservation about participants' public exposure to the entire audience is also noted (Dervan, 2014; Hill & Fielden, 2017; Holubek, 2020). For the educator / researcher, immediate RSs are effective allies that offer the ability to create more productive teaching models and broaden learners' cognitive horizons easily and meaningfully (Gómez-Espina et al., 2019; Hill & Fielden, 2017).

On the other hand, some studies presented either negative perceptions or unexpectedly low acceptance of RSs in classrooms (Holubek, 2020). In the same sense, Balta and Tzafilkou (2019) concluded that the participants in their study were not as interested as they expected in using RSs, and there were no differences in perceptions across different genders.

However, implementing the technology without understanding the attitudes of the students would be unwise. We felt that it was important to explore students' attitudes about working within RSs given that it was a new teaching approach in our university's curriculum. This study aims to explore the views formed by students after their participation in distance lectures using RSs applications.

1.3 Research Hypotheses and Research Design

The focus of this study is the views and attitudes of students who used RSs in the interdepartmental course entitled: "Pedagogical issues from the introduction of Information and Communication Technologies in Education". We chose Socrative and Mentimeter as two of the most user-friendly and popular online RSs for students for this study (Holubek, 2020). Socrative and Mentimeter are defined as web-based platforms that can be accessed using any

Internet-connected browser (Treve, 2021; Hussein, 2019; Luxton, 2019).

Initially, four dimensions were formulated that were used as dependent variables in the research and relate to specific topics: 1. Overall satisfaction with RSs experiences, 2. Impact of Teaching Process, 3. Feedback / Self-assessment and 4. Metacognitive function. In addition, the effect of independent variables such as Gender, University Department, Semester, High School Graduation Area was examined. The present study answers the following research hypotheses:

1. The students who experienced the use of RSs for online activities positively perceived these experiences' their use does make the lesson more attractive.
2. Applications such as Socrative and Mentimeter enhance students' sense of active participation.

In search of bivariate correlations between dependent and independent variables, the present study was further guided by the following four research hypotheses:

3. There is not a statistically significant relationship between gender and students' views on the positive impact of the overall satisfaction with RSs experiences on teaching.
4. There are statistically significant differences in the positive views of participants about the sense of active participation, depending on the University Department.
5. There are statistically significant differences in the positive views of participants about the use of RSs in teaching practice, depending on those studying in the upper semester will be more receptive to the use of RSs applications.
6. There are statistically significant differences in the positive views of participants about the use of RSs in teaching practice, depending on the High School Area of Graduation.

2. Method

2.1 Overview

This study focuses not only on the combination, during the simultaneous teaching of two RSs through the Socrative and Mentimeter applications but also on their continuous use in all the lectures (twelve online courses) of the spring semester 2020, when the lockdown was implemented due to the Covid-19 pandemic. Also, the statistical analysis using SPSS 26 combined different forms of multiparametric processing, contributing to the field of relevant research and in the context of promoting the theory of the effective use of RSs in teaching practice.

2.2 Participants

This paper explores the views of 199 students from nine different departments at Aristotle University of Thessaloniki, which is the largest University in Greece. The nine different departments are: Philosophy and Education, Philology, History-Archaeology, English, German, and Italian Language and Philology and three departments of the School of Sciences: Mathematics, Physics and Informatics on issues related to the use of RSs such as the tools Socrative and Mentimeter. Detailed demographics of the students who participated in the research: 50.25% were students of the Department of Philosophy and Education, 73.37% were students in the 8th semester and 80.40% were female.

2.3 Research Means

A quantitative research method was used in this study, aiming to reveal students' views on the use of RSs in teaching in the collection, analysis and discussion of data. Questionnaires were distributed through the Socrative Student application.

The research tool was a questionnaire developed for the needs of the present study, which included 22 questions. For the development of the questionnaire, similar work was considered and the wording, structure, coherence and clarity of the questions in the recent research of Dervan (2014), of Gómez-Espina et. al (2019), of Lin & Lin (2020) and Holubek (2020) were carefully studied and used. In addition, the theoretical structure and practical possibilities of the online interactive social feedback tools Socrative and Mentimeter were studied in depth.

The research questionnaire consisted of five thematic areas/axes. The first included five questions about the profile of the participants (University Department, Gender, Semester, High School Background). The second axis (five questions) concerned the respondents' views on the experience of using the applications (ease / friendliness, concern, pleasure, connection device, previous experience). In the third axis (eight questions) the views on didactic issues were recorded (understanding of a subject, strengthening active participation and cooperation, saving time). The fourth axis (two questions) referred to the views on the pedagogical contribution of the applications, improvement of the metacognitive function, strengthening of the self-evaluation and feedback. In the fifth axis there were two questions that recorded participants' expectations and prospects for future use of the Socrative and Mentimeter applications.

For the statistical analysis, comparisons of the independent groups were held using parametric or non-parametric tests (independent samples t-tests, One-way ANOVA, Kruskal Wallis test), as well as the visualization of data and results, a complete set of software services was used for the analysis of data, calculations and Figures in SPSS. Regarding the answers of the respondents, a five-point Likert scale was used from 1-5 where value 1 represents the answer "Strongly disagree", 2 "Disagree", 3 "Neither agree nor disagree", 4 "Agree" and 5 "Strongly Agree".

2.4 Reliability Analysis

Prior to the study of the research questions, a reliability analysis was carried out on the dimensions of students' views on the use in the teaching of RSs. Regarding the opportunity to use RSs in another course 89.80% of the students (N = 176) did not have the opportunity to utilize an application. The results show that there is acceptable internal reliability since the values of Cronbach Alpha in all dimensions are higher than 0.70. Specifically, the dimension "Positive view for the Socrative Student" had a reliability of 0.71, the dimension "Positive view for the Mentimeter" 0.92, the "Positive view for the Socrative Student and Mentimeter" 0.75. Due to the satisfactory internal reliability the variables in each dimension were grouped using the mean value estimator.

3. Results

3.1 Views on the Overall Satisfaction of Using the RSs

The results of the first research hypothesis which explores if the students who experienced the use of RSs (Socrative and Mentimeter) for online activities, positively perceived these experiences and make the lesson more attractive, are presented in Table 1 and Figure 1. According to Table 1, students strongly agree with the view that Socrative is extremely easy and user-friendly, and they agree quite strongly that applications such as Socrative make the course more attractive. In addition, the students strongly agree that the Socrative application saves time and visualises the students' understanding of the course and that using applications such as Socrative was a pleasant experience.

Table 1. General opinions on Socrative Student

Opinions on Socrative	Mean	SD
Socrative is extremely easy and user-friendly	4.72	0.58
Applications like Socrative make the course more attractive	4.49	0.66
The Socrative application saves time and visualizes the understanding of the lesson by the students	4.39	0.62
Using applications such as Socrative Student was a pleasant experience	4.38	0.64

According to Figure 1, students strongly agree with the fact that Mentimeter is extremely easy and user-friendly, applications such as Mentimeter make the course more attractive, the application Mentimeter saves time and visualizes the understanding of the course by the students and that their experience from the use of applications as Mentimeter was useful.

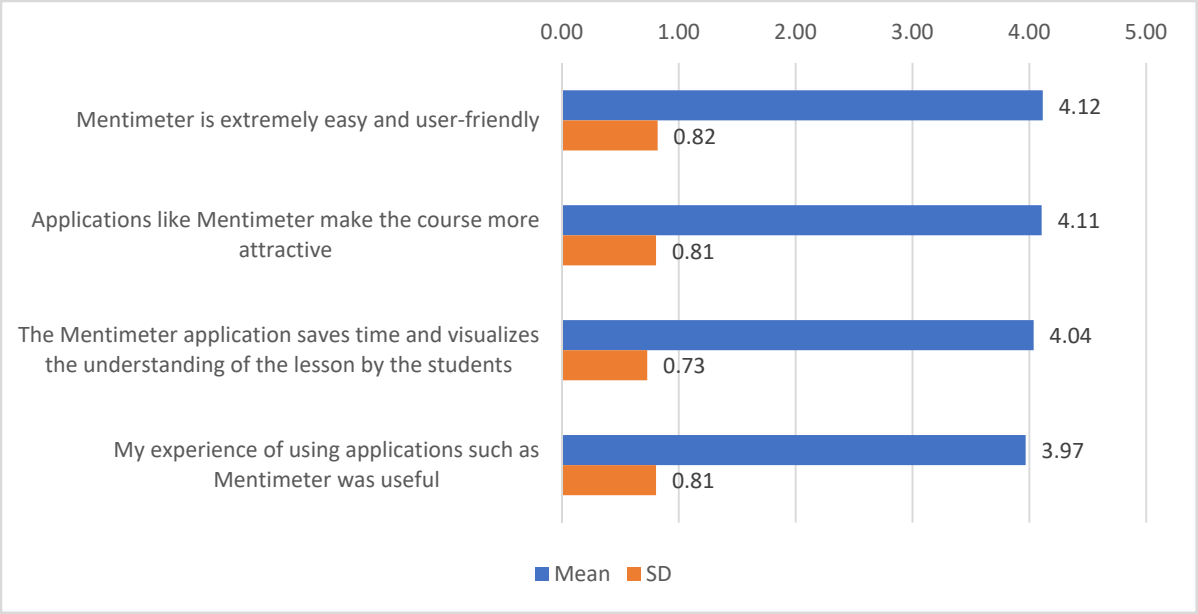

Figure 1. General opinions on Mentimeter

3.2 Effect of RSs on the Teaching Process

Regarding the second research hypothesis, Table 2 presents students' views on the effect of RSs on the teaching process. According to the results of the table, students strongly agree with the fact that applications such as Socrative and Mentimeter enhance the sense of active participation and that the disclosure of answers given by the classmates and the comparison with their own answer was a self-assessment experience, which actively and pleasantly engages students in a process of metacognitive function. They also strongly agree that applications such as Socrative and Mentimeter enhance collaborative learning.

Table 2. Teaching process

Effect of RSs on the teaching process	Mean	SD
Applications such as Socrative Student and Mentimeter enhance the sense of active participation.	4.50	0.68
Revealing the answers given by the classmates and comparing them with my own answer was a self-assessment experience, which actively and pleasantly engages the trainees in a process of metacognitive function.	4.43	0.59
Applications such as Socrative Student and Mentimeter enhance collaborative learning	3.84	0.89

3.3 Gender Satisfaction with RSs Experiences on Teaching

Regarding the third research hypothesis, the independent samples t-tests of the dimensions by gender showed that no statistically significant difference of mean values between males and females was found ($p > 0.05$). Therefore, the third research hypothesis is verified. Students, regardless of gender, have a positive view about the ease of use and active participation of the RSs. Table 2 presents the results of the independent samples t-test of the dimensions in terms of gender, where no statistically significant difference of mean values was detected ($p > 0.05$).

Table 2. Gender

Results of non-significant independent samples t-test of gender dimensions	t	df	p
Positive impact of the overall satisfaction with Socrative experiences on teaching	1.72	43.15	0.093
Positive impact of the overall satisfaction with Mentimeter experiences on teaching	0.43	190	0.665

3.4 Positive Views of Participants about the Sense of Active Participation in Teaching Practice Depending on the University Department

The 4th research hypothesis is also verified. We present the results of the statistically significant ANOVA tests of the dimensions by the University Department of students, where statistically significant differences of mean values between groups appeared ($F(2,189) = 4.62$, $p = 0.011 < 0.05$). Multiple comparisons of LSD (Fisher's Least Significant Difference) show that the mean value of Philosophy and Education students of AUTh (Mean = 4.65) is statistically higher ($p = 0.003 < 0.01$) than that of students of Sciences AUTh (Mathematics, Physics, Informatics, etc.) (Mean = 4.27).

3.5 Positive Views of Participants about the use of RSs in Teaching Practice Depending on the Semester of Studies

Figure 2 presents the results of the statistically significant independent samples t-test of the dimensions with respect to the semester, where statistically significant differences in mean values occurred. It appears that in the dimension "Positive view for Socrative" the mean value of the 8th semester students (Mean = 4.53) is statistically higher ($t(192) = 2.05$, $p = 0.042 < 0.05$) than that of graduate students (Mean = 4.38), so the 5th research hypothesis is refuted; that is, students in the higher semesters study more positively for the RSs compared to those who study in other semesters.

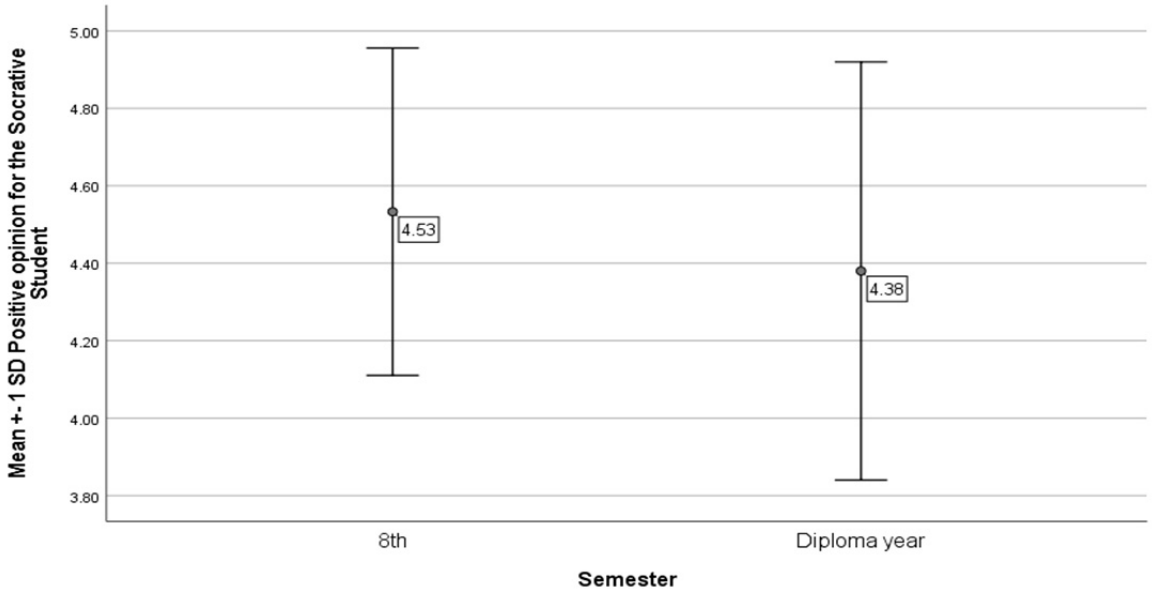

Figure 2. Mean of positive opinion for the Socrative Student in the two semesters of study

3.6 High School Area of Graduation

Regarding the sixth research hypothesis, Table 3 presents the results of the statistically significant Kruskal Wallis tests of the dimensions with respect to the high school graduation area, where statistically significant effects occurred. It turned out that in the dimension "Positive view for RSs" the mean of students from Rural / Island area (a village with less than 2000 inhabitants) is statistically higher than that of the others.

Table 3. Statistically significant Kruskal Wallis dimensions test results by the high school graduation area

Dimension	Graduation High School Area	N	Mean Rank	H (2)	p
Positive opinion for the RSs	Rural /Island area (a village with less than 2.000 inhabitants)	19	129.24	7.02	0.030
	Semi-urban area (a town from 2000 to 10.000 inhabitants)	58	94.91		
	Urban centre (a city with more than 10.000 inhabitants)	117	93.63		

4. Discussion

Through a quantitative study the researchers found that students were impressed by the RSs' user-friendliness, the ability to relay responses in real-time, its time-saving capabilities, and the fact that it facilitated student assessments through online quizzes. These findings show that RSs are appropriate for use during the Covid-19 pandemic to ensure the continued interaction with the course materials despite the challenges. The present study, in which 199 students participated, aimed to explore student views on the experience they gained from using the direct response tools Socrative Student and Mentimeter. Most of the participants were 8th semester students from the Department of Philosophy and Education of Aristotle University of Thessaloniki. Regarding the High School background, it is pointed out that most of the participating students graduated from an urban centre. About nine out of ten students stated that they had not had any prior use of the RSs applications during their studies at Aristotle University of Thessaloniki.

Regarding the first research hypothesis about the students who experienced the use of RSs in the teaching process, their views were positive for both investigated systems of immediate response, which is in line with international research (Dervan, 2014; Dakka, 2015; Grigoryan, 2018; Hussein, 2019). Specifically, they have stated that these applications enhance active participation and collaborative learning and engage them actively and pleasantly in a metacognitive function process; these findings align with previous literature references such as Lin and Huang (2018).

In particular, from the processing and analysis of students' opinions who participated in the research, high levels of satisfaction were observed from the use of the Socrative application; nearly everyone stated that they would have appreciated other teachings that would utilize RSs. The students also formed a positive view of the RSs applications. Specifically, they stated that Socrative is extremely easy-to-use and user-friendly, makes the lesson more attractive, saves time, visualizes the understanding of the lesson, enhances active learning and collaboration, and they generally enjoyed this experience. The view that the Socrative application is an easy-to-use, attractive and a useful pedagogical tool for improving teaching seems to be in line with the findings of other researchers (Yoon, 2017; Lim, 2017; Hussein, 2019; Holubek, 2020).

Similarly, students' views on the Mentimeter application were very positive. Students state that they find it extremely easy and simple to use, it makes the lesson enjoyable, saves time and visualizes the understanding of the lesson and enhances active learning; in general, their experience was useful and fun, which, again, is in line with the findings of similar research (Hill & Fielden, 2017; Langford & Damsa, 2020).

The second research hypothesis concerned whether or not applications such as Socrative and Mentimeter enhance students' sense of active participation. Most students stated that both have equally good feedback. This fact explains the high levels of metacognitive skills after the use of RSs. No similar research was found in the literature and internet search, neither in Greece nor internationally, so they cannot be compared with some other findings.

The effect of the demographic profile on students' views was then studied. The third research hypothesis examined whether gender affects students' views on the positive impact of the overall satisfaction with RSs experiences on teaching. The results showed that students, regardless of gender, have a positive view about the ease of use and active participation of the RSs.

An interesting element that emerges in the following fourth and fifth research hypotheses from students' answers is that there were statistically significant differences of their views about the sense of active participation in teaching practice in relation to the University Department and the semester. More specifically, students of the Department of Philosophy and Education have more positive views about the sense of active participation in teaching practice compared to students at the Schools of Science. It was also observed that 8th semester students recognize to a greater extent the advantages of RSs compared to older students, who being at the end of their studies may have as a priority their fast graduation. No similar surveys were found neither in Greece or internationally to compare the above bivariate correlations.

The sixth research hypothesis assumed that there are statistically significant differences in the positive views of participants about the use of RSs in teaching practice, depending on the High School Area of Graduation. The results showed that students who graduated from a rural / island area are more positive in the use and utilization of Socrative.

Generally, the RSs are valuable for students because they allow themselves to monitor the progress through quizzes. The RSs enable students to view the responses in real-time and these are time-saving applications, thereby allowing students and lecturers more time to interact with the content material for the benefit of all.

5. Conclusions

The findings of this study showed that the RSs tools are appropriate for use during the Covid-19 pandemic and ensure the continued interaction with the course materials despite the challenges. In addition, developing these student-centered methodologies does shed light on the learning process, reinforcing joint work between educators and students. In the context of Covid-19, with many activities shifted online, RSs have shown motivational effect and potential to enable student participation and improve attention and engagement.

The opportunity for students to participate anonymously and enjoyably enhances democratic contribution to each session and the whole course. As a result, students experience higher engagement with their learning process, as they pay more attention and feel inclined to collaborate with educators and peers in a more relaxing atmosphere compared to that found in traditional passive learning. However, further research is needed to test whether engagement and attention are retained over time, as the novelty effect of the software fades.

The evaluation of Socrative and Mentimeter as students' RSs applications by students is a prerequisite for the effectiveness of RSs in teaching practice. This work proposed a systematic approach to the investigation of online, interactive instant RSs applied in higher education. The methodological aspects of this effort add to the literature of RSs by defining

influences and ways of creating theory. This study provided empirical evidence for the acceptance of RSs by students, while at the same time the findings enrich the theoretical foundation and practice and provide the impetus for further research. The last observation is that university education should systematically create further incentives for learning using digital media with the use of sophisticated RSs that actively involve students. Curricula need to integrate the dynamics of digital tools systematically and experientially with modern educational applications.

Despite the clear findings, the present research has limitations mainly from its research character as the quantitative method of processing and analysing results was used almost exclusively. Given that it is one of the few research efforts on two RS at the same time (Socrative and Mentimeter) and the sample is not representative of Greek students, the results should be treated with caution in terms of generalization issues. Therefore, future research should try to repeat similar studies, as the dimensions examined in the present study can be extended to a variety of other variables, which may play an important role in the pedagogical utilization of RSs.

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Appendix

International Terminology of Response Systems

The terminology used internationally varies and Response Systems in the literature are also referred to as Interactive Response Systems, Web-Based Response Systems, Cloud-Based Response Systems , Game-Based Response Systems, Online Audience Response Systems, Smart Personal Response Systems, Personal Responsibility Systems, Manual Systems Hand-held Response Systems, Clicker Device Systems, Real-time question / answer Response Systems, Polling Systems, Electronic Classroom Electronic Classroom Response Systems, Classroom Communication Systems, Electronic Feedback Systems (Online).

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