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Effectiveness of Plasma Television Integration in Teaching Secondary School Biology

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The purpose of this study was to evaluate the relative effectiveness of Plasma TV (PTV) integration in teaching secondary school Biology at Haramaya University Secondary Model School Ethiopia. The sample consisted of 48 students from Grade 9 and were randomly split into control [non-plasma TV] and experimental [plasma TV] groups. A chapter on "Cell Biology" was taught to the two groups by two teachers having similar qualifications for a month's time. After the treatment, post-test was administered to the subjects. Independent-sample t-test was used to determine whether there was a statistically significant difference in the mean scores of the two groups. The analysis of data indicated that there were no significant differences in the mean scores between the two groups on pre and post- tests. Similarly, high achievers in the control and experimental groups didn't significantly differ either. Furthermore, there was no significant mean scores difference between low achievers of control and experimental groups. The results generally implied that teaching students through PTV didn't significantly contribute to better understanding of the lesson compared to the conventional method of teaching. Finally, the present study provides an opportunity to be replicated to make a comprehensive conclusion about the effectiveness of PTV to teach secondary school Biology.

Keywords: Effectiveness, Plasma Television, Integration, Teaching Secondary School Biology.

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Introduction And Background

Ethiopia is a federal democratic state located in the eastern part of Africa. It is one of the poorest countries in the world. According to the World Economic Freedom Index (WEFI, 2011) report, Ethiopia ranked 144 out of 179 countries in the world. Ethiopia's poverty-stricken economy is based on agriculture, accounting for almost 50% of GDP, and 85% of total employment. The agricultural sector suffers from frequent drought and poor cultivation practices (CIA World Factbook, 2012). According to the World Bank (2010) report, GDP per-capita (US$) was only 344.0 confirming that Ethiopia is one of the underprivileged nations in the globe. In 2012, Ethiopia's population is estimated to be 93, 815,992 (Index Mundi, 2012). Lastly, Ethiopia's Education expenditure, according to the World Bank report (2010), was 25.4% of the total government expenditure. In an attempt to reduce poverty and align herself by 2020 along with middle income countries, Ethiopia has been striving in devising various strategies that assist it in gearing towards achieving this goal. Among the strategies that exist is delivering quality, equitable, accessible and relevant education to its citizens. This was taken as a panacea to the problems.

Following the 1994 education and training policy reforms, the ministry of education (MOE, 1994) of the Federal Democratic Republic of Ethiopia (FDRE) has made a number of paradigm shifts with respect to the teaching and learning practices that encompassed the introduction of student-centred learning (active learning approaches), teachers training, ICT [such as television, radio, internet, videos, films etc.] integration in education and others. The need for these reforms was targeted in tackling problems related to the shortage of qualified and experienced teachers at all levels, lack of instructional aids, laboratories and the required chemicals and apparatuses; lack of ICT centres, poor curricular orientation and other handicaps (observed in the previous education system) have been hampering the access, relevance, equity and quality of education in Ethiopia for decades. In connection to this, the MOE (1994) stated that Ethiopia's education is entangled with complex problems of relevance, quality, accessibility and equity. The objectives of education didn't take cognizance of the society's needs and didn't adequately indicate future direction. The absence of interrelated contents and mode of presentation that can develop student's knowledge, cognitive abilities and behavioural change by level, to adequately enrich problem-solving ability and attitude, are some of the major problems of our education system. Inadequate facilities, insufficient training of teachers, overcrowded classes, shortage of books and other teaching materials, all indicate the low quality of education provided.

Ministry of Education, 2004 (MOE) believed that the successful integration and proper utilization of ICTs in schools could be considered as the panacea to the aforementioned educational crisis and hence, MOE stated, "the

introduction of ICT will be done phase by phase starting at the secondary level followed by the primary and then ultimately at all levels. At present for the secondary level (9-12) multi-faceted programmes and major preparations have been underway to reach the goal of implementing ICT in the education sector and improve the quality of education". Accordingly, the MOE of Ethiopia recently introduced educational broadcast through a satellite receiving device known as plasma display panel (PDP) which is commonly called plasma television [PTV] to all secondary schools throughout the country since 2004 whereby five subjects viz: Biology, Chemistry, Mathematics, Physics and Civic and Ethical Education are being broadcast and implemented for the last nine years.

The assumptions held by the MOE in integrating PTV based educational broadcast into the classrooms in all the secondary schools were that PTV:

- Presents abstract concepts in a simplified manner.
- Transmits uniform education to many students found in different places at the same time.
- Enables students to have access to model and competent teachers.
- Demonstrates laboratory equipment found in one place (classroom) to other learning classrooms.
- Brings the "real world" into a classroom.

Furthermore, MOE (2004) argued, "most high schools in our country used ICT to teach such practical subjects like physics, chemistry and Biology theoretically without adequate support with experiments. This was due to high scarcity of laboratory equipment and chemicals. Now it is possible to demonstrate experiments by using PTV that teachers are unable to exhibit in classrooms. In this respect, broadcasting television programs in every school from a centre using satellite technology is indispensable to improve the quality of education".

However, as the researcher's secondary school teaching experiences and secondary schools' stakeholders [teachers, students, parents etc.] reflections imply that the technology introduced [PTV] has remained a debatable issue as to its effectiveness in terms of interactivity, harmony with the traditional classroom teaching, curriculum, needs of the society, role of the classroom teacher, language of instruction, time allocation between classroom and PTV teachers, pace and length of broadcast, power supply, technical conditions; attitudes, awareness, and skills, cooperation and coordination between and among school community etc. are some of the crucial issues that the present researcher retrospect's. Similarly, studies by Hussein (2006), Tessema (2004), Bitew (2008) and Lemma (2006) also showed that a similar situation prevails in PTV educational broadcast. It is these "Customers" frequent complaints and dissatisfactions towards the way PTV educational broadcast is underway in

Ethiopian secondary schools that initiated the researcher to conduct the present experimental study on the effectiveness of PTV in teaching secondary school Biology. Thus, the present study was conducted at Haramaya University secondary model school mainly focusing on teaching and learning activities of secondary school Biology.

Review Of Related Literature

Educationists are of the opinion that the educational problems relating to quantity and quality could be tackled by the proper utilization of instructional technologies (IT). TV as compared to other instructional technologies, makes instructions more effective, understandable and meaningful (Gillani, 2005). Correspondingly, different studies (such as Mhlolo, 2007; Yusuf, 2005; Kulik and Kulik, 1991; cited in Aladejana, 2008), have noticed that IT has been identified as playing a critical role in curriculum implementation as it has been found that its proper use can enhance the process of teaching and learning. Furthermore, Nicolle (2005) claimed that IT is fundamentally aimed at improving the efficiency of the educational system by increasing the rate, depth, precision, and value of the learning, which takes place. These aims are also in line with the aims of IT as described by Gillani (2005). Different literatures (e.g. Neo, 2007; Rakes, Fields and Cox 2006; Sandholtz, Ringstaff and Dwyer 1997; cited in Abdo and Semela, 2010) contended that integration of IT in school curriculum is believed to bolster the quality of instruction via fostering student-centred pedagogies.

The successful integration of IT in education has the great potential to boost up the quality, quantity, relevance and equity. When properly utilized, IT exceedingly helps students' learning and hence, improves students' academic performances. Corroborating these points, Gillani (2005) claimed that the principal role of IT is to help improve the overall efficiency of the teaching/learning process. She further elaborated that in education and training, improved efficiency can manifest itself in many ways, for example (i) increasing the quality of learning, or the degree of mastery; (ii) decreasing the time taken for learners to attain desired goals; (iii) increasing the efficiency of teachers in terms of numbers of learners taught, without reducing the quality of learning.

In one of its studies, MOE (2004) pointed out that ICT greatly assists in realizing educational access, equity, relevance and quality. The same was reported by different literatures such as Aucoin and Learning, 2011; USAID, AED and EDC, 2005; Reddi, 2003; Abdo and Semela, 2010. In another study, Gillani (2005) remarked that IT has the potential for moving the old traditional education process from a teacher-focused inflexible structure to highly flexible and integrated learning environment. Without the complete integration of IT

into the education process, this environment will not be achievable and what we call 'educational' institutions today will lose their current dominant position as providers of education services. It's undeniable that learning technologies, TV among them, can be significant contributors to the students' academic performance (CPB, 2004).

Television, which is the main focus of this study, constitutes an important medium widely used to disseminate information to its viewers. It has the unique feature of combining audio and visual technology and thus, considered to be more effective than audio media. It serves multiple purposes of entertainment, edutainment, information and education. Besides performing motivational functions, it helps in providing discovery learning and cognitive development of its viewers. Because of its better accessibility, it can bring learning materials to the masses in more direct, effective and personal way than other educational media (Vyas, Sharma and Kumar, 2002). Moreover, CPB (2004) stated that one of television's most obvious characteristics is its visual aspect. Humans intuitively grasp the power of images to convey meaning, as can be seen in the old adage that values a picture at a thousand times the value of a word. Television, of course, offers information in multiple forms: not just images, but motion, sounds, and, at times, text. Research has shown that multiple tracks of audio and visual information convey powerful learning benefits, as each source complements the other.

Instructional Television (ITV), which is otherwise called Educational Television (ETV) in this inquiry, and which is also the focus of this study, is among the audio-visual technologies that can be used in education and ITV is believed to play an important role as other instructional technologies in improving students' understanding and retention of the subject matter they learned. It is the time-tested fact that apposite integration/utilization of ITV in the classroom lessons has the big power to increase the opportunity of students' learning through creating excitement, motivation, engaging, stimulating creative and critical thinking. Furthermore, ITV has the capability of concretizing the lessons students learn. Studies have shown that people generally remember 50% of what they learned through seeing and hearing (audio-visual learning). To see is to believe something. In many situations, seeing is remembering, too. In this regard the role of ITV is very high. In relation to this, research studies (such as Wiken, 2005) have demonstrated that the effective integration of technology into classroom instruction can positively impact students' motivation, engagement and interest in learning. He/she also indicated that the surveyed teachers believed this increased attention led to increased motivation and, retention which ultimately led to better learning and improvement in the students' academic performances.

ITV, in addition to providing information in a more entertaining format

which leads to an enjoyable classroom setting, studies have indicated that there is a direct relationship between attention and achievement in an educational setting (Brofenbrenner, 1976; Gagne, 1985), in Roussell (1996). As stated by Dave Hendry (2001), TV is an excellent medium for illustrating applications, describing context, and generating interest among learners. This explanation is in congruence with the findings of Vyas, Sharma and Kumar (2002); Sherry (1996); Kopp (1982 in Roussell, 1996,); Pettit (1998) and Hizal (1983). Similarly, multitudes of studies (such as MOE, 2004; 2005; NOUN, 2008; Wiken, 2005; Gillani, 2005) have substantiated that TV-based education has got paramount significances to students learning and better academic performances.

Despite the fact that integration of TV in education has myriads of useful benefits to students (MOE, 2004; 2010), sometimes lack of skills on how to watch TV lesson broadcasts, lack of proficiency in the language of broadcast, lack of keen attention, interest and intention, perception about TV lessons and so forth can have an awful effect in the academic performances of the students. There are a number of findings (for e.g., CPB, 2004; Kozma, 1991; Hussein, 2006; Tessema, 2006; Bitew, 2008) that support the idea that lack of the aforementioned aspects (skills, interests, attention, intention, language proficiency) adversely affects students' learning and their success. In particular, CPB (2004) contended that watching TV may seem a very simple act, but it actually involves a rather complicated thinking process.

Although PTV-based education in Ethiopia is considered as a "silver bullet" (as explained in the introductory part) to all of its educational problems (for e.g. availability and utilization of educational resources – such as teaching aids and science laboratory chemicals and equipments; quality and quantity of teaching staffs; educational quality, equity, access and relevance), as different studies such as Hussein (2006), Latchanna and Garkebo (2012); Tessema (2006), Bitew (2008; 2010); and Lemma(2006) show that the PTV broadcast has got several weaknesses that relate to the professional role of the classroom teacher; PTV's speed and language of broadcast; its interactivity, power supply, technical quality and flexibility. All the above inferences about the effectiveness of PTV-based education were purely based on survey studies i.e. they were not based on empirical data.

Therefore, the purpose of the present study was to experimentally evaluate the relative effectiveness of PTV integration in teaching secondary school Biology at Haramaya University Secondary model school in Ethiopia.

Objective Of The Study

The objective of the study is to assess the relative effectiveness of PTV integration in teaching secondary school Biology to students of both experimental and control groups.

Hypotheses

Keeping in view the objective stated above, the following null hypotheses [Ho] were formulated for testing.

i. There is no statistically significant difference between the performance of control and experimental groups on pre-test.
ii. There is no statistically significant difference between the performances of high achievers in the control and experimental groups on pre-test.
iii. There is no statistically significant difference between the performances of low achievers in the control and experimental groups on pre-test.
iv. There is no statistically significant difference between the performance of the control and experimental groups on post-test.
v. There is no statistically significant difference between the performances of low achievers in the control and experimental groups on post-test.
vi. There is no statistically significant difference between the performances of high achievers in the control and experimental groups on post-test.

Delimitation Of The Study

Owing to the constraints of money and time, the present study was curbed to only one secondary school. Furthermore, it didn't include all grade levels (9-12) and all subjects (students) rather; it focused on a randomly selected grade level (9th grade) and one subject (Biology).

Limitations Of The Study

Because of the very nature of the experimental study (costly and involving small experimental subjects) and constraints imposed (financial and time), the study was conducted in only one secondary school on 48 Grade 9 students for one month with two teachers of the same qualifications and work experiences. Thus, the outcome of the present study might be influenced by factors like the study period (one month), individual differences of the teachers, number, lack of exposure to PTV and attitudes of students involved in the study. Therefore, the findings of this study may not be generalized to the whole secondary schools in Ethiopia though the stipulated objectives of the study are successfully achieved. However, we (the authors), strongly believe that the present study can be taken as a quantum leap – a step forward in making its contributions in the PTV educational broadcast research and hence, it opens gates for further studies.

Research Methodology

Research Design

The experimental design is found to be most effective for this particular study

involving the pre-test and post-test equivalent group design. This design minimizes threats to the experimental validity. In this design, two groups are randomly formed from the total available students. One of the two groups is treated as an experimental group and the other a control group. This design affords an opportunity to check the initial equivalence of the two groups. Many other factors affecting the internal and external validity can also be controlled. The equivalence of the two groups was secured by equating the students of both groups on the variable of pre-test scores.

Furthermore, students under each group (control and experimental) were re-grouped as "low and high achievers". The purpose of formation of the groups was simply to see which method of instruction (PTV-based or traditional) favours which groups of students (high or low achievers). In another words, the purpose was to assess whether the treatments had same or different effects on the "low and high achievers" of the two groups. The grouping was based on the students' achievements in their pre-test. Finally, the mean scores of the experimental and control groups were subject to a test of statistical significance to achieve the objectives of the study.

Sample

Random sampling technique was adopted to select a grade level from grades 9-12. Accordingly, grade 9 was randomly chosen. Ninth grade had a total of 48 students divided (by the school) into two classes as section A and B. Since the total number of students was manageable, all the students were included in the study, which were later randomly categorized as control and experimental groups.

Treatment

The topic of instruction was randomly selected from the curriculum of Grade 9 Biology text book. Accordingly, chapter two which deals with "Cell Biology" was chosen. Under this chapter, cell types, shapes, structures and functions; cell and cell environments, cell solutions (Isotonic, hypotonic and hypertonic solutions), diffusion, osmosis and turgor pressure; Microscopes: types (light and electron), parts and their functions were thoroughly presented according to the time table set by MOE for both the plasma-based and non-plasma based modes of instruction. The topic was taught for a month with 17 contact hours for each group. Thus a total of 34 contact hours were spent for both control and experimental groups. The experimental group was exposed to 20-25 minutes of PTV instruction followed by 15-20 minutes of conventional method of teaching by the classroom teacher whereas the control group was treated by the conventional method of teaching for the whole 40 minutes by the classroom teacher.

Validity And Reliability

The content validity of the pre and post test were checked by the school's Biology teachers and head of the department of Biology to make sure that the tests were capable of measuring what they are intended to measure. Accordingly, valuable comments were given by the school's Biology teachers and department head. Similarly, reliability of the tests was calculated by using Cronbach's alpha (using SPSS) for their internal consistency. Accordingly, the reliability of the tests was estimated to be 0.70.

Data Analysis

The pre and post-test scores of both groups [control and experimental] were listed. After preparing lists of both test scores for each group, the means, standard deviations, and differences of the mean scores were computed using SPSS. Significance of differences between the mean scores on pre-test and post-test of the experimental and control groups were tested at 0.05 alpha level by applying t-test (independent samples t-test)

Results Of The Study

The analysis and interpretation of the data obtained through pre and post-test scores from both the control and experimental groups is summarized as the significance of difference between the mean scores of the control and experimental groups on pre and post-test scores in the selected Biology topic (Cell Biology). This is shown in tabular and descriptive forms hereunder for each hypothesis separately.

Assumption: Subjects whose pre and post-test scores are greater than the group mean score were considered as high achievers whereas those who scored below group mean score were sorted out as low achievers. Similar assumptions were made in earlier studies such as Gillani (2005).

Null Hypothesis 1: There is no statistically significant difference between the performance of control and experimental groups on pre-test. The results of Ho are presented in Table 1 below.

Table 1

Significance of the Difference Between the Mean Scores of Control and Experimental Groups on Pre-Test.

Group	N	Mean	SD	SEM	df	*t*
Control	24	50.63	10.481	2.14		1.029*
Experimental	24	47.57	10.084	2.06	46	

**Not Significant t-value at 0.05=2.02*

As can be seen from table 1 above, the mean scores of the pre-test in the selected topic of Biology for the control and experimental groups were 50.63 and 47.57 respectively. As the t-test statics shows, the difference between the two means was not statistically significant at alpha level of 0.05. Hence, the null hypothesis "There is no statistically significant difference between the performance of control and experimental groups on pre-test" was accepted. Therefore, both groups could be treated as equal with respect to the variable of pre-test scores in the selected Biology topic i.e. there was no significant difference between the control and experimental groups in terms of their academic performances before the application of the treatments.

Null Hypothesis 2: There is no statistically significant difference between the performances of high achievers in the control and experimental groups on pre-test. Table 2 below summarizes the results as follows.

Table 2

Significance of Difference Between the Mean Scores of High Achievers of the Control and Experimental Groups on Pre-Test

Group	N	Mean	SD	SEM	df	*t*
Control	12	42.50	5.71	1.65		0.56*
Experimental	14	41.07	7.09	1.89	24	

**Not Significant t-value at 0.05=2.09*

Table 2 above indicates that the mean scores of the high achievers of the control and experimental groups, on the pre-test in the selected Biology topic of treatment, were 59.03 and 56.67 respectively. The t-test proved that there was no statistically significant difference between the performances of high achievers of the control and experimental groups on pre-test. Accordingly, the null hypothesis "There is no statistically significant difference between the performances of high achievers of the control and experimental groups on pre-test" was accepted. Therefore, it can be concluded that high achievers in both groups had comparable abilities or performances before they were exposed to the experimental treatments.

Null Hypothesis 3: There is no statistically significant difference between the performances of low achievers in the control and experimental groups on pre-test. Table 3 below depicts the results for null hypothesis three.

Table 3

Significance of Difference Between the Mean Scores of Low Achievers of the Control and Experimental Groups on Pre-Test

Group	N	Mean	SD	SEM	df	*t*
Control	12	59.03	6.68	1.93	20	0.896*
Experimental	10	56.67	5.44	1.72		

**Not Significant t-value at 0.05=2.06*

It can be understood from the Table 3 that the mean scores of the low achievers of the control and experimental groups on the pre-test were 42.50 and 41.07, respectively, on the Biology topic selected for the treatment. The independent-sample t-test confirmed that there was no statistically significant difference between the performances of low achievers in the control and experimental groups on pre-test. Hence, the hypothesis "There is no statistically significant difference between the performances of low achievers in the control and experimental groups on pre-test was accepted. Therefore, it can be inferred that low achievers of the both groups could be treated as equal in their performances.

Null Hypothesis 4: There is no statistically significant difference between the performance of the control and experimental groups on post-test. The results of null hypothesis four are presented in table 4 below.

Table 4

Significance of Difference Between the Mean Scores of Control and Experimental Groups on Post-Test

Group	N	Mean	SD	SEM	df	*t*
Control	24	55.42	21.40	4.37	46	0.24*
Experimental	24	54.10	16.44	3.36		

**Not Significant t-value at 0.05=2.02*

As can be seen from table 4 above, the mean scores of the post-test in the selected topic of Biology for the control and experimental groups were 55.42 and 54.10 respectively. The t-test shows that the difference between the two means was not statistically significant at alpha level of 0.05. Hence, the null hypothesis "There is no statistically significant difference between the performance of control and experimental groups on post-test" was accepted. The control and experimental groups demonstrated similar academic performances on the variable of post-test scores. The implication is that the treatment applied (instructional broadcast by PTV) on the experimental group had no significant impact or contribution with respect to the better understanding of the lesson compared to the control group taught by the traditional method of teaching.

Null Hypothesis 5: There is no statistically significant difference between the performances of low achievers of the control and experimental groups on post-test. The results of null hypothesis five are depicted in Table 5 hereunder.

Table 5

Significance of Difference Between the Mean Scores of Low Achievers of the Control and Experimental Groups on Post-Test.

Group	N	Mean	SD	SEM	df	*t*
Control	13	41.16	9.26	2.57	23	0.20*
Experimental	12	40.42	9.13	2.64		

**Not Significant t-value at 0.05= 2.06*

It can be observed from Table 5 that the mean scores of the low achievers of the control and experimental groups on the post-test were 41.16 and 40.42 respectively. The results of the independent-sample t-test proved that there was no significant difference between the performances of low achievers in the control and experimental groups on post-test. Thus, the hypothesis "There is no statistically significant difference between the performances of low achievers in the control and experimental groups on post-test was accepted. Therefore, it can be inferred that low achievers of both groups showed similar performances in the lessons taught and post-test administered.

Null Hypothesis 6: There is no statistically significant difference between the performances of high achievers in the control and experimental groups on post-test. The analysis of data for this null hypothesis is shown in Table 6 below.

Table 6

Significance of Difference Between the Mean Scores of High Achievers of the Control and Experimental Groups on Post-Test.

Group	N	Mean	SD	SEM	df	*t*
Control	10	75.83	16.11	5.10	20	1.50*
Experimental	12	67.78	8.57	2.47		

**Not significant t-value at 0.05= 2.086*

Table 6 above indicates that the mean scores of the high achievers of the control and experimental groups were 75.83 and 67.78, respectively, on the post-test in the selected Biology topic used in the treatment. The t-test results confirmed that there was no statistically significant difference between the performances of high achievers in the control and experimental groups on post-test. Accordingly, the null hypothesis "There is no statistically significant difference between the performances of high achievers in the control and experimental groups on post-test" was accepted. So, it can be concluded that high achievers in both groups had comparable performances after they were exposed to the experimental treatments.

Conclusion

The following conclusions were drawn on the basis of the analysis and summary of the study. First, as to the performance differences between the control and experimental groups on pre and post-tests, no statistically significant mean score differences were observed at = 0.05. And hence, the null hypothesis "There is no statistically significant mean differences between the control and experimental groups on pre and post test scores" was accepted. Second, there was no significant mean score differences between low achiever of both groups (control and experimental groups) on pre and post test scores at =0.05. Thus, the null hypothesis which states "There is no statistically significant mean scores difference between low achievers of control and experimental groups" was not rejected. Third, as the t-test (=0.05) showed, there were no considerable mean scores differences between high achievers of control and experimental groups on both the pre and post-tests. As a result of that the null hypothesis" There is no statistically significant mean differences between high achievers of control and experimental groups on pre and post-test" was accepted.

Overall, as the independent-sample t-test showed at confidence level of 0.05, there were no statistically significant mean score differences between the control and experimental groups on the variables of study (dependant variable - students' achievement; independent variable – methods of teaching (traditional and PTV instructions). The implication is that (in this particular study) teaching students through PTV didn't significantly contribute to the better understanding of the lesson compared to the conventional method of teaching. However, it should be noted that proper implementation or utilization of the instructional technologies such as PTV could significantly help students' learning and improve their academic performances. As depicted above, in this paper, students of both groups didn't show any significant differences in their academic performances. Probably, this may be attributed to various extraneous factors such as differences in the teachers' competency and approaches of teaching/integrating PTV (though they had same qualification and work experience); students' attitudes and their lack of exposure to PTV instruction; availability and utilization of instructional resources (for e.g., teaching aids and laboratories) in the school to enrich classroom lessons. Consequently, it should be confessed that all the aforementioned factors (including others) might have affected the outcome of the study.

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