symmetry

MDPI

Article

Multimedia Technology and Learner Autonomy: An Experimental Study for Asymmetric Effects

Xianghu Liu [1,*], Yanni Liu [2] and Jih-Fu Tu [3]

[1] College of Foreign Languages, Bohai University, Jinzhou City 121013, China
[2] Jianchang County No. 3 Senior High School, Huludao 125300, China; lyn20200312@hotmail.com
[3] Department of Industrial Management and Business Administration, St. John's University, Tamsui District, New Taipei City, 25135 Taiwan; tu@mail.sju.edu.tw
* Correspondence: liuxianghuinchina66@hotmail.com

Received: 14 February 2020; Accepted: 9 March 2020; Published: 14 March 2020

Abstract: One of the advantages of multimedia-assisted instruction is that it makes students more interested in sustainable learning and assists them to access information and learn more effectively. This research sought to explore the asymmetric effects of the development of sustainable multimedia-assisted instruction (MAI) on student reading practice in areas such as the implementation of learner autonomy and the improvement of reading ability, primarily based on multimedia technology-assisted instruction. This experiment was conducted in a junior high school in China. Eighty-six students from two parallel grade two classes were selected as research participants. Class One was set as the experimental class (EC) and Class Two was symmetrically designed as the control class (CC). The research results indicate that MAI encouraged students in the EC to adopt reading strategies more frequently and helped them to improve their level of learner autonomy, from a low level to an intermediate level, for the use of an asymmetrical technology, in comparison with the control class. Furthermore, the EC's reading ability was significantly enhanced. Additionally, there is a discussion of pedagogical implications and constructive suggestions considered to be beneficial for sustainable learning skills, teaching and for further research on the symmetrical application of technology in education. Finally, one of the most significant findings from this study is the effectiveness of combining modern sustainable technology and advanced educational concepts with symmetry in promoting learner autonomy within a sustainable learning model.

Keywords: multimedia-assisted instruction (MAI); learner autonomy; multimedia technology; asymmetric effects

1. Introduction

Over the past decades, a number of scholars have sought to define multimedia because it is a significant issue in the field of modern technology. The consensus is that that multimedia refers to using computers to combine text, graphics, audio and video, and presenting information so that the users can navigate, interact and create. In other words, multimedia means the use of diverse media formats simultaneously or sequentially in a given presentation or self-study program. It is believed that multimedia is a combination of media formats which are digitally manipulated by computers [1]. In short, multimedia is the integration of multiple forms of media which depends on computer technology.

As far as the four language skills are concerned, reading is the fundamental way of obtaining knowledge. Because a large amount of written information needs to be processed and understood, reading plays a vital role in English learning [2]. As Cohen [3] states, reading, as one of the most significant input channels, is an advanced skill which plays a quite crucial role in language learning,

and almost ninety-five percent of new information is acquired through reading. Thus, the notion that reading occupies a considerable position in language learning is convincing. Therefore, to cultivate learners' reading abilities is of great significance for EFL (English as a foreign language) teaching. However, the traditional English reading teaching overemphasizes the teachers' delivery of language knowledge, and ignores the active learning of students. Such "spoon-fed" teaching not only neglects the cultivation of learning interest and motivation but also hinders the development of autonomous reading competence. If things go on like this, students would meet more and more difficulties in English learning, for instance, they may lose confidence in reading learning or even English learning. Therefore, it is necessary to cope with the problem in the current reading teaching situation appropriately and immediately. Fortunately, the finding from a study on the use of technology in language teaching reveals that the current situation discussed above can be improved by using computers in schools [4]. Computers and the other relevant technologies come to be considered to have changed the mode of language instruction ([5,6]). Meanwhile, current developments in modern education have heightened the need of the combination of basic education with advanced science and technology. Over the past decades, some empirical studies have been carried out to integrate technology into English reading teaching to evaluate the effectiveness, and the results have shown that the benefits of MAI (multimedia-assisted instruction) is significant. in addition, multimedia technology is expected to bring great changes to English instruction with its obvious advantages.

The general purpose of this research project was to investigate the effectiveness of multimedia technology so as to improve the current situation of reading teaching and learning. The research examines the changes to high school students' use of reading strategies after instruction assisted by multimedia technology. Then it aims to investigate the effects of the development of multimedia sustainable technology on learner autonomy (or autonomous learning) for junior high students' reading. Finally, it explores the extent to which teaching assisted by multimedia technology improves reading ability. Apart from these specific goals, the research is expected to make a contribution to practical teaching, as well as to the further study of the development of sustainable modern technology when applied to education.

2. Literature Review

2.1. Advantages of MAI

Considerable attention has focused on multimedia technology-assisted teaching and learning over the past decades [7]. To begin with, MAI can arouse learning motivation. Motivation is a significant factor in learning [8]. Technology-supported instruction activities can motivate learners to read more actively [9]. Surveys demonstrate that multimedia technology-assisted instruction is a useful element for second language learning and that it can encourage second language learning motivation, because multimedia can provide many kinds of media forms and activities, as often as necessary, and reduce learning anxiety [10].

In addition, MAI enables individuals to learn by themselves. Learners are provided with the variety of media, such as graphs, videos and images, which can help learners to transform complex or abstract concepts into simple explanations and generalizations. Multimedia technology seems to help students by building background knowledge on a certain topic [11]. MAI enables teachers to provide various resources related to teaching topics that can help students to learn [12].

2.2. An Overview of Learner Autonomy

Learner autonomy derives from the concept of life-long learning, which has been regarded as a significant goal since the early 1960s [13]. In the 1970s, learner autonomy, also called autonomous learning, was first introduced into the field of second language teaching. Autonomous learning has received increasing focus because it is closely linked to student development in language learning [14]. Holec first defined autonomous learning as the ability to take charge of one's own learning [15]. That is

to say, autonomy is a kind of ability to have and to hold the responsibility for all the decisions of learning process. Recently, Benson has refined Holec's definition of autonomous learning to mean the capacity to control one's own learning, rather than the ability to take charge of one's own learning [16]. This kind of capacity includes three components, namely, the ability of learning a language, the desire of carrying out a learning task and the freedom of controlling the learning [17].

Based on Holec's initial view [15], other scholars have also given definitions. Autonomous learning can be seen as an ability which is embodied and measured by the dynamic learning process and closely related to meta-cognition [18]. It can include the ability to think critically, to act independently and to make one's own decisions.

These standpoints are supported by Littlewood, who asserts that autonomous learners can carry out their own decisions independently [19]. He divides the capacity into two components, ability and willingness. The former refers to decision-making skills. The latter involves learner motivation to carry out their decision responsibly. A common factor to be seen in their statements is that autonomous learning is a kind of ability, which can be considered to be a form of sustainable learning skills for lifelong learning.

Set against that, Dickinson associates the definition of autonomous learning with different focuses [20]. He maintains that autonomous learning is not only just a kind of ability but also a sort of attitude. In other words, autonomous learning refers to an attitude toward learning either to take, or not take responsibility. Furthermore, learners are expected to be fully responsible for their study instead of any instructors. In brief, autonomous learning, on the one hand, covers abilities to makes decisions, critical reflection, and independent action. On the other hand, it refers to a positive attitude in putting decision and reflection into practice responsibly.

2.3. Constructivism—The Theoretical Foundation of This Study

In this study, constructivism constitutes the theoretical foundation. Piaget puts forward the notion of constructivism and gives many systematic and classical interpretations of it. His basic idea of this theory is activation of learning requires the original knowledge [21]. He holds the view that the two aspects of construction at the same time constitute the learning process. One aspect is the construction of the new meaning. The other one is the reconstruction of the previous knowledge and experience. That can be put in this way that learning is the process of constructing new knowledge based on prior knowledge and experience. Therefore, teaching should take learner's original knowledge into consideration and guide the learner to gain new knowledge based on his/her original experience, which is regarded as a new growing point of knowledge.

As time goes by, constructivism has been prevalent in educational area, and its influence has extended to a wider scope, afterwards quite a few scholars make further research on constructivism based on Piaget. Beatty [22] proposes that constructivism indicates that learners construct new knowledge and information based on their past experience or concepts. Learners can take charge of what they have learned and what to learn next in an ideal context.

The application of multimedia technology in educational activities is supported by constructivism. Multimedia technology which includes various media forms, for instance audio, video, image, animation, text, and so on, can create a real and operational learning environment for students; under such an environment, students' mutual communication are promoted. Additionally, the combination of constructivist theory and technology can offer a better application and integration of technology tools in the classroom effectively [23]. Meanwhile, students' interests of learning also can be stimulated by rich and colorful information. In consequence, students can explore and construct new knowledge autonomously. The application of constructivism in the field of education will influence the enhancement of learner autonomy to a great degree in language teaching and learning [24].

2.4. Relevant Studies on Multimedia-Assisted Instruction to Reading

Applying multimedia technologies in the educational area is an increasing trend in the wake of the development of new sustainable technologies. Kern [25] examined the effects of multimedia technology-assisted instruction on reading comprehension and found that MAI has positive effects on the improvement of reading comprehension. Other studies appear to agree. Macaruso and Rodman investigated the benefits of MAI at a middle school [26]. In the treatment class, the teacher utilized multimedia technology to assist the teaching of reading, which was compared with the traditional reading teaching methods used in the control class. They found that the treatment class improved in reading. However, their study seems to be short of qualitative analysis methods such as the analysis of interviews, which differs from our present study analyzed by both quantitative and qualitative analysis methods, although their research finding is confirmed by other scholars as well. In one empirical study comparing the outcome of language teaching supported by computer technology with non-supported teaching, the result indicated that the group using technology obviously outperformed the other [27]. Similarly, researchers have evaluated a multimedia-based program for improving reading, with multimedia technology having significant positive effects on reading competence [28].

In view of the drawbacks of the previous studies, this experimental study attempted to examine the effectiveness of MAI for junior high school students' English reading from the above-mentioned aspects simultaneously. The specific design and details of this study follow.

3. Research Methodology

This section starts with the research questions which are based on the literature and current teaching situation, and then the research design and participants are described in detail. It goes on to list the specific instruments which comprise the interviews, questionnaires and tests. The research procedures are illustrated in step-by-step sequence, especially the experimental teaching sample lessons are emphasized. Finally, data collection and analysis are dealt with.

3.1. Research Questions

This study was an experimental study designed to explore the asymmetric effects of multimedia technology on autonomous learning for junior high students' reading, as well as to understand to what extent MAI enhance students' reading ability. The research questions were:

1. What effects does multimedia technology have on learner autonomy for junior high school students' English reading?
2. To what extent does multimedia technology-assisted teaching improve student achievement in English reading?

3.2. Research Design

Research design is the framework of a research project, and it is used as a blueprint when collecting and analyzing the data. To a certain extent, a research design can boost the paper [29]. In order to cope with the research questions, we symmetrically designed an experimental class (EC) and a control class (CC) as the participants. The instruction assisted by multimedia technology in the English reading lesson was considered to be the independent variable and the use of students' reading strategies, learner autonomy regarding reading and reading performance, correspondingly, were deemed to be the dependent variables.

For the sake of collecting and analyzing the data, both quantitative and qualitative methods were employed. For quantitative analysis, a reading strategies questionnaire and a questionnaire on learner autonomy in terms of reading, as well as pre- and post-tests in English reading, were conducted. Interviews, as a qualitative method, were used to gain more information.

3.3. Research Participants

The research participants, 89 in total, were recruited from two parallel classes in junior grade two of a high school in China. All the students were 15 years old on average and had at least five years of English learning experience. In this research setting, Class One was the experimental class (EC), consisting of 45 students, and Class Two was the control class (CC), totaling 44 students. These students had one year of English learning experience in junior high school. Furthermore, they had a strong desire to participate in this research in order to improve their reading abilities. Last but not least, comparing the EC and CC showed that the participants had almost the same level of English proficiency at the start of the research project.

3.4. Research Instruments (Methods)

The application of the primary research instruments (methods) in this study was questionnaires and interview, pre- and post-testing in order to collect qualitative and quantitative data. Meanwhile, the data analysis adopted qualitative and quantitative methods. For instance, the analysis of the questionnaires, the pre- and post-test results quantitatively was to use statistical analysis such as the use of SPSS while the analysis of interviews was to use interpretative methods such as the use of content analysis. As a result, the combination of qualitative and quantitative research methods could make the research project more reliable and convincing. The implementation of the research approaches mentioned above was described below respectively.

3.4.1. Questionnaires

The questionnaire for junior high school students' learner autonomy in English reading was devised on the basis of the autonomous learning model of Winne and Butler [30]. After personal information, participants needed to answer 20 items which could then be divided into four dimensions: leaning motivation (1–5), goal setting (6–10), learning strategies (11–15) and self-evaluation abilities (16–20).

3.4.2. Interviews

There were nine questions proposed for the interviews concerning the enhancement of learner autonomy through the use of multimedia technology based on sustainable learning environments. The questions were in accordance with Patton that six kinds of questions can be asked in an interview, questions on experience, opinions, feelings; knowledge, senses and background [31]. The interview questions adopted by Smith and Craig in their research were our main references [32].

The interviews were conducted at the end of the experiment with students from the EC. The students from the EC were divided into three groups on the basis of their post-test scores, and then two students were randomly chosen from each group to be the interviewees. Students who ranked in the bottom 27% were the low-level group, those who ranked the top 27% were the high-level group, and the other students were grouped as the intermediate level [33].

3.4.3. Tests

In order to check student progress and compare their reading performance, pre-tests and post-tests were administered before and after the experiment. One of the benefits of testing is in assisting researchers to make it clear the effects on learners' abilities and performances. The pre-test was designed to explore the current level of reading proficiency and to investigate whether the students have similar reading abilities or not. The post-test aimed to examine the change in reading performance after the research.

To ensure reliability and validity, the pre-test paper was selected from the English reading part of a junior high school final exam. The post-test paper was taken from an English reading mid-term examination. The difficulty of the post-test paper was almost similar to the previous pre-test or a little

bit higher than that. Both tests contained four reading passages, each passage having five multi-choice questions and each correct answer was awarded one point.

3.5. Research Procedures

The research procedures included a pilot study, a pre-questionnaire, a pre-test, reading teaching, a post-questionnaire, a post-test and an interview. In the process of analysis, statistics collected from the questionnaire and the reading test were analyzed by independent *t*-test and paired samples *t*-test. The former was used to compare the performance of the students in the EC and CC, and the latter to compare the performance of the students pre- and post-experiment. The information collected from the interview was analyzed using content analysis.

4. Results and Discussion

The following parts analyze and discuss the collected data in order that the two research questions could be answered.

4.1. Data Analysis and Discussions of Research Question 1

(This section focuses on replying to Research Question 1 (What effects does multimedia technology have on learner autonomy for junior high school students' English reading?), by analyzing and discussing the questionnaire of students' learner autonomy in English reading, together with Interview I to examine the effects of multimedia technology, combined with the concept of learner autonomy.

4.1.1. The Effects of Multimedia Technology on Learner Autonomy

The questionnaire on student learner autonomy in English reading, together with Interview I, was designed to answer the first research question. There are three levels of learner autonomy [34]. If the mean value is lower than 2.4, the participants have low autonomy level and a negative attitude toward autonomous reading. If the mean value is higher than 3.5, it indicates a high autonomous level and a positive attitude in terms of reading. A mean value between 2.5 and 3.4 shows an intermediate level and a moderate attitude toward learner autonomy and reading.

4.1.2. Analysis of Pre-Questionnaire on Learner Autonomy between the EC and CC

The total mean values for learner autonomy among the participants on the English reading in pre-questionnaire shows that the students in EC and CC share quite similar total mean values (EC is 1.98, and CC is 1.97), meaning both classes were at a low reading level of learner autonomy before the experiment. According to the results of the independent sample *t*-test for the scores of the two groups in the pre-questionnaire, the students of both the EC and CC had no significant difference in their level of learner autonomy (t (79.35) = 0.13, $p > 0.05$).

4.1.3. Analysis of Pre-Questionnaire and Post-Questionnaire on Learner Autonomy in the EC

Table 1 shows the mean values of pre- and post-questionnaires on learner autonomy for the students in the EC (Experimental Class).

From the data, it is clear that the mean of each item, the mean of each dimension and the total mean for the post-questionnaire increased to more than 2.5 and less than 3.4, especially the mean for self-evaluation ability, which illustrates that the level of learner autonomy in reading changed from a low level to an intermediate level. Additionally, the paired samples t-Test for the pre-questionnaire and post-questionnaire for the EC shows that the significant difference between the scores of students in thre pre- and post-questionnaire can be easily seen (t (44) = −17.61, $p < 0.05$), which proves that after the MAI, there was an obvious improvement in the level of autonomous reading of students in the EC.

Table 1. A description for the pre-questionnaire and post-questionnaire on learner autonomy in EC.

Dimension	Items	M(Pre-Q)	TM	M(Post-Q)	TM
Learning motivation	1. I read so as to find a job.	2.02	1.92	2.53	2.65
	2. I read in order to get a high score.	1.96		2.69	
	3. I believe that writing plays an important role in improving my English level.	1.82		2.58	
	4. I think I can learn a lot from reading in English.	1.93		2.80	
	5. I try those reading tasks that are challenging.	1.84		2.67	
goal setting	6. I can set a short-term learning goal.	1.89	1.98	2.71	2.77
	7. With the help of the teacher, I can set a long-term learning goal.	2.04		2.76	
	8. My goal is reading scores will rank in the top five in my class.	2.07		2.84	
	9. My goal is to master all the learned grammar in order to understand the reading materials.	1.96		2.78	
	10. I can set learning goals based on practical situation, and put it into practice.	1.96		2.78	
learning strategies	11. I can use appropriate learning strategies.	2.04	1.99	2.91	2.80
	12. When reading an article, I usually skim first, and then read carefully.	2.07		3.02	
	13. When take reading note, I usually write down good sentences and key points.	1.96		2.62	
	14. In the process of reading, I often use original knowledge to understand new knowledge.	1.91		2.69	
	15. I can find important information in an article according to the teachers' questions.	1.96		2.73	
self-evaluation ability	16. I can reflect my reading behavior, method and skills.	2.02	2.02	2.96	2.82
	17. I usually evaluate whether my reading strategies are appropriate.	2.04		3.00	
	18. I often summarize my successful reading experience.	1.98		2.67	
	19. I am willing to learn successful readers' reading methods.	2.09		2.60	
	20. I usually absorb the lesson from the errors in reading.	1.96		2.89	
Total Mean		1.98		2.76	

Note: "EC" refers to the experimental class; "M" represents "mean"; "Q" stands for "questionnaire"; "TM" stands for "total mean".

In summary, after the experiment, the EC students showed a higher level of learner autonomy when they did the reading tasks. In other words, multimedia technology-assisted instruction has

positive effects on learner autonomy for students' reading. For the sake of providing more convincing evidence, Interview I was carried out in the EC.

In the light of the interviewees' answers, their attitudes toward learner autonomy in terms of reading are strong. For instance, the students from the high level group point out that their learner autonomy had been notably enhanced. This group showed a higher level of learning autonomy than before. It is very close to the claims of students from the intermediate level group who become acquainted with the method of autonomous reading. Moreover, for students from the low-level group, MAI not only improved their learner autonomy in terms of reading, but also converted their attitude to a positive one in the long run.

From the outcome of the interview, it is possible to conclude that the interviewees are fully conscious of the benefits of MAI. During the class assisted by technology, the teacher plays an important role in fostering an autonomous learning atmosphere, such as the participant, resource-provider and promoter. By this way, reading confidence and interest are stimulated. More significantly, the fact that MAI improves learner autonomy in terms of reading is accepted. Combining the analysis of Questionnaire I with the results of the Interview I, it is obvious that the effect of MAI on learner autonomy for English reading is positive and profound.

To sum up, it is found that MAI has positive effects on learner autonomy for junior high students' English reading, which supports the ideas of Craig [35] and Mutlu and Eroztuga [36]. Besides, we have given a more specific finding about the enhancement degree of learner autonomy in the present study than the others.

4.2. Data Analysis and Discussions of Research Question 2

This section emphasizes answering Research Question 2 (To what extent does multimedia technology-assisted teaching improve students' achievement in English reading?). In order to answer the research question and check student reading progress, pre- and post-tests in reading were conducted. Additionally, Interview II was undertaken after the reading post-test.

4.2.1. Analysis of Pre-Test between the EC and the CC

Statistics from the pre-test shows that the mean value of the students in the EC was 9.82 and 9.7 in the CC. There is a rather small difference between the means. The results of the independent sample *t*-test for pre-test in the EC and CC indicate that there was no significant difference between the students in the EC and CC in reading before the experiment (t (87) = 0.30, $p > 0.05$). The students were; therefore, at a similar or same level of reading ability and were chosen to be the participants for this research project.

4.2.2. Analysis of Post-Test between the EC and the CC

The mean value for the EC reading post-test was 13.36 and 9.95 for the CC, an obvious difference. The independent samples *t*-test for the EC and CC post-test scores indicates a significant difference between the EC and CC (t (87) = 8.09, $p < 0.05$). In other words, after the experimental teaching, students in EC and CC had different levels of reading.

Above all, the pre-test carried out on the EC and CC demonstrates that students were at the similar reading level. Afterwards, one of the authors conducted the 12-week experiment, during which EC students were taught with MAI and students in the CC were taught with traditional teaching methods. The post-test shows that students in the EC and CC were significantly different in levels of reading. Moreover, by comparing the scores of the EC students both in pre-test and post-test, it is shown that the EC students' reading had significantly improved, in sharp contrast with the performance of the students in the CC.

In conclusion, following the experiment, students realized the effects and importance of MAI. As for using reading strategies, they could consciously apply new or useful reading strategies to facilitate their reading. Moreover, it is worth mentioning that their learner autonomy in terms of reading

has been somewhat fostered to a higher level. In addition, with the help of MAI, the students have more confidence to read in English and their reading proficiency has improved. Further, the answers to Interview II, along with the results of the reading test, provide strong evidence that MAI can enhance student reading levels to some extent. As a result, the finding of the second research question is coincident with Macaruso and Rodman [26] and Shannon et al. [28]. Compared with the previous researchers, we seem to apply more analysis methods. For example, both quantitative and qualitative analysis methods were adopted, and both independent sample *t*-test and paired sample *t*-test were conducted.

4.3. Summary of Research Results and Significances

This section summarizes the research findings, which have been obtained from the collected data by analyzing and discussing through quantitative and qualitative methods. Table 2 gives a concisely illustration of the primary research results in this project.

Table 2. An illustration of the research questions and their findings.

Research Questions	Research Instruments	Research Findings
1. What effects does multimedia technology have on learner autonomy for junior high school students' English reading?	Questionnaire on learner autonomy; Interview I	Multimedia technology can improve students' learner autonomy level in terms of reading.
2. To what extent does multimedia technology-assisted teaching improve students' achievement in English reading?	Pre-test and post-test; Interview II	Students' reading achievements are noticeably improved by the assistance of MAI.

Table 2 indicates that the researcher carries out questionnaires, interview and pre- and post-test to address the two research questions. Besides, aiming at each question, the author gives detailed analysis and comments. In belief, multimedia technology has some positive effects on students' reading. Firstly, it is beneficial for students to foster a higher level of the learner autonomy in terms of reading. Additionally, it performs a striking effectiveness on improving students' reading achievement.

Regarding the significances of this research project, it is expected to make contributions to reading learning and teaching. In terms of the theoretical aspect, this research project is a further study of MAI, and it enriches the theories of the field of multimedia technology-assisted language learning. In this paper, literatures related to MAI are reviewed critically, and the previous research results are also analyzed. Additionally, autonomous learning in reading are also emphasized and connected with multimedia, which to some extent enlarges the theory of MAI. Therefore, this research project inevitably promotes the theoretical development of MAI.

In regard to the practical aspect, this research promotes the application of multimedia technology in English reading instruction. In this paper, multimedia technology is put into practical use in daily reading teaching, which is an important progress for MAI. Additionally, empirical studies on MAI until now are mainly focused on reading achievement. However, this study not only pays attention to it, but also focuses on the training of reading strategies and the fostering of autonomous learning. Therefore, this research is significant for the practice.

5. Conclusions

This research studied the effects of multimedia technology on junior high school students' English reading. The following findings can be summarized. Two research questions were addressed and the findings mirror those of the previous studies that have examined the effects of MAI.

Research Question 1 was, "What effects does multimedia technology have on learner autonomy for junior high school students' English reading". Based on the analysis of the data collected from Questionnaire I, it is clear that, after the experiment, the EC students' learner autonomy in terms of

reading increased from a low level to an intermediate level. Furthermore, the information gathered from Interview I also shows that students acknowledge the benefit of MAI in fostering their learning autonomy in terms of English reading.

Research Question 2 was, "To what extent does multimedia technology-assisted teaching improve students' achievement in English reading?" After the scores of the two groups in the pre-test and post-test were compared, it can be safely stated that the EC students have a better performance in the post-test than their performance in the pre-test. From the paired sample *t*-test, it is clear that the improvement in the EC's reading performance is significant. However, the scores of the CC students show little change compared to those of the pre-test. Furthermore, the student answers from Interview II also state that, with the help of MAI, they have become more confident when doing a reading task, and perform better in their reading proficiency. Therefore, the finding of the second research question is that multimedia had improved reading to a great extent.

Compared with to previous research, the analysis in this study was more detailed, for example, in using both quantitative and qualitative analysis methods, and conducting both independent sample and paired sample *t*-tests.

Together, it is found that MAI has positive effects on learner autonomy for junior high students' reading. Further, there are more specific findings about the degree of enhancement in learner autonomy.

Finally, one of the most significant findings from this study was the effectiveness of combining modern sustainable technology and advanced educational concepts with symmetry to promote learner autonomy within the learners' sustainable learning model.

Author Contributions: X.L. and Y.L. contributed equally to the conception of the idea, implementing and analyzing the experimental results, writing the manuscript and so on. J.-F.T. contributed to the guidance to the research design. X.L. plays a leading role in completing the article. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Vaughan, T. *Multimedia: Making It Works*, 8th ed.; McGraw Hill: New York, NY, USA, 2011.
2. Smit, N.; Grift, W.; Bot, K.; Jansen, E. A classroom observation tool for scaffolding reading comprehension. *System* **2017**, *65*, 117–129. [CrossRef]
3. Cohen, A.D. *Strategies in Learning and Using a Second Language*; Foreign Language Teaching and Research Press: Beijing, China, 2000.
4. Bax, S. Normalisation Revisited: The Effective Use of Technology in Language Education. *Int. J. Comput.-Assist. Lang. Learn. Teachnol. IJCALLT* **2011**, *1*, 1–15. [CrossRef]
5. Chang, C.K.; Hsu, C.K. A mobile-assisted synchronously collaborative translation-annotation system for English as a foreign language (EFL) reading comprehension. *Comput. Assist. Lang. Learn.* **2011**, *24*, 155–180. [CrossRef]
6. Hsu, L.W. An empirical examination of EFL learners' perceptual learning styles and acceptance of ASR-based computer-assisted pronunciation training. *Comput. Assist. Lang. Learn.* **2016**, *29*, 881–900. [CrossRef]
7. Stockwell, G. A review of technology choice for teaching language skills and areas in the CALL literature. *ReCALL* **2007**, *19*, 105–120. [CrossRef]
8. Gardner, R.C. *Social Psychology and Second Language Learning: The Role of Attitudes and Motivation*; Edward Arnold: London, UK, 1985.
9. Park, H.R.; Kim, D. English language learners' strategies for reading online texts: Influential factors and patterns of use at home and in school. *Int. J. Educ. Res.* **2017**, *82*, 63–74. [CrossRef]
10. Taylor, R. *The Computer in the School: Tutor, Tool, Tutee*; Teachers College Press: New York, NY, USA, 1980.
11. Carrell, P.L. *Interactive Approaches to Second Language Reading*; World Publishing Corporation: Beijing, China, 2006.
12. Garcia, M.R.; Arias, F.V. A comparative study in motivation and learning through print-oriented and computer-oriented tests. *Comput. Assist. Lang. Learn.* **2000**, *13*, 457–465. [CrossRef]

13. Gardner, D.; Miller, L. *Establishing Self-Access: From Theory to Practice*; Cambridge University Press: Cambridge, UK, 1999.
14. Crabbe, D. Fostering autonomy from within the classroom: The teacher's responsibility. *System* **1993**, *21*, 443–452. [CrossRef]
15. Holec, H. *Autonomy and Foreign Language Learning*; Pergmon Press: Oxford, UK, 1985.
16. Benson, P. *Teaching and Researching: Autonomy in Language Learning*; Pearson Education: London, UK, 2011.
17. Huang, J.; Benson, P. Autonomy, agency and identity in foreign and second language education. *Chin. J. Appl. Linguist.* **2013**, *36*, 7–28. [CrossRef]
18. Little, D. *Learner Autonomy: Definitions, Issues and Problems*; Authentik: Dublin, Ireland, 1991.
19. Littlewood, W. Self-Access: Why do we want it and what can it do. In *Autonomy and Independent in Language Learning*; Benson, P., Voller, P., Eds.; Longman: London, UK, 1997.
20. Dickinson, L. *Self-Instruction in Language Learning*; Cambridge University Press: Cambridge, UK, 1987.
21. Zhai, X.H. The Application of Multimedia Computer-Assisted Language Teaching to English Reading Teaching in Senior High School. Master's Thesis, Henan University, Zhengzhou, China, 2015.
22. Beatty, K. *Teaching and Researching Computer-Assisted Language Learning*; Longman: London, UK, 2010.
23. Gilakjani, A.P.; Leong, L.M.; Ismail, H.N. Teachers' Use of Technology and Constructivism. *Int. J. Mod. Educ. Comput. Sci.* **2013**, *4*, 49–63. [CrossRef]
24. Wang, P. Constructivism and Learner Autonomy in Foreign Language Teaching and Learning: To what Extent does Theory Inform Practice? *Theory Pract. Lang. Stud.* **2011**, *1*, 273–277. [CrossRef]
25. Kern, R.G. Restructuring classroom interaction with networked Computers. *Effects Quant. Charact. Lang. Prod.* **2000**, *79*, 457–476.
26. Macaruso, P.; Rodman, A. Benefits of computer-assisted instruction for struggling readers in middle school. *Eur. J. Spec. Needs Educ.* **2009**, *24*, 103–113. [CrossRef]
27. Grgurovic, M.; Chapelle, C.A.; Shelley, M.C. A meta-analysis of effectiveness studies on computer technology-supported language learning. *ReCALL* **2013**, *25*, 165–198. [CrossRef]
28. Shannon, L.C.; Styers, M.K.; Wilkerson, S.B.; Peery, E. Computer- assisted learning in elementary reading: A randomized control trial. *Comput. Sch.* **2015**, *32*, 20–34. [CrossRef]
29. Kothari, C.R. *Research methodology: Methods and techniques*; New Age International Publishers: New Delhi, India, 2004.
30. Winne, P.H.; Butler, D.L. Feedback and self-regulated learning: A theoretical thesis. *Rev. Educ. Res.* **1998**, *65*, 245–281.
31. Patton, M.Q. *Qualitative Research and Evaluation Methods*; Sage Publications: Thousand Oaks, CA, USA, 2001.
32. Smith, K.; Craig, H. Enhancing the autonomous use of CALL: A new curriculum model in EFL. *CALICO J.* **2013**, *30*, 252–278. [CrossRef]
33. Tseng, W.T.; Dörnyei, Z.; Schmitt, N. A new approach to assessing strategic learning: The case of self-regulation in vocabulary acquisition. *Appl. Linguist.* **2006**, *27*, 78–102. [CrossRef]
34. Oxford, R.L.; Burry-Stock, J. Assessing the use of language learning strategies worldwide with the ESL/EFL version of the strategy inventory for language learning (SILL). *System* **1995**, *23*, 1–23. [CrossRef]
35. Craig, H. Learner autonomy in a task-based 3D world and production: Language Learning education. *Meisei Univ. Humanit. Rev.* **2010**, *46*, 137–155.
36. Mutlu, A.; Eroztuga, B. The role of computer-assisted language learning (CALL) in promoting learner autonomy. *Eurasian J. Educ. Res.* **2013**, *51*, 107–122.