World Applied Sciences Journal 32 (7): 1268-1283, 2014
ISSN 1818-4952

DOI: 10.5829/idosi.wasj.2014.32.07.1956

Investigating the Impact of Audience Response System on Student's Performance Outcomes

[1]Mantikayan Jonathan, [1]Abdullah Lili, [2]Ayu Media,
[1]Adamu Abubakar and [1]Abdulgani Montadzah

[1]Department of Information Systems,
International Islamic University Malaysia, 50728 Kuala Lumpur, Malaysia
[2]Universitas Siswa Bangsa International,
Jl. MT Haryono Kav 58-60, Jakarta Selatan 12780

Abstract: In this paper Audience Response System (ARS) impact on performance outcomes of secondary school pupils has been studied. Previous research has shown that ARS improves interactive learning and enhances teacher's ability to understand the degree of how students comprehend his/her teaching. Unfortunately, this might not truly reflect the student's performance, since the teacher's concern is to evaluate his/her teaching which might eventually not inculcate the academic values to the students. This paper presents an investigation of the impact of ARS on performance outcomes. The study uses qualitative experiment and evaluates the impact of ARS within some sample of secondary school pupils. An Independent samples T-test was calculated comparing the mean differences of posttest result outcome scores in the treatment group to the mean differences of posttest result score in the control group for each pair of classes taught by the same teacher. No significant difference was found except in class 1 and 2. On further analysis Students utilizing ARS performance has seen to focus on the questions raised by the teacher which improves their memorization ability. Consequently improves their performance outcome.

Key words: Audience Response System · Performance outcomes · Secondary school pupils

INTRODUCTION

Audience response systems have been used on university campuses since the 1990's especially in large lecture science courses [1]. The use of audience response systems in college classrooms grew out of the military's use of filmed instruction material in the 1950's [1]. During this time, the U.S. government had begun producing instructional training films and using computers in education and training. Instructional technology emphasized the systematic development of teaching and learning procedures and programmed instruction [2]. Much of this focus was based in behavioral psychology [3] in stimulus response and operant conditioning helped guide this progression in programmed instruction [4].

During the early use of audience response systems, college instructors could use either tagged or anonymous systems to gather data from their students [1]. The tagged system recorded answers from every seat in the classroom, while the anonymous system provided a count of the responses for each available answer. The Litton Student Response System, which was also introduced in the 1960's, provided a vibrating responder dial at each student seat if the correct answer was given by the student [1]. The ARS of today are somewhat similar to the ARS used in the 1960's and 1970's[1]. Although structural technological differences exist, most audience response systems are similar to each other in design and function, with three basic components including the software, a receiver and the actual audience response system device [8]. The main purpose of the system is to create

Corresponding Author: Mantikayan Jonathan, Department of Information Systems, International Islamic University Malaysia, 50728 Kuala Lumpur, Malaysia.

interactivity between the audience and the presenter. Slides are developed through the response system software which seamlessly integrates to presentation software. A slide is projected that displays a question, generally in a multiple choice format. The audience then participates by selecting an answer on their individual ARS keypad. A receiver attached to the presenter's computer collects the results and the aggregate data are then displayed in graphic form for all to see. Data can be collected anonymously or traced to individual ARS keypads. Reports ranging from attendance to moment by moment detail of individual ARS keypads can be generated within the instructor's audience response system software. Wireless hardware has become the standard for audience response systems. Radio frequency and infrared frequency are the two primary technologies that exist to transmit the data from the keypad to the receiver. Browser-based software is also available and routes data via an internet protocol address. The wireless receiver can collect up to 1000 responses in seven seconds, allowing the presenter to collect immediate feedback from the audience or students.

Various authors describe ARS as facilitating a variety of good teaching practice. ARS in higher education can give the following: engage students, encourage peer instruction, facilitate diagnostic assessment, formative assessment, provide constructivist method of teaching, question based method, problem based method, critical thinking skills and anonymity [9]. Active learning such as engagement, discussion and interaction among student and teacher are important components of the educational experience for all students [10-14]. Therefore this paper will explore the effects of audience response system on active learning and outcome.

Following this section is section 2 which describe the ARS, section discuss the research 3 methodology, section 4 provides data analysis and result, finally section 5 presents the conclusion of the work.

Audience Response Systems: Audience Response Systems (ARS) has been described to be a technology product - combination of hardware and software design to support communication and interactivity in classes [15]. Whereas Active Learning involves any instructional method that gets students involved in activity in the classroom rather than passively listening to a lecture (Bonwell and Eison, 1991), thus this might improve student's performance outcome. However performance outcome of students involved meaningful processing that enhanced students' abilities to integrate new information with existing knowledge, creating clearer understandings of themselves and the world around them [16]. ARS can facilitate the practice of interactive engagement for active learning in the classroom and, thereby, make the practice accessible and feasible to adopt [17]. Also, the ease of use would free the instructor to concentrate on pedagogy and content and not be distracted by the tool [18]. ARS seeks to help students and teachers develop habits of mind that will help them to cope with problems, questions and situations they face in their daily lives, both in school and beyond school. By asking students to consider open-ended, multi-faceted tasks and by avoiding certain common classroom practices, teachers can instill in students a need to know and the motivation to learn [19]. ARS has a great amount of flexibility based on the wide variety of questions that can be presented. An additional important feature, at the discretion of the instructor, is the grading associated with the keypad responses [20]. Crouch [21] Find out that, upon first implementing ARS, our students' scores on the Force Concept Inventory and the Mechanics Baseline Test improved dramatically and their performance on traditional quantitative problems improved as well. Subsequent improvements to our implementation, designed to help students learn more from pre-class reading and to increase student engagement in the discussion sections, are accompanied by further increases in student understanding. Learning of systems physiology concepts, including control systems and neurophysiology is at least as and potentially more effective when in-class quizzes and activities with instant feedback via a wireless classroom communication system are used in place of traditional learning activities including passive lectures and homework [22]. This new approach results in time savings for both students and those who grade homework assignments. When the results of this study are interpreted in light of a major confounding factor, it appears that the modified instruction may be more effective than the traditional instruction [22].

ARSs offer an innovative method of maintaining student interest and concentration, enhancing active learning and the level of interaction in a lecture setting, allowing students as well as lecturers an opportunity to monitor the level of student understanding [23]. Using handsets is fun and breaks up the monotony of the lectures; it makes lectures more interactive and involves the whole class; students are able to contribute without fear of making a mistake; students have an idea how they compare to their peers; it gives lecturers a chance to see if students are doing as well as they think before the final exam. These are all valid reasons and explain why the author enjoyed using them in practice. However, the current system certainly has limitations. The flexibility that this system offers pertains mainly to the lecturer. It does not give the students the opportunity to ask actively for clarification in the same anonymous way as they can answer questions [24]. The students gained new, exciting insights much more often during the paediatrics course than before. We as teachers found that voting during lectures could easily overcome some of the obstacles of good lecturing. Most of the students felt that voting improved their activity during lectures, enhanced their learning and that it was easier to make questions during lectures than earlier wired classroom helped them improve their understanding of difficult concepts when compared with conventional lecture classes. more active involvement in learning, more time to think and reflect in class (i.e. when given a concept test), the motivational effects of receiving immediate feedback (the histogram display) and the feeling that the teacher was adapting instruction in response to their learning needs [25]. In the business world these systems are used to support a wide range of group sense-making activities in such areas as knowledge management, quality, business process re-engineering, focus groups and a wide variety of other processes. They are particularly useful for face-to-face processes that have some element of self-assessment where open and honest feedback is required [26]. Using interactive technology for our class was a rich experience [27]. The system is a good tool for reinforcing basic concepts, though it requires more involvement from the instructor to craft meaningful questions. However, since questions can be saved and incorporated in future lessons, in the long run this approach could end up being a time-saver. Lopez [28] ARS proved to be of significant value with respect to improving the learning experience for the student and increasing the assessment information available to the faculty member [29].

Experimental Design: This paper adopts a Quasi-experimental design in which it involves selecting groups, upon which a variable is tested, without any random pre-selection processes. This kind of design includes treatment group and a comparison group. One group will use ARS to assist in performance outcome and one group will not. There will be a pretest conducted before the intervention is implemented.

Materials Required: Experimental tools and materials are very important in any experiment [30-32]. The materials require for this experiment are desk top computer, internet connection and projector. The evaluation is carried out on computer studies subject of high or secondary school level. The teaching of the computer studies subject the primary text for this course depend on the school textbook for each computer studies class. National computing center (NCC) Computer pioneer, International general certificate of secondary education (IGCSE) information and communication technology (ICT) textbook and Computer studies book for secondary education are examples of the books used. There is a personal desktop computer connected with the internet in the classroom. At the front of the classroom are a whiteboard/blackboard, projector screen and an LCD projector attached to the teacher computer. Each instructor used his or her own lecture slides. The Audience response system used in this study is polleverywhere.com. It works on any web or mobile device. The benefits of web-based ARS are:

- Do not require any installed software or "plug-ins."
- Live, real-time, animated charts update based on students' responses right in PowerPoint (or Keynote) alongside regular class slides.
- It works on every device: Students can use classroom PC, cell phones, smart phones, laptops, or tablets
- Not need to install other software or hardware [33].

Another available alternative ARS used in the class is socrative.com. Socrative is a smart student response system that empowers teachers by engaging their classrooms with a series of educational exercises and games[34].To access socrative class should have internet connection. The browser based solution supports Internet Explorer, Firefox, Chrome browsers running under any operation system. The types of question can be asked are the following:

Polls: Audience voting

Short Answer Question: Open ended form for audience to answer questions

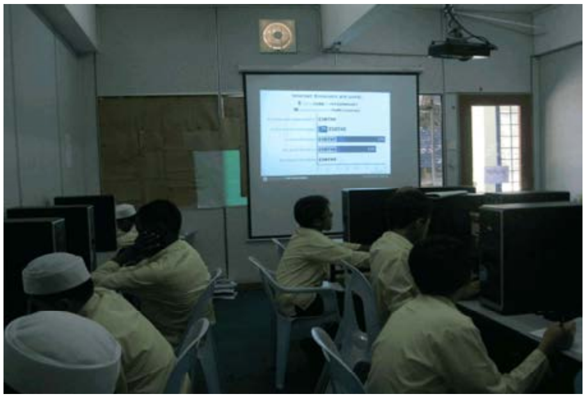

Fig. 1: The first experimental scenario where students are asked to use the ARS and vote for an answer to the question given by the teacher.

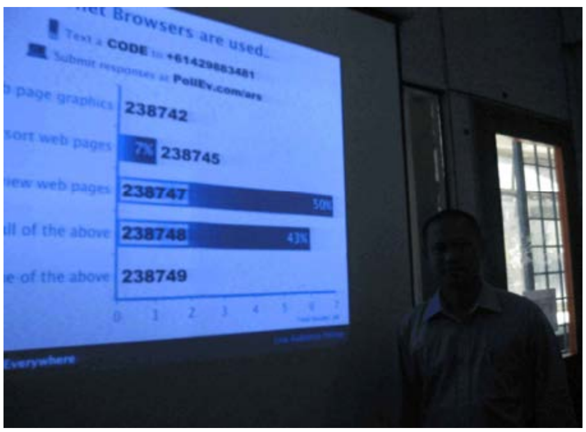

Fig. 2: The second experimental scenario where the teacher received real-time feedback from the students responses.

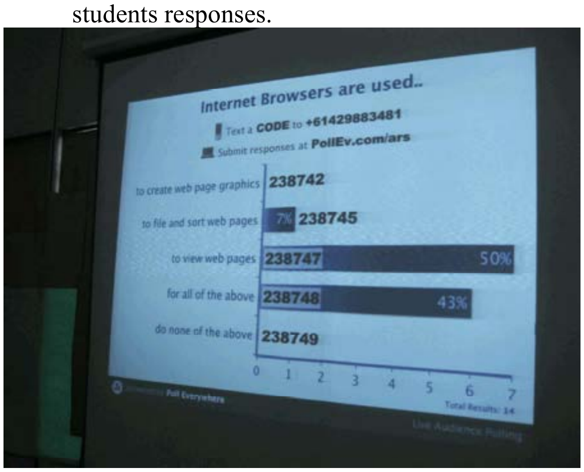

Fig. 3: The student's real-time responses.

Exit Tickets: Check student understanding with a few quick questions before they leave class each day.

Space Race: Teams of students answer questions in this fast-paced rocket race game.

Before the intervention, pretest was conducted to know the student level of achievement and compare to the posttest result. Exam result score of both comparison and treatment group will be collected at the end of semester to compare the result outcome.

Procedures: Defining experimental procedure is crucial to any experiment [5] Figure 1, 2 and 3 shows the experimental scenarios. The data included tests result from 14 separate classrooms. This stage contains results of the analyzed data (approximately 262 post-tests) collected from 14 different computer studies class at secondary level environment with 7 different teachers. The willingness to participate in this research study was completely voluntary by the teachers. The findings of this study allude to the classes as Class l, Class 2; Class 3, Class 4; Class 5, Class 6; Class 7, Class 8; Class 9, Class 10; Class 11, Class 12; Class 13, Class 14, See Table 1 below for details.

Test scores provided necessary data to investigate the effects of ARS on student result outcome at secondary school computer studies class. Data were analyzed from seven approaches:

- Data analysis and interpretation of pretest score
- Data analysis and interpretation of posttest result outcome by classes.
- Data analysis and interpretation of posttest accumulated classes.
- Data analysis and interpretation of posttest combined classes.
- Data1 analysis and interpretation of all classes combined excluding the researcher's.
- Data analysis and interpretation of all classes combined by country.

Data analysis and interpretation of pretest and posttest result outcome score

RESULT

Pre Test: Before the intervention implemented pretest was taken for all the participants to determine their level of achievement. Means and standard deviations of the difference pretest result outcome scores by class are presented below (Table 2).

Table 1: Details of classes used in the study

Class	Control/ Treatment	Teacher	Institution
Class 1	Non-ARS	Researcher1	ADNI
Class 2	ARS	Researcher1	ADNI
Class 3	Non-ARS	2	ISS
Class 4	ARS	2	ISS
Class 5	Non-ARS	3	BIS
Class 6	ARS	3	BIS
Class 7	Non-ARS	4	SAA
Class 8	ARS	4	SAA
Class 9	Non-ARS	5	MIT
Class 10	ARS	5	MIT
Class 11	Non-ARS	6	EKII
Class 12	ARS	6	EKII
Class 13	Non-ARS	7	DIPMC
Class 14	ARS	7	DIPMC

Table 2: Descriptive Statistics for difference of pretest result outcome score by class

	CLASS	N	Mean	Std. Deviation	Std. Error Mean
PRETEST SCORE	T1Non-ARS	19	68.53	7.441	1.707
	T1ARS	21	69.71	8.776	1.915
	T2Non-ARS	19	66.16	15.421	3.538
	T2ARS	18	66.17	13.250	3.123
	T3Non-ARS	19	76.68	7.682	1.762
	T3ARS	21	72.67	11.350	2.477
	T4Non-ARS	19	50.68	15.228	3.494
	T4ARS	18	65.72	16.542	3.899
	T5Non-ARS	20	63.15	15.598	3.488
	T5ARS	18	70.83	14.272	3.364
	T6Non-ARS	18	62.11	14.656	3.455
	T6ARS	17	64.88	13.683	3.319
	T7Non-ARS	18	60.28	14.045	3.311
	T7ARS	17	63.65	11.699	2.837

Table 3: Independent Sample T-Test of mean difference between pretest result outcome score in control group and treatment group by class

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference t	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Class 1	Equal variances assumed	.466	.499	-.459	38	.649	-1.188	2.587	-6.425	4.049
	Equal variances not assumed			-.463	37.855	.646	-1.188	2.565	-6.382	4.006
Class 2	Equal variances assumed	1.157	.289	-.002	35	.999	-.009	4.739	-9.629	9.612
	Equal variances not assumed			-.002	34.683	.999	-.009	4.719	-9.592	9.575
Class 3	Equal variances assumed	1.527	.224	1.297	38	.203	4.018	3.098	-2.255	10.290
	Equal variances not assumed			1.322	35.318	.195	4.018	3.040	-2.152	10.187
Class 4	Equal variances assumed	.441	.511	-2.879	35	.007	-15.038	5.223	-25.641	-4.435
	Equal variances not assumed			-2.873	34.346	.007	-15.038	5.235	-25.673	-4.403
Class 5	Equal variances assumed	.291	.593	-1.578	36	.123	-7.683	4.869	-17.558	2.191
	Equal variances not assumed			-1.586	35.986	.122	-7.683	4.846	-17.511	2.144
Class 6	Equal variances assumed	.093	.762	-.577	33	.568	-2.771	4.800	-12.537	6.995
	Equal variances not assumed			-.579	32.997	.567	-2.771	4.790	-12.517	6.975
Class 7	Equal variances assumed	1.391	.247	-.769	33	.448	-3.369	4.383	-12.287	5.549
	Equal variances not assumed			-.773	32.510	.445	-3.369	4.360	-12.245	5.507

The independent sample t-test was used to compare the control group and treatment group and to discover any significant differences between the average outcome scores. Table 3 illustrates the results from the Levene's test for equality of variance. Prior to conducting the parametric statistical analysis, such as the independent t-test, several assumptions need to be verified. One of those assumptions is the equality of variance. The test for equality of variances determined that the data in classes1, 2, 3, 4, 5, 6 and 7 did not have a significant p-value. All p-values appeared to be above the level of significance 0.05. This shows that there is no significant difference in the variances of the two groups at $\alpha = 0.05$ level. The following are the statistical details of the results for each pair of classes taught by the same teacher:

- Class 1, 2: No significant difference was found ($t(38) = -.46$, $p>0.05$).The variance of the ARS group (*M= 69.71*, SD = *8.77*) was not significantly different from the variance of the non-ARS group (M= 68.53, SD=*7.44*).
- Class 3, 4: No significant difference was found ($t(35) = -.002$, $p>0.05$. The variance of the ARS group (M= 66.17, SD = 13.25) was not significantly different from the variance of the non-ARS group (M= 66.16, SD = 15.42).
- Class 5, 6: No significant difference was found ($t(38) = 1.29$, $p>0.05$. The variance of the ARS group (M= 72.67, SD = 11.35) was not significantly different from the variance of the non-ARS group (M= 76.68, SD = 7.68.
- Class 7, 8: No significant difference was found ($t(35) = -2.87$, $p>0.05$. The variance of the ARS group (M= 65.72, SD = 16.52) was not significantly different from the variance of the non-ARS group (M= 50.68, SD = 15.22.
- Class 9, 10: No significant difference was found ($t(36) = -1.57$, $p>0.05$. The variance of the ARS group (M= 70.83, SD = 14.27) was not significantly different from the variance of the non-ARS group (M= 63.15, SD = 15.59.

Table 3: Independent Sample T-Test of mean difference between pretest result outcome score in control group and treatment group by class

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Class 1	Equal variances assumed	.466	.499	-.459	38	.649	-1.188	2.587	-6.425	4.049
	Equal variances not assumed			-.463	37.855	.646	-1.188	2.565	-6.382	4.006
Class 2	Equal variances assumed	1.157	.289	-.002	35	.999	-.009	4.739	-9.629	9.612
	Equal variances not assumed			-.002	34.683	.999	-.009	4.719	-9.592	9.575
Class 3	Equal variances assumed	1.527	.224	1.297	38	.203	4.018	3.098	-2.255	10.290
	Equal variances not assumed			1.322	35.318	.195	4.018	3.040	-2.152	10.187
Class 4	Equal variances assumed	.441	.511	-2.879	35	.007	-15.038	5.223	-25.641	-4.435
	Equal variances not assumed			-2.873	34.346	.007	-15.038	5.235	-25.673	-4.403
Class 5	Equal variances assumed	.291	.593	-1.578	36	.123	-7.683	4.869	-17.558	2.191
	Equal variances not assumed			-1.586	35.986	.122	-7.683	4.846	-17.511	2.144
Class 6	Equal variances assumed	.093	.762	-.577	33	.568	-2.771	4.800	-12.537	6.995
	Equal variances not assumed			-.579	32.997	.567	-2.771	4.790	-12.517	6.975
Class 7	Equal variances assumed	1.391	.247	-.769	33	.448	-3.369	4.383	-12.287	5.549
	Equal variances not assumed			-.773	32.510	.445	-3.369	4.360	-12.245	5.507

Table 5: Descriptive Statistics for difference of posttest result outcome score by class for the Control Group

CLASS	N	Minimum	Maximum	Mean	Std. Deviation
T1Non-ARS	19	48	78	69.95	7.114
T2Non-ARS	19	40	91	68.05	16.645
T3Non-ARS	19	64	93	78.63	8.713
T4Non-ARS	19	23	76	49.68	17.114
T5Non-ARS	20	40	91	66.30	17.394
T6Non-ARS	18	40	91	62.17	15.931
T7Non-ARS	18	40	91	61.56	16.346

Table 5: Descriptive Statistics for difference of posttest result outcome score by class for ARS classes

CLASS	N	Minimum	Maximum	Mean	Std. Deviation
T1ARS	21	51	89	73.05	10.447
T2ARS	18	40	91	73.72	14.966
T3ARS	21	49	91	78.33	10.753
T4ARS	18	36	98	69.94	20.495
T5ARS	18	40	92	75.39	14.476
T6ARS	17	35	90	68.94	14.801
T7ARS	17	35	89	68.29	13.873

- Class 11, 12: No significant difference was found (t(33) = -.57, p>0.05. The variance of the ARS group (M= 64.88, SD = 13.68) was not significantly different from the variance of the non-ARS group (M= 62.11, SD = 14.65.
- Class 13, 14: No significant difference was found (t(33) =.76, p>0.05. The variance of the ARS group (M= 63.65, SD = 11.69) was not significantly different from the variance of the non-ARS group (M= 60.28, SD = 14.04.

Data Analysis and Interpretation of Result from the Outcome by Classes: The difference of result outcome was used to measure and compare the achievement of students in the control group against students in the treatment group. Means and standard deviations of the different posttest result outcome scores by class are presented below (Table 4 and Table 5). In general, the maximum posttest scores from classes which used ARS appeared to be higher than the maximum scores from the control group. Out of the 7 classes, 4 maximum values are from the ARS group. Higher average posttest scores between the control and the ARS group from different classes are mostly from ARS group as shown by 6 out of 7 average posttest scores. The group which produced the highest average came from class T5 of ARS group with a score of 75.39 while the lowest average score, 49.68, came from T4 of the control group. Figure 4 also shows the boxplot representing the descriptive statistics of posttest score difference organized by class. The independent sample t-test was used to compare the control group and treatment group and to discover any significant differences between the groups result outcome scores. As a requirement for using independent samples T-test, it is

Table 6: Independent Sample T-Test of mean difference between posttest result outcome score in control group and treatment group by class.

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
CLASS 1	Equal variances assumed	4.479	.041	-1.085	38	.285	-3.100	2.857	-8.884	2.683
	Equal variances not assumed			-1.106	35.417	.276	-3.100	2.804	-8.790	2.589
CLASS 2	Equal variances assumed	.318	.577	-1.087	35	.284	-5.670	5.214	-16.254	4.915
	Equal variances not assumed			-1.091	34.911	.283	-5.670	5.199	-16.224	4.885
CLASS 3	Equal variances assumed	.500	.484	.096	38	.924	.298	3.115	-6.009	6.605
	Equal variances not assumed			.097	37.574	.923	.298	3.082	-5.944	6.541
CLASS 4	Equal variances assumed	1.757	.194	-3.271	35	.002	-20.260	6.194	-32.835	-7.685
	Equal variances not assumed			-3.255	33.197	.003	-20.260	6.225	-32.922	-7.598
CLASS 5	Equal variances assumed	1.784	.190	-1.740	36	.090	-9.089	5.225	-19.685	1.508
	Equal variances not assumed			-1.757	35.800	.088	-9.089	5.174	-19.584	1.406
CLASS 6	Equal variances assumed	.172	.681	-1.301	33	.202	-6.775	5.206	-17.366	3.817
	Equal variances not assumed			-1.304	32.993	.201	-6.775	5.195	-17.343	3.794
CLASS 7	Equal variances assumed	1.576	.218	-1.311	33	.199	-6.739	5.140	-17.196	3.719
	Equal variances not assumed			-1.317	32.644	.197	-6.739	5.115	-17.150	3.673

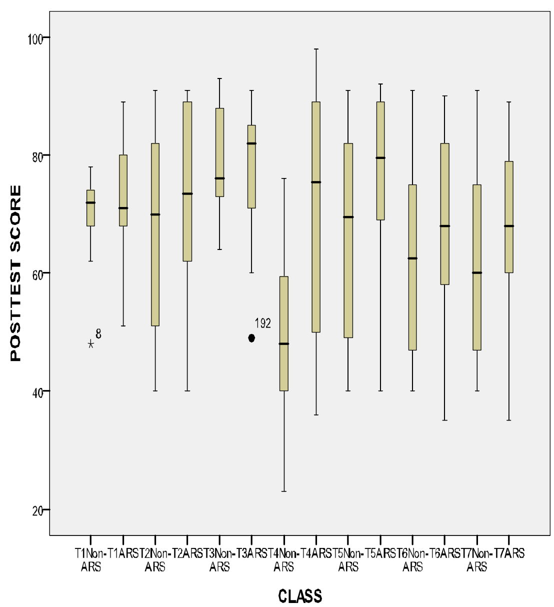

Fig. 5: Boxplot representing posttest result outcome score difference organized by class

necessary to examine the variances of each group to determine if equal variances exist. The statistical test for homogeneity used in this study was Levene's test for equality of variances. Table 6 illustrates the results from the Levene's test for equality of variance

The test for equality of variances determined that the data in classes 2, 3, 4, 5, 6 and 7 did not have a significant p-value at alpha = 5%. This shows that there is no significant difference in the variances of the two groups at the $\alpha = 0.05$ level. However, the test for equality of variances determined that the data in class 1 had a p-value greater than 5%, thus, resulting in significantly different variances. As a result, variances can be assumed to be equal when conducting the independent samples T-test calculation for the last six classes; however, variances cannot be assumed to be equal when conducting the independent samples T-test calculation for class 1. The following are the statistical details of the results for each pair of classes taught by the same teacher:

- Class 1, 2: A difference was found ($t(38) = -1.09$, $p<0.05$); Cohen's d=0.35. The mean of the ARS group *(M= 73.05*, SD = *10.45*) was significantly higher than the mean of the non-ARS group (M= 69.95, SD= *7.11*).With the application of ARS in the learning environment of the students, the posttest scores produced were significantly higher than the scores from the group with the traditional lecture setting.
- Class 3, 4: No significant difference was found ($t(35) = -1.08$, $p>0.05$; Cohen's d = 0.36. The mean of the ARS group (M= 73.72, SD=14.96) was not significantly different from the mean of the non-ARS group (M= 68.05, SD= 16.645). With the application of ARS in the learning environment of the students, the posttest scores produced from the ARS group and the control group were not significantly different from each other.
- Class 5, 6: No significant difference was found ($t(38) = 0.09$, $p>0.05$; Cohen's d = 0.03. The mean of the ARS group (M= 78.33, SD = 10.753) was not significantly different from the mean of the non-ARS group (M= 78.63, SD = 8.713. With the application of ARS in the learning environment of the students, the posttest scores produced from the ARS group and the control groups were not significantly different from each other.

- Class 7, 8: No significant difference was found (t(35) = -3.27, p>0.05; Cohen's d = 1.07. The mean of the ARS group (M= 69.94, SD = 20.49) was not significantly different from the mean of the non-ARS group (M= 49.68, SD = 17.11.With the application of ARS in the learning environment of the students, the posttest scores produced from the ARS group and the control group were not significantly different from each other.
- Class 9, 10: No significant difference was found (t(36) = -1.74, p>0.05; Cohen's d = 0.56. The mean of the ARS group (M= 75.39, SD = 14.476) was not significantly different from the mean of the non-ARS group (M= 66.30, SD = 17.39.With the application of ARS in the learning environment of the students, the posttest scores produced from the ARS group and the control group were not significantly different from each other.
- Class 11, 12: No significant difference was found (t(33) = -1.30, p>0.05; Cohen's d = 0.44. The mean of the ARS group (M= 68.94, SD = 14.801) was not significantly different from the mean of the non-ARS group (M= 62.17, SD = 15.93.With the application of ARS in the learning environment of the students, the posttest scores produced from the ARS group and the control group were not significantly different from each other.
- Class 13, 14: No significant difference was found (t(33) = -1.31, p>0.05; Cohen's d = 0.44. The mean of the ARS group (M= 68.29, SD = 13.87) was not significantly different from the mean of the non-ARS group (M= 61.56, SD = 16.346.With the application of ARS in the learning environment of the students, the posttest scores produced from the ARS group and the control group were not significantly different from each other.

Data Analysis and Interpretation of Result from Accumulated Classes: A One-way ANOVA was performed to accumulate all control and treatment group between the non-ARS classes, as well as the ARS classes to determine if there are any significant differences between the teachers' or classes. The decision to use a one-way ANOVA was based on the fact that a one-way ANOVA compares the means of two or more groups of subjects that vary on a single independent variable. When there are more than two groups, a T-test could be used to determine differences between two groups; however, more than two T-tests would need to be performed. When multiple T-tests are conducted there are higher chances for a Type I error and therefore, higher chances of drawing inappropriate conclusions. Under typical conditions, each statistical analysis has a 5 percent chance of being wrong just by chance. Given the number of groups to be compared on the table below, we have 7 classes and comparing two groups at a time for all the groups would mean 21 comparisons, 5 percent of 21 is 1.05. This would mean that you could expect that when you do 20 analyses or more, one of them would give a wrong result, just by chance. ANOVA compensates for these multiple comparisons and gives a single answer that determines if any of the groups is different from any of the other groups.

First, the mean difference of posttest result outcome score of control group from seven different teachers was compared using a one-way ANOVA. There was a significant difference between groups as determined by one-way ANOVA F(6,123)= 10.760, p<O.05). The students' scores from the seven different non-ARS classes differed significantly (Tables 7 and 8).The effect of the different teachers to the average posttest scores varies from one non-ARS class to another.

Second, the mean difference of posttest result outcome scores of ARS (treatment group) students from seven different teachers was compared using a one-way ANOVA. There was a significant difference between groups as determined by one-way ANOVA F(6,125) = 3.116, p<.05). The students' scores from the seven ARS classes differed significantly (Tables 9 and 10). Seven ARS classes taught by different teachers produced at least one significantly different average posttest score. This could mean that within the ARS classes, the difference in the average posttest scores from the students are affected by the teachers.

From the results so far, there was significant differences between the groups as a whole. The table 11 below, multiple comparisons shows which groups differed from each other. The Tukey post-hoc test is generally the preferred test for conducting post-hoc tests on a one-way ANOVA. Pairwise mean comparison such as Tukey's was used after a significant result from the ANOVA is achieved. This was to determine specifically which group of means differ from each other and which means are in a group with the others. In the case that the overall ANOVA shows significance, but the post-hoc comparisons do not show any significant difference among the groups, the post-hoc comparisons are more powerful and focused and should be the ones trusted (Hsu, 1996). We can see from the (table 4.12) below that there is a significant difference of posttest result outcome

Table 7: Descriptive Statistics for mean difference of posttest result outcome scores of all non-ARS groups

					95% Confidence Interval for Mean			
Class	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Class 1	19	69.95	7.114	1.632	66.52	73.38	48	78
class 2	19	68.05	16.645	3.819	60.03	76.08	40	91
class 3	19	78.63	8.713	1.999	74.43	82.83	64	93
class 4	19	49.68	17.114	3.926	41.44	57.93	23	76
class 5	20	66.30	17.394	3.889	58.16	74.44	40	91
class 6	18	53.22	11.441	2.697	47.53	58.91	34	73
Class 7	16	56.94	12.047	3.012	50.52	63.36	40	80
Total	130	63.50	16.376	1.436	60.66	66.34	23	93

Table 9: Descriptive Statistics for mean difference of posttest result outcome scores for all ARS groups

					95% Confidence Interval for Mean			
Class	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Class 1	21	73.05	10.447	2.280	68.29	77.80	51	89
Class 2	18	73.72	14.966	3.527	66.28	81.16	40	91
Class 3	21	78.33	10.753	2.347	73.44	83.23	49	91
Class 4	18	69.94	20.495	4.831	59.75	80.14	36	98
Class 5	18	75.39	14.476	3.412	68.19	82.59	40	92
Class 6	19	64.53	15.313	3.513	57.15	71.91	30	84
Class 7	17	61.35	16.093	3.903	53.08	69.63	33	89
Total	132	71.14	15.498	1.349	68.48	73.81	30	98

Table 10: ANOVA Results of mean difference of posttest result outcome of all ARS groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4093.194	6	682.199	3.116	.007
Within Groups	27371.072	125	218.969		
Total	31464.265	131			

Table 11: Tukey's HSD Post-Hoc comparison of mean difference of posttest result outcome scores of all treatment groups

					95% Confidence Interval	
(I) Class	(J) Class	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Class 1	Class 2	-.675	4.753	1.000	-14.92	13.57
	Class 3	-5.286	4.567	.908	-18.97	8.40
	Class 4	3.103	4.753	.995	-11.14	17.35
	Class 5	-2.341	4.753	.999	-16.59	11.90
	Class 6	8.521	4.685	.538	-5.52	22.56
	Class 7	11.695	4.828	.198	-2.77	26.16
Class 2	Class 1	.675	4.753	1.000	-13.57	14.92
	Class 3	-4.611	4.753	.959	-18.86	9.63
	Class 4	3.778	4.933	.988	-11.00	18.56
	Class 5	-1.667	4.933	1.000	-16.45	13.12
	Class 6	9.196	4.867	.491	-5.39	23.78
	Class 7	12.369	5.005	.179	-2.63	27.37
Class 3	Class 1	5.286	4.567	.908	-8.40	18.97
	Class 2	4.611	4.753	.959	-9.63	18.86
	Class 4	8.389	4.753	.574	-5.86	22.63
	Class 5	2.944	4.753	.996	-11.30	17.19
	Class 6	13.807	4.685	.057	-.23	27.85
	Class 7	16.980*	4.828	.011	2.51	31.45

Table 11: Continue

(I) Class	(J) Class	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Class 4	Class 1	-3.103	4.753	.995	-17.35	11.14
	Class 2	-3.778	4.933	.988	-18.56	11.00
	Class 3	-8.389	4.753	.574	-22.63	5.86
	Class 5	-5.444	4.933	.926	-20.23	9.34
	Class 6	5.418	4.867	.923	-9.17	20.00
	Class 7	8.592	5.005	.606	-6.41	23.59
Class 5	Class 1	2.341	4.753	.999	-11.90	16.59
	Class 2	1.667	4.933	1.000	-13.12	16.45
	Class 3	-2.944	4.753	.996	-17.19	11.30
	Class 4	5.444	4.933	.926	-9.34	20.23
	Class 6	10.863	4.867	.286	-3.72	25.45
	Class 7	14.036	5.005	.083	-.96	29.03
Class 6	Class 1	-8.521	4.685	.538	-22.56	5.52
	Class 2	-9.196	4.867	.491	-23.78	5.39
	Class 3	-13.807	4.685	.057	-27.85	.23
	Class 4	-5.418	4.867	.923	-20.00	9.17
	Class 5	-10.863	4.867	.286	-25.45	3.72
	Class 7	3.173	4.940	.995	-11.63	17.98
Class 7	Class 1	-11.695	4.828	.198	-26.16	2.77
	Class 2	-12.369	5.005	.179	-27.37	2.63
	Class 3	-16.980*	4.828	.011	-31.45	-2.51
	Class 4	-8.592	5.005	.606	-23.59	6.41
	Class 5	-14.036	5.005	.083	-29.03	.96
	Class 6	-3.173	4.940	.995	-17.98	11.63

*. The mean difference is significant at the 0.05 level.

of class 3 (p = 0.011) as well as class 7 (p = 0.011). However, there were no differences found from class 1, 2, 4, 5 and 6. There is a significant difference between the mean posttest scores from group 3 and group 7 however, groups 1, 2, 4, 5 and 6 all have similar averages to group 3 and group 7. The average from group 3 has the largest average between the classes while average from group 7 has the smallest value. In comparing group of means, all means will be listed in descending order and each mean will be compared to all the other means. In this case, group 3 has the largest mean and is first compared to all the other means. Group 7 having the least average produced a significantly larger difference with group 3's average. The next comparison will include group 5's average to all the other means. Given an average not so close and not so far from both group 3's and group 7's averages, group 5 resulted to have the same averages with the two groups (3 and 7). The same procedure will be done to groups 2, 1, 4 and 6. Results from these comparisons are the same with group 5.

Data Analysis and Interpretation of the Result from Combined Classes: Data from the difference in students' posttest scores from all ARS classes were analyzed against data from the difference in students' posttest scores in all non-ARS classes. Means and standard deviations of the difference of posttest scores for all ARS and all non-ARS groups are presented below (Table 12). In general, the average posttest scores from non-ARS group tend to be smaller than the ARS group. A larger standard deviation can also be seen from the group, implying varied results from the different classes without the application of ARS. Also, as clearly visualized by the boxplot, there was a wider spread of the values from the control group than the treatment group. The median, in this case, is still higher in the treatment group than the control group. Figure 5 shows the boxplot representing posttest score difference for all ARS and non-ARS Classes.

An independent samples T-test was conducted to compare the combined ARS classes and combined non-ARS classes and to discover any significant differences between the groups' result outcome scores. The statistical test for homogeneity used once again was Levene's test for equality of variances. Table 13 illustrates the results from the Levene's test for equality of variance.

As implied by the p-value = 0.059, a value that is higher than the preset alpha = 0.05, the variances of the two groups, ARS and non-ARS groups, are not significantly different from each other. The criteria being satisfied, the Independent T-test for the comparison of means between the two groups may be used.

Table 12: Descriptive Statistics of posttest scores differences in control group and treatment group Classes

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
POSTTEST SCORE	Control Group Score	132	65.25	16.613	1.446
	Treatment Group Score	130	72.73	14.498	1.272

Table 13: Independent Samples T-Test of mean differences between posttest scores in ARS and non-ARS groups

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
POSTTEST SCORE	Equal variances assumed	3.58	.059	-3.88	260	.000	-7.481	1.92	-11.27	-3.68
	Equal variances not assumed			-3.88	256.30	.000	-7.481	1.92	-11.27	-3.68

An independent-samples t-test was conducted to compare posttest result outcome of student utilizing ARS and non-ARS classes. There was a significant difference in the scores for ARS class (M = 72.73, SD = 14.49) and non-ARS (M = 65.25, SD = 16.61) groups; t (260) = -3.881, p =.001; Cohen's d = 0.47. These results suggest that utilizing ARS in the computer studies class really does have an effect on students' result outcome score. Specifically, our results suggest that when teacher utilize ARS in the classroom, students' result outcome increases.

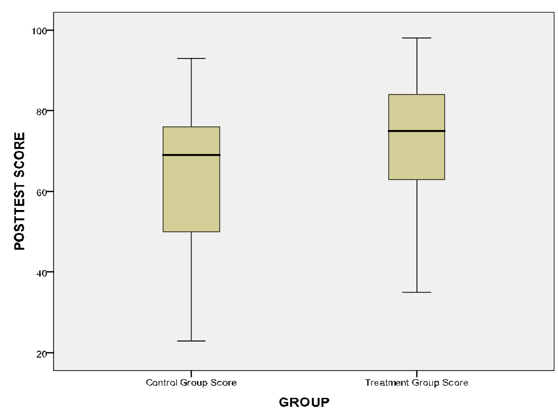

Fig. 6: Boxplot representing posttest score difference for all ARS and non-ARS Classes

Data Analysis and Interpretation of the Result from All Classes Combined Excluding the Researcher's Class: Removing personal biases is a key aspect of quantitative research. The data related to human subject has a possibility of researcher bias; although in hard sciences, quantitative research has a very minimal amount of bias. The research bias is assessed based on whether the researcher has a considerable chance of failing to perform his or her duties due to conflict of interest (Shamoo and Resnik, 2009). The participation as a trainer as well as teacher in one pair of ARS and non-ARS classes (classes 1, 2) may cause some concern of the researcher bias. To allay this fear of the researcher bias and promote trust of the findings is to present the results without the researcher's pair of control and treatment groups; so, only reporting results for classes two through seven. The data from the difference in students' posttest scores from the last six ARS classes were analyzed against data from the difference in students' posttest scores in the last six non-ARS classes. Means and standard deviations of the difference of posttest scores for all six ARS and all six non-ARS groups are presented below (Table 14). Still after eliminating class 1 and 2 from the total scores of the students, the average from the ARS group still appeared to be higher than the average from the control group. And since bias due to the researcher has been removed, the new averages provided a much more valid result showing an advantage on the use of ARS as also implied by the independent T-test conducted for the averages of the two groups. Figure 6 shows the boxplot representing posttest score difference for the last six ARS and non-ARS Classes.

An independent sample T-test was calculated comparing the mean differences of posttest scores in the last six ARS groups to the mean differences of posttest scores in the last six non-ARS groups (Table 15). An independent samples t-test was conducted to compare posttest result outcome of student utilizing ARS and non-ARS classes excluding the researchers' class. There was a significant difference in the scores for ARS class (M = 72.67, SD = 15.19) and non-ARS (M = 64.46, SD = 17.61) groups; t (220) = -3.71, p =.001; Cohen's d = 0.49.

Data Analysis and Interpretation of All Classes Combined by Country: Data from the difference in students' posttest scores from Malaysia were analyzed against data from Philippines. Means and standard deviations of the difference of posttest scores for all classes utilizing ARS and non-ARS groups are presented

Table 14: Descriptive statistics of difference of posttest scores in classes 2,3,4,5.6,7

GROUP	N	Minimum	Maximum	Mean	Std. Deviation
Control Group Score	113	23	93	64.46	17.615
Treatment Group Score	109	35	98	72.67	15.193
Total	222	23	98	68.49	16.941

Table 15: Independent Samples T-Test of mean differences between posttest in ARS and Non-ARS groups of classes 2, 3, 4, 5, 6, 7

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
POSTTEST SCORE	Equal variances assumed	4.90	.028	-3.71	220	.000	-8.21	2.21	-12.56	-3.85
	Equal variances not assumed			-3.72	217.32	.000	-8.21	2.20	-12.55	-3.86

Table 16: Descriptive statistics of difference of posttest scores in ARS classes and non-ARS classes by country

Country	N	Minimum	Maximum	Mean	Std. Deviation
Malaysia	121	24	93	72.77	13.593
Philippines	141	23	98	65.70	17.218
Total	262	23	98	68.96	16.014

Table 17: Independent Samples T-Test of mean differences between posttest scores in ARS class and Non-ARS class by country.

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
POSTTEST SCORE	Equal variances assumed	16.673	.000	3.647	260	.000	7.074	1.939	3.255	10.892
	Equal variances not assumed			3.713	258.267	.000	7.074	1.905	3.322	10.825

Table 19: Descriptive Statistics for mean difference of pretest and posttest result outcome

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRETEST SCORE	65.91	262	14.125	.873
	POSTTEST SCORE	68.96	262	16.014	.989

Table 20: Paired sample test of pretest and posttest result outcome

Paired Samples Test									
		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	PRETEST SCORE - POSTTEST SCORE	-3.050	5.239	.324	-3.687	-2.412	-9.422	261	.000

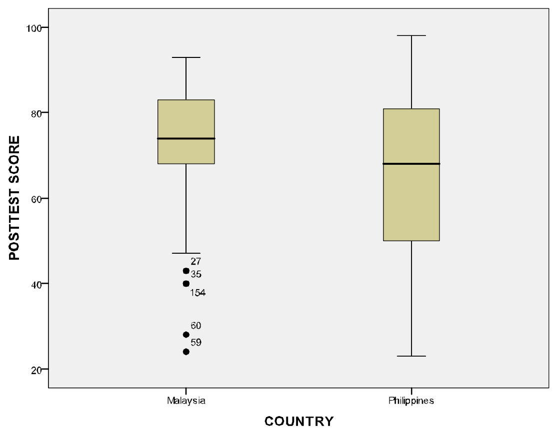

Fig. 8: Boxplot representing posttest score in ARS classes and non-ARS classes by country

below (Table 16). Though the samples from the two countries are different (121 from Malaysia and 141 from the Philippines), the difference can be accounted from their averages as the scores will be estimated in general for each student. As presented in the table below, the average from Malaysian students from ARS and non-ARS groups is higher than the average from the Filipino students.

Figure 7 shows the boxplot representing posttest score difference for all ARS and non-ARS Class by country. The boxplot below showed a wider spread of values of scores from the Filipino students while Malaysian tends to have a much smaller range. There were four outliers as presented by the small dots on the plot. These outliers are more inclined on the lower side of the graph thus, a possibility of pulling the large total scores of the other Malaysian students down.

An independent-samples t-test was conducted to compare posttest result outcome of student utilizing ARS and non-ARS classes by country (Table 4.18). There was a significant difference in the posttest result outcome scores for class in Malaysia (M = 72.77, SD = 13.59) and Philippines class (M = 65.70, SD = 17.21); t (260) = 3.647, p =.001; Cohen's d = 0.46. These results suggest that there is a difference in the posttest scores of Malaysian and Filipino students from the ARS and non-ARS group

Result Analysis of Pretest and Posttest Result Outcome Score: A paired-samples t-test was conducted to compare pretest and posttest result outcome of both control and treatment group. There was a significant difference in the scores for posttest (M=68.96, SD=16.014) and pretest (M=65.91, SD=14.125) conditions; t(261) = 9.42, p < 0.05 (Table 19 and Table 20). These results suggest that posttest score is higher than the pretest. Specifically, our results suggest that when classes utilize ARS, the student result outcome increases.

RESULTS AND CONCLUSION

This paper presents an investigation of the impact of ARS on performance outcomes. The study uses qualitative experiment and evaluates the impact of ARS within some sample of secondary school pupils. An Independent samples T-test was calculated comparing the mean differences of posttest result outcome scores in the treatment group to the mean differences of posttest result score in the control group for each pair of classes taught by the same teacher. No significant difference was found except in class 1 and 2. Comparing the same set of classes taught by the same teacher eliminates the possible effect from the teacher. And based on the results, the classes taught by the same teacher but on different settings, one with ARS and the other without ARS, are not significantly different except from the classes 1 and 2. Eliminating the effect of bias from the teacher, the first set of comparison (classes 1 and 2) still produced significantly different results. In order to combine all ARS and all non-ARS classes, a one-way ANOVA was conducted on the mean difference of scores for both ARS and non-ARS classes to identify any significant difference among the classes. There was a significant differences found among the seven ARS classes and the non-ARS classes. Thus, the classes taught in an environment with ARS produced significantly different scores from each other. Another test was also conducted to determine differences in scores between the classes taught using the traditional setting. Based on the results, even after the application of the same settings on their lectures, the group with ARS still produced varied results. And the non-ARS group also produced varied results. The seven classes in each group were combined to determine the significance. An independent sample T-test was conducted comparing the mean posttest result score in the ARS group to the mean posttest result score in the non-ARS group. There was a significant difference found. As it was previously tested, the difference between the same groups of classes taught by the same teacher only produced significant results for classes 1 and 2. This may have affected the overall average posttest scores when the average scores from the ARS group and the non-ARS group are being compared. Analysis of results for the comparison of all combined ARS and all combined non-ARS classes, excluding the

Table 21: Summary result of experiment analysis

No		Class	Independent sample t-test	Significant/No Significant
1		By Class/Teacher		
	Pretest	Class 1, 2	(t(38) = -.459, p>0.05)	No Significant
		Class 3, 4	(t(35) = -.002, p>0.05)	No Significant
		Class 5, 6	(t(38) = 1.297, p>0.05)	No Significant
		Class 7, 8	(t(35) = -.2879, p>0.05)	No Significant
		Class 9, 10	(t(36) = -1.578, p>0.05)	No Significant
		Class 11, 12	(t(33) = -.579, p>0.05)	No Significant
		Class 13, 14	(t(33) =.769, p>0.05)	No Significant
2		By Class/Teacher		
	Posttest	Class 1, 2	(t(38) = -1.09, p<0.05); Cohen's d = 0.35	Significant
		Class 3, 4	(t(35) = -1.08, p>0.05); Cohen's d = 0.36	No Significant
		Class 5, 6	(t(38) = 0.09, p>0.05); Cohen's d = 0.03	No Significant
		Class 7, 8	(t(35) = -3.27, p>0.05); Cohen's d = 1.07	No Significant
		Class 9, 10	(t(36) = -1.74, p>0.05); Cohen's d = 0.56	No Significant
		Class 11, 12	(t(33) = -1.30, p>0.05); Cohen's d = 0.44	No Significant
		Class 13, 14	(t(33) = -1.31, p>0.05); Cohen's d = 0.44	No Significant
3		Accumulated Class	ANOVA	
	Posttest	Non-ARS Class	(F(6,123) = 10.760, p<0.05)	Significant
		ARS Class	(F(6,125) = 3.116, p<0.05)	Significant
			Independent sample t-test	
4	Posttest	Combined Classes	(t(260) = -3.881, p< 0.05); Cohen's d = 0.47	Significant
5		Excluding Researcher Class	(t(220) = -3.71, p<0.05); Cohen's d = 0.49.	Significant
6		By Country	(t(260) = 3.647, p<0.05); Cohen's d = 0.46.	Significant
		Paired Samples Test		
7		Pretest and Posttest Comparison	t(261) = 9.42, p < 0.05.	Significant

researcher's own class. Since we had eliminated the possibility of having the different teachers teaching the same course on two kinds of settings to have an effect on the scores, the researcher's bias on one of the group was also eliminated for this analysis. An independent sample T-test was calculated comparing the mean differences of posttest result outcome score of the first six ARS classes to the mean differences of posttest result outcome scores in the first six non-SRS classes. There was a significant difference between the two groups. Analysis of results for the comparison of all combined ARS and all combined non-ARS classes by country. There was a significant difference between the two countries. Our study was composed not mainly of students of the Philippines but also from another Asian country, that is, Malaysia. Since we did not compare the ARS and the non-ARS group from these two countries, instead the comparison is done between the two countries comprising of students both from ARS and non-ARS group, the result can only be used to determine the difference in the scores of the students from the same course, that is, Computer studies, by country. And as initially stated, the result was significant, showing that Malaysian students produced significantly higher scores from Computer studies regardless is the subject was being taught on an environment with ARS or without. A paired-samples t-test was conducted to compare pretest and posttest result outcome of both control and treatment group. There was a significant difference in the scores for posttest. The analysis for the improvement of the scores after the subject was taught in a setting with ARS was implemented to determine if, in general, ARS could be of great help in improving the average scores of students specifically in Computer studies. The significant result only showed that Audience Response System can be used as a tool for increasing scores of students. The statistical analysis of the pretest and posttest result outcome score, reveal significant differences for most of the major comparisons. There were comparisons for which no significant difference was found mostly in by class (Refer to the above table 21 below). Above all ARS is secure, this could be verifiable via risks assessment [35-37].

REFERENCES

1. Judson, E. and D. Sawada, 2002. Learning from Past and Present: Electronic Response Systems in College Lecture Halls. Journal of Computers in Mathematics and Science Teaching, 21(2): 167-181.

2. Treat, A.R., Y. Wang, R. Chadha and M.H. Dixon, 2006. Major Developments in Instructional Technology: During the 20th Century. Retrieved April 18, 2011from: http://www. indiana. edu/~idt/shortpapers/documents/ITprior20.html.
3. Abdullah, A., M.A. Embi and N. Nordin, 2011. The Role of Students in the Development of a Collaborative Learning Community through Networked Learning: A Malaysian Perspective. The International Journal of Learning, 18(1): 347-360.
4. Embi, M.A., A. Hamat and A.H. Sulaiman, 2011. The Use of Learning Management Systems Among Malaysian University Lecturers. The International Journal of Learning, 18(4): 61-70.
5. Hamzah, I., A. Ismail, A.H. Tamuri, M.A. Embi and A.L. Maimun, 2011. The Emergence of New Technology in Malaysian Smart Schools: Views of Islamic Education Teachers and Students. The International Journal of Learning, 16(4): 249-262.
6. Nordin, N., N.M. Isa, E. Zakaria and M.A. Embi, 2011. Development and Evaluation of Webquest for the Science Subject. The International Journal of Learning, 18(5): 221-236.
7. Ely, D.P., 2000. The field of educational technology: Update 2000: A dozen frequently asked questions. ERIC Clearinghouse on Information and Technology. Retrieved April 18, 2011 from http://www.eric. ed. gov/PDFS/ED438807.pdf.
8. Kaleta, R. and T. Joosten, 2007. Student response systems: A University of Wisconsin study of clickers. EDUCAUSE Center for Applied Research, Research Bulletin, 10: 2-12.
9. Banks, D.A., 2006. Audience Response Systems in Higher Education: Application and Cases. Idea Group Inc. Australia.
10. Ayu, M.A., K. Taylor and T. Mantoro, 2009. Active learning: Engaging Students in the Classroom Using Mobile Phones. IEEE Symposium on Industrial Electronics and Applications (ISIEA 2009), pp: 711-715.
11. Bonwell, C. and J. Eison, 1991. Active Learning: Creating Excitement in the Classroom. ERIC Clearinghouse on Higher Education Washington DC.
12. Boyle, J.T. and D.J. Nicol, 2003b. Using classroom communication systems to support interaction and discussion in large class settings. ALT-J, 11(3): 43 -57.
13. Mantikayan, J.M. and M.A. Ayu, 2010. Exploring audience response system: Impacts in learning institutions. Information and Communication Technology for the Muslim World (ICT4M), A13- A17.
14. Mattheos, N., 2004. Information Technology and Interaction in Learning: Studies of Applications in Academic Oral Health Education. Centre for Educational Research and Technology in Oral Health, Sweden.
15. Beatty, I., 2004. Transforming student learning with classroom communication systems. EDUCAUSE Research Bulletin, 2004(3): 1-13.
16. Weinstein, C.E., 1989. Helping Students Develop Strategies for Effective Learning. Educational Leadership, 46(4): 17-19.
17. Mantikayan, J.M., M.A. Ayu, T. Mantoro and H. Mohammed, 2012. The Effects of Audience Response Systems on Active Learning. Proceedings of International Conference on Active Learning (ICAL 2012), Melaka, Malaysia.
18. Cue, N., 1998. A Universal Learning Tool for Classrooms? First Quality in Teaching and Learning Conference.
19. Dufresne, R.J., W.J. Gerace, J.P. Mestre and W.J. Leonard, 2000. Assessing Student Knowledge with Instructional Technology. University of Massachusetts Physics Education Research Group UMPERG Technical Report, pp: 1-28.
20. Burnstein, R.A. and L.M. Lederman, 2001. Using wireless keypads in lecture classes. The Physics Teacher, 39(1): 8-11.
21. Crouch, C.H. and E. Mazur, 2001. Peer instruction: Ten years of experience and results. American Journal of Physics, 69(9): 970-977.
22. Paschal, C.B., 2002. Formative Assessment in Physiology Teaching using a Wireless Classroom Communication System. Advance in Physiology Education, 26(4): 299-308.
23. Elliott, C., 2003. Using a Personal Response System in Economics Teaching. International Review of Economics Education, 1(1): 80-86.
24. Wit, E., 2003. Who wants to be... The use of a personal response system in statistics teaching. MSOR Connections, 3(2): 14-20.
25. Boyle, J.T. and D.J. Nicol, 2003a. Peer Instruction versus Class-wide Discussion in Large Classes: a comparison of two interaction methods in the wired classroom. Society for Research into Higher Education, 28(4): 457-473.

26. Banks, D.A., 2003. Using keypad-based group process support systems to facilitate student reflection. Proceedings of the 20th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE), 37-46.
27. Mantikayan, J.M. and M.A. Ayu, 2013. Assessing audience response systems using task-technology fit. Paper presented at the Information and Communication Technology for the Muslim World (ICT4M), 2013 5th International Conference on.
28. Lopez-Herrejon, R.E. and M. Schulman, 2004. Using Interactive Technology in a Short Java Course: An Experience Report. ITiCSE ’04.
29. Silliman, S.E. and L. McWilliams, 2004. Observations on Benefits/Limitations of an Audience Response System. Proceedings of the 2004 American Society for Engineering Education Annual Conference and Exposition (Session Number: 2531).
30. Adamu I. Abubakar, Teddy Mantoro and Murni Mahmud, 2011. Exploring end-user preferences of 3D mobile interactive navigation design, Proceedings of the 9th International Conference on Advances in Mobile Computing and Multimedia, pp: 289-292
31. Badi, J. Maimona and M.Z. M Khedher, Akram and Mahmud, Murni, 2011. Relevance of multimedia in education. In: Advancement in E- learning. IIUM Press, Kuala Lumpur, pp: 11-14. ISBN 978-967-418-105-5.
32. Abubakar A. and T. Mantoro, 2012, "Web Application Development Process ", In Ayu. M.A. (Ed.) The Web: Its Utilisation, Evaluation and Security. IIUM Press. ISBN.: 978-967- 418-112-3
33. www.polleverywhere.com. 2012. Student Response System for K12. Retrieved: 28 May 2012 from http://www.polleverywhere.com/k12-student-response-system.
34. www.socrative.com. 2013. Socrative: engage the class. Retrieved on 4 October 2013 from http://www.socrative.com/how-it-works.
35. Abdullah, L.M. and J.M. Verner, 2009. Outsourced Strategic IT Systems Development Risk. RCIS, pp: 275-286.
36. Abdullah, L.M. and J.M. Verner, 2012. Analysis and application of an outsourcing risk framework. Journal of Systems and Software, 85(8): 1930-1952.
37. Verner, J.M. and L.M. Abdullah, 2012. Exploratory case study research: Outsourced project failure. Information and Software Technology, 54(8): 866-886.