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Creating Educational Content to Prepare Jordanian Children for Future Challenges

Duaa Albaw, Shafiq AL-Haddad*, George Sammour

Princess Sumaya University for Technology

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* *Corresponding author:*
s.haddad@psut.edu.jo

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Abstract

The objective of this study is to investigate the effectiveness of creating and using an educational animated video on Jordanian children's conceptual understanding of and attitude toward the roles and functions of future innovations in human society. Mayer's principles of the Cognitive Theory of Multimedia Learning (CTML) guide the design and development of the animated video and the intervention. The participants are 112 children in age 10 to 11 years old from three different districts of Jordan. The study uses a qualitative experiment design. The children were separated into experimental groups and control groups to investigate two different pedagogical environments. The first experimental group uses animated video within Multimedia Learning intervention. The second control group uses the Traditional Teaching method. To measure the intervention's effects, the study uses pre- and post-conceptual understanding tests and post-attitude questionnaires. To find out more about the experiences with using the animated video within Multimedia Learning intervention, a sub-sample of children was interviewed. The findings of the study reveal that creating and using animation have a statistically significant effect, at the 0.05 level, on children's conceptual understanding of future innovations and future challenges. Their attitudes towards learning about future innovations are positive.

Keywords: Future innovations, human workforce displacement, conceptual understanding, attitude toward learning, multimedia learning.

تصميم محتوى تعليمي لإعداد الأطفال الأردنيين لتحديات المستقبل

دعاء البو، شفيق الحداد*، جورج سمور

جامعة الأميرة سمية للتكنولوجيا

ملخّص

تهدف الدراسة إلى بحث أثر تطوير محتوى فيديو رسوم متحركة تعليمي واستخدامه في إطار بيئة التعلم باستخدام الوسائط المتعددة على الفهم النظري للطفل الأردني لدور الابتكارات المستقبلية ووظيفتها في حياة المجتمعات. جرى تطوير فيديو الرسوم المتحركة واستخدامه في إطار عملية تدخل تعليمية ممنهجة باستخدام الوسائط المتعددة. كما جرى تصميم المحتوى التعليمي وتطويره بناءً على مبادئ النظرية المعرفية للتعلم بالوسائط المتعددة. (CTML) تشمل العينة المشاركة في الدراسة 112 طفلًا تتراوح أعمارهم بين 10-11 عامًا من ثلاث محافظات مختلفة في المملكة الأردنية الهاشمية. جرى توزيع الأطفال بالتساوي إلى مجموعات تجريبية ومجموعات ضابطة. يتعلم الأطفال في المجموعة التجريبية من خلال فيديو الرسوم المتحركة في إطار التعلم باستخدام الوسائط المتعدد، بينما يدرس الأطفال في المجموعة الضابطة المادة التعليمية بمنهجية التدريس التقليدية. ولقياس آثار التدخل، تستخدم الدراسة عدة أدوات للقياس، وهي الاختبار القبلي والبعدي للفهم النظري عند الطفل، واستبانة بعدية لقياس موقف الطفل من العملية التعليمية. ولجمع معلومات أكثر شمولًا وتفصيلًا حول تجربة الطفل في التعلم عن الابتكارات المستقبلية باستخدام الوسائط المتعددة، جرى اختيار عينة من المجموعة التجريبية لإجراء مقابلة معها. وخلصت الدراسة إلى أن تطوير محتوى تعليمي عن الابتكارات المستقبلية وعرضه باستخدام فيديو رسوم متحركة في بيئة التعلم بالوسائط المتعددة له تأثير ذو دلالة إحصائية، بمعدل 0.05، على فهم الطفل النظري للابتكارات المستقبلية ودورها في حياة الإنسان، كما أن له تأثير ذو دلالة إحصائية على فهم الطفل للمهن المستقبلية كأحد أهم التحديات في المستقبل، كما تؤثر هذه البيئة التعليمية على موقف الأطفال من التعلم عن الابتكارات المستقبلية إيجابًا.

الكلمات الدالة: الابتكارات المستقبلية، استبدال القوى العاملة البشرية، الفهم النظري، الموقف من التعلم، التعلم باستخدام الوسائط المتعددة.

1. Introduction: With the emergence of new technologies and future innovations, many industries, including education, will be affected. One of the future challenges is that the digital workforce will replace human workers. Therefore, unprepared generations may find themselves stuck with severe and negative impacts. These are related to the lack of investment that is required to develop education systems (Jackson, 2018). To address this concern, the current study adopts a qualitative experiment design to investigate children's conceptual understanding and attitudes toward the following topic:

"The roles and functions of (ROBOTS) in human society, as one of the most important future innovations, with specific reference to the future's challenges associated with human workforce displacement by Robots."

1.1. Statement of the Problem: In the digital era, the age of information announced and the pace of change in technological advances are more rapid than ever before (Tyner, 2014). Nothing can slow down digital transformation (Williams & Allen, 2017). The largest risk is to resist the change that the new technologies bring with them (Barcevičius et al., 2019). According to PricewaterhouseCoopers (PwC)'s, 2016 Global Industry, profound digital and technological transformations are now underway, knowing that the Middle East is no exception. It still has a long journey to catch up (Geissbauer et al., 2016). Future innovations and technological transformations contribute to changing the landscape around us and are expected to reshape the future (Lee & Trimi, 2018). That drives us to wonder what does the future hold for the new generation?

Lee & Trimi (2018) suggest that "The ultimate purpose of innovations should be much more far-reaching, helping create a smart future where people can enjoy the best quality of life possible". Innovation must predict the uncertain future and search for intelligent solutions for the well-being of society (Lee & Trimi, 2018:1). One of the main future challenges is that new technologies, automation, and AI software are expected to displace the human workforce and enable digital workforces (Carrington & Fallick, 2017). Gartner Customer 360 Summit predicts that 95% of customer interactions will be handled without the human workforce by 2025 (Gartner, 2015). Therefore, unprepared generations may find themselves stuck with severe and negative impacts. However, the opportunity lies in not resisting new innovations in technology. On the contrary, it's our chance to embrace them (Barcevičius et al., 2019). This certainly generates a sense to have the ultimate goal of preparing the new generation to be a smart society in the future (Williams et al., 2015).

At once, the programs of the Organization for Economic Co-operation and Development (OECD) provided for International Student Assessment (PISA) emphasize that significant numbers of students in many countries lack even a low level of skills during their compulsory and formal schooling (OECD, 2015). Therefore, education systems will increasingly become under the pressure to adjust the way educational institutions are preparing children for the opportunities and challenges of the future (Williams et al., 2015). The gathered evidence can be utilized to design up to date curricula, education, and training systems. Investing in high-quality education, especially in initial schooling and early childhood education, is a significant and efficient strategy to enhance the first skills of the new generation and pave their way for future skills development (OECD, 2015). With digital tools available today, learning extends beyond the traditional classroom setting and children can learn whatever, no matter where they live, and at significantly affordable prices (Geissbauer et al., 2016). Animated content is considered as one of the most effective digital tools (Vratulis et al., 2011).

A Large-scale review of previous studies in the context of the effectiveness of animation as an educational approach is under execution. Some studies report that students report learning difficulties regarding some concepts. Therefore, the use of animation in the learning process is investigated and used to play a critical role in the construction of knowledge. Its use increases (Mnguni, 2014). There have been other studies that prove that animated content and MeTS, Media, Technology, and Screen Time, have long-term effects on young children (Sharkins et al., 2016). For example, many studies prove that certain educational television programs can significantly influence early literacy skill acquisition (Schryer, 2015). The results of other studies show that via the animated cartoon, children could recognize elements of foreign culture, such as language, traditions, ways of life, symbols, … etc. (Corneliomar, 2015). Additionally, some studies show that after viewing short clips of popular educational programs in which animated characters solve problems, children attempted to solve real-world problems (Richert & Schlesinger, 2017).

However, cognitive learning processes are intricate. Therefore, it is important to primly exhibit a reasonable theoretical basis before conducting the study (Mnguni, 2014). This study theorizes the process of learning through animated content by blending what researchers have presented on the principles of the "Cognitive Theory of Multimedia Learning," (Mayer, 2008).

The Cognitive Theory of Multimedia Learning (CTML) has been popularized by Richard E. Mayer. It basically occurs due to building a coherent mental representation from pictures and words. Implementation of visual learning, such as animation, combined with verbal learning as channels for delivering information is different from the traditional teaching methods (Swerdloff, 2016). To help children learn efficiently and maximize their learning effectiveness, this theory mainly addresses how to structure instructional multimedia materials and employ cognitive strategies. (Sorden, 2012) The theory argues that multimedia enhances how the human brain learns (Tayo & Oluwakemi, 2015). The learner is supposed to make sense of the multimedia material and construct new knowledge (Held et al., 2006). Therefore, Mayer (2008) suggests that the ultimate purpose of multimedia learning is to foster generative processing, minimize extraneous processing, and to manage the essential processing. Out of around 100 studies, Mayer developed multimedia instructional principles (Sorden, 2016).

In an attempt to help children learn efficiently about future innovations, and prepare them to face the challenge of human workforce displacement in the future, an animated simulation is created and used. It is designed based on the principles of the Cognitive Theory of Multimedia Learning (CTML). It is being deployed in the learning process to learn effectively about the roles and functions of future innovations, such as Robots, in human society. The animation includes a specific reference to the future's challenges associated with human workforce displacement.

1.2. Importance of the Study: Children usually report learning difficulties regarding the construction of some scientific and technical concepts. Therefore, the animation is used to play a critical role in the construction of such knowledge. Consequently, the use of animations in the learning process is increasing (Mnguni, 2014). Therefore, this study suggests that creating and using animated content affect children's conceptual understanding of the roles of future innovations in human society. It also suggests that it has a significant effect on their awareness of one of the most threatening future's challenges, which is human workforce displacement. Their attitudes towards learning about them are expected to be positive.

According to the best of my knowledge, few association studies have been conducted to discuss the relationship between these factors. There have been plenty of studies that prove that animated content has a long-term effect on young children. While several studies have been conducted to verify the role of multimedia and animated content that incorporate the principles of CTML in enhancing the effectiveness of the learning process globally. This topic has not been investigated much in Jordan.

However, none of the previous studies, according to what has come to our attention, integrally discussed that animated content, incorporating the principles provided by CTML and involving the future innovations, could significantly influence children's awareness of future's challenges. The objective of this study is to address this gap.

Moreover, this study proposes a remedy for learning and teaching in Jordan. Therefore, the results of this study support the policymakers in MOE. Educational institutions, primary schools, edupreneurs (educational entrepreneurs), and any specialist interested in compulsory schooling can benefit from the results of this study.

1.3. Objectives of the Study: To answer the questions of this study, it is important to highlight the following objectives:

- To investigate the effectiveness of the animated content on the children's conceptual understanding of the roles and functions of future innovations in human society.
- To investigate the effectiveness of the animated content on the children's conceptual understanding of the future's challenges associated with digital workforce transformation,
- To support children's perception of and attitude toward learning about future innovations, in terms of using Multimedia Learning environments compared to traditional teaching methods.

The study also regards the use of animated content in Multimedia Learning as an alternative to Traditional Teaching methods. To achieve the objectives of this study, full agreement and cooperation were held with an instructor specialized in (technological education) in three educational institutions in Jordan.

2. Model of the Study: As shown in Figure (1), the proposed model suggests that using animated simulation prepared in accordance with the principles of (CTML) increases children's conceptual understanding of the functions and the roles of future innovations in human society. Moreover, it increases their conceptual understanding of the future's challenges associated with human workforce displacement. Also, it improves children's attitudes toward learning about the future.

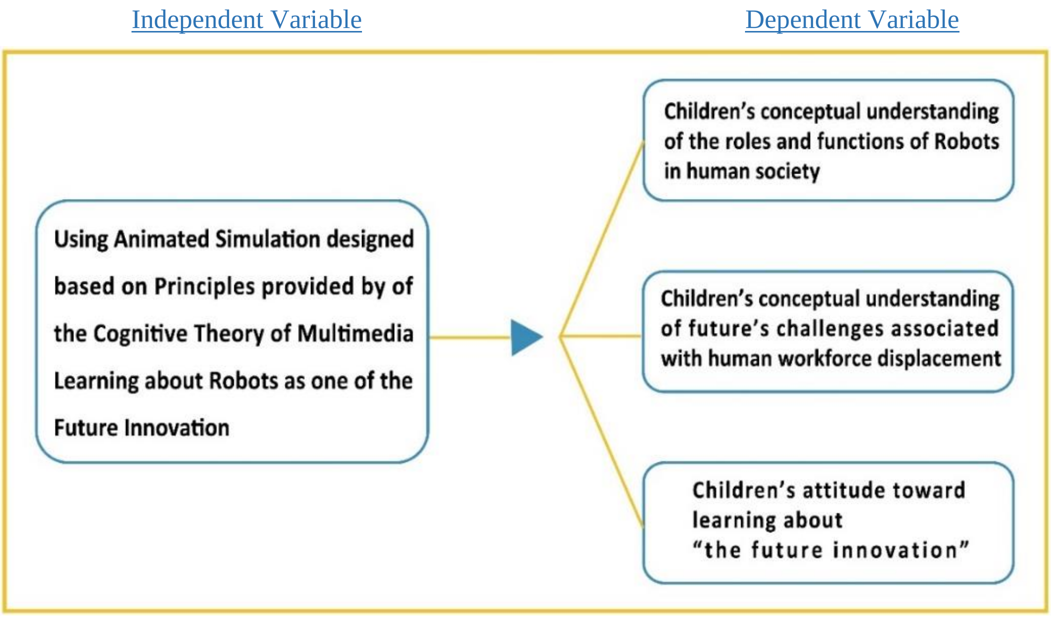

Figure (1): This model was developed by the researcher based on (Mayer, 2010)

2.1. Hypotheses of the Study: Considering the previous model, the following hypotheses are investigated:

H1: There is a statistically significant difference between children who learn using animated simulation in Multimedia Learning environment and children who learn through traditional teaching methods, in terms of their conceptual understanding of the roles and functions of future innovations in human society, with specific reference to the future's challenges associated with human workforce displacement,

H2: There is a statistically significant difference between children who learn through animated simulation, compared with those who use Traditional Teaching methods, with regards to their attitudes towards learning about the roles and functions of future innovations in human society.

H3: Children prefer Multimedia learning more than Traditional Teaching

H4: Children's opinions or impressions of using animated simulation in multimedia learning will be positive.

2.2. Procedure of the Development and Design of Animation: There are many factors and considerations that affect the use of multimedia in education. Mayer's CTML has provided practical factors that affect the application of multimedia learning through animation on the ground. Part of these practical factors are related to the virtual environment and hardware and software resources, such as the educational animated video, and the projector screen connected to a computer or laptop (Figure: 2).

Crosier, Cobb, & Wilson (2002) have suggested successive contextual considerations that are important in the design and development of animated video for education. These contextual considerations are related to the efficiency of users, availability of equipment and facilities to apply the Multimedia Learning principles (infrastructure), and the usability of the program to achieve the educational objectives. Based on Crosier et al.'s considerations, the current study has developed a six-stage model for intervention: (Crosier et al., 2002)

2.2.1. Identify the characteristics of video users: The first type of users is the instructor. She has skills and expertise in technological education. That means that she is typically able to use the technology-based educational tools and integrate them in the process of teaching. Children are the second group of users. The targeted children are in age 10 to 11 years old. Children, in both experiment and control groups, have the same educational experience in previous academic years.

2.2.2. Consider the equipment and facilities available in the educational institution: Some of the educational institutions in Jordan were visited to (a) find out the hardware available, and to (b) find out the software available. The classroom should be designed in a way that supports the achievement of the educational objectives of the study. Higgins et al., (1999) have pointed out 15 guidelines to set up an educational IT area and other guidelines to the use of ICT more effectively in foundation subjects. These are considered at this stage such as safe electrical extensions, highly visible data display system, and enough light levels of the classroom. It is considered also to check out the computer specifications and to put away anything that distracts children.

2.2.3. Select the simulation type that is suitable for the facilities and equipment available in the educational institution and the user's characteristics: This study chooses animation as an appropriate simulation type and effective visual model in an attempt to construct new knowledge and communicate content relevance as mentioned in the review of the previous studies. (Mnguni, 2014a) To create an effective animated simulation for the virtual educational environment, the researcher used all his skills in graphic design, writing, editing and proofing. A professional company, called "Masmoo3", was also engaged for the audio recording. The script was reviewed by scenarist working at MBC3. Then, it was turned into an animated simulation.

2.2.4. Identify the specific topic to be taught through the Multimedia Learning: One topic is selected to achieve the objectives of the current study: "The roles and functions of (ROBOTS) in human society, as one of the most important future innovations, with specific reference to the future's challenges associated with human workforce displacement by Robots." By the end of the session, the children are expected to be able to explore the definition of the concept (Robots), and conceptually understand their roles and functions in human society with specific reference to human workforce displacement by Robots. Moreover, children's attitudes towards learning about future innovation are expected to be positive.

2.2.5. Design and develop the animated video based on Mayer's principles of CTML.

2.2.6. Evaluate the animated video to identify and rectify weak points: The last step was to investigate any difficulties or obstacles that the instructor or the children would have in using or dealing with the animated simulation. Therefore, a pilot study was conducted at one of the educational institutions, and a list of points was taken into account, such as, the validation of the computer used, clarity of the terminologies shown on the animated simulation, and clarity of the instructions and the prior teaching.

2.2.7.

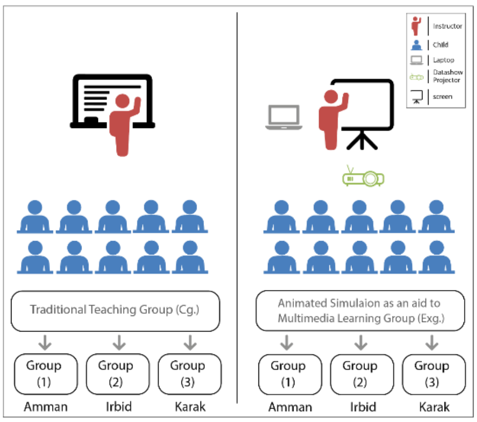

Figure (2): The Children Distribution in Traditional Teaching Group (CG) and Multimedia Learning Group (EXG)

3. Research Methodology: Educational studies are complicated in nature. It is difficult to adequately validate the results of the study in quantitative measurements alone. Therefore, the study combines quantitative measures and qualitative data to highly validate the experimental design. Patton (1990) suggests that 'mixed-method' designs have different advantages. For example, quantitative methods enable the researchers to measure the reactions of a large number of participants to a limited set of questions. Therefore, it facilitates statistical aggregation and comparison of data. This results in a generalizable, great and broad set of findings. By contrast, the qualitative approach gives a wealth of detailed information involving much smaller samples or cases. Consequently, situation and cases, understanding under study increases. However, that affects the generalizability of the study (Patton, 1990). Thenceforward, the study uses a qualitative experiment design as one of the qualitative-heuristic methods (Naber, 2015).

Associated with qualitative experimental research, this study uses qualitative strategies of in-depth semi-instructed interviews and focus groups within conditions of the randomized stimulus. Robinson & Mendelson (2012) elaborates on a qualitative experiment design. They demanded both pre-test and post-test switching to individual semi-structured interviews between three conditions. The reason why the researcher conducted a pre-and-post-test is to measure the participants' attitudes and general cognitive preferences (Robinson & Mendelson, 2012).

Robinson & Mendelson (2012) also proposes a general path of a hybrid-technique design of a qualitative study. it represents one of the qualitative studies executed in 4 phases. In phase (1), the participants receive a pre-test as a survey of open-ended questions. Then, the participants exposed to stimulus representation (Phase 2). Subsequently, they interacted with the entire process of stimulus representation in the post-test, interview or focus group (Phase 3). The form of analysis technique varies according to the research theoretical framework, research questions, sample size, and execution (Robinson & Mendelson, 2012).

Three integrated approaches of evaluation using a combination of quantitative and qualitative are summarized. These approaches are provided by Draper, Brown, Henderson, and McAteer (1996). However, they recommend to beware of the good delivery of the educational material. In addition, it's important to make sure that the quiz questions match the learning objectives. According to them, it is significant to use mixed evaluation methods in order to effectively come up with accurate results. They note that using one evaluation method is considered insufficient to communicate students' attitudes and conceptual understanding (Draper et al., 1996)

The design of this study investigates whether using animated simulation created based on the principles of (CTML) affects children's conceptual understanding of and attitudes towards learning about the "future innovations".

The study includes children aged 10 – 11 years old from three different districts of Jordan: (Amman, the capital of Jordan); (Irbid in the north of the county); (Karak in the south of the country). The districts were selected using the convenience sampling method, taking into account the diversity in the socio-economic conditions, educational standards, the geographical area, and the children's exposure to technology. In every district, one educational institution has been selected. The study has been conducted, and the following data have been obtained, using the qualitative experiment, with a sample size of (112) children.

In each educational institution, children have randomly divided into two groups, control and experimental groups, to eliminate the possibility of sampling bias. In the qualitative experiment, a randomized pre-test and post-test have been undertaken. In the (first /control) group, stimulus representation has been delivered using the traditional chalk-talk method; and in (the second/experimental) group, animated educational simulation has been used.

In order to measure children's attitudes toward learning about future innovations, post-questionnaires were filled out by all groups after both occasions. To investigate the effectiveness of the animated videos on the children's perception of the challenges of the future, in-depth semi-structured interviews within focus groups have been conducted, and answers of the children in the (first/control) group have been compared to those of the (second/experimental) group. (Figure: 3)

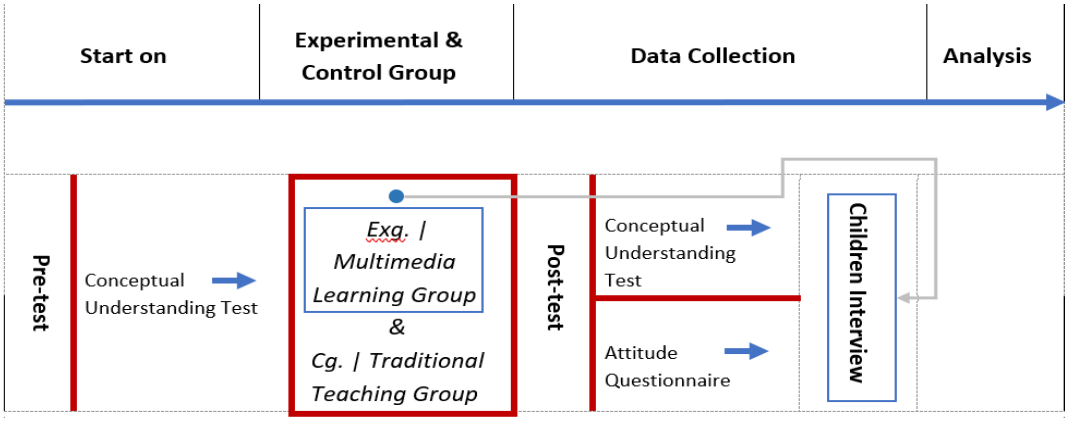

Figure (3): the Current Study Design (Robinson & Mendelson, 2012)

As the sample included Arabic speakers and users, both the animated simulation and the tests have been prepared in Arabic to avoid discrepancies. Thereafter, the responses have been translated into English. For both control and experimental groups, 10 minutes were given for the pre-test and 30 minutes for both traditional chalk-talk and multimedia learning environment. To minimize the biases and differences of the instructor, the same instructor specialized in (technological education) has been chosen and trained to present the lessons in all the selected educational institutions. The educational institutions in which children are studying have been considered as controlled variables.

3.1. Methods of data analysis:

3.1.1. Analysis of quantitative data: The Analysis of the quantitative data collected is done by using IBM SPSS Statistics version 21.0. *P*-values are taken into consideration to decide the significance level where $p>0.05$ means that there is no meaningful difference. Besides, $p<0.05$ means there is a statistically significant difference.

First, the current study uses “Independent Samples t-Test” in SPSS in order to show the total scores of the pre-test for the topic of the Multimedia Learning and Traditional Teaching environments. For the purpose of measuring that all children in both the experimental and control groups are equal at the baseline, mean scores are compared between the control group and the experimental group.

According to the analysis of the results of the children’s conceptual understanding, the “Independent Samples t-Test” is used for the post-test in order to compare the extent of the effect of the animated simulation on the post-test of children’s conceptual understanding of the topic. This is because the taught topic using the animated simulation as a treatment tool (intervention tool) is new for the children. The post-test of children’s conceptual understanding analysis is as follows:

- Comparing the results (in post-test) between children who used animated simulation (EXG) and those who use traditional teaching (CG). To measure the impact on the results of the measurement tools, (Effect Size) is used. Effect Size is a complementary test to previous significant statistics but not an isolated one. It supports the results of the study and explores how enormous the differences between and within groups are. Therefore, this test is used to consider the significance of findings aside from the significant statistic for hypothesis (*p*-value) (LeCroy & Krysik, 2007). Effect Size is conducted between and within, before and after the experimental and control groups in the study.

One of the most common types of this measure is the “standardized mean difference”. Accordingly, effect size measure shows the standardized difference between the means of the experimental and control groups (LeCroy & Krysik, 2007). Therefore, there are two scales included in the standardized mean difference: Hedge’s g and Cohen’s d. (Baguley, 2009). The current study incorporates Cohen’s d. The mean value for experimental and control groups is divided by the estimated population standard deviation. Cohen’s (d) has proposed the following standards (J. Cohen, 2013): (1)Small effect $d \geq 0.2$;(2) Medium effect $d \geq 0.5$; (3) Large effect $d \geq 0.8$.

3.1.2. Analysis of qualitative data: In the current study, the qualitative measurement tool is the interview. The objective of these interviews was to examine the results of the conceptual understanding of post-test and the attitude questionnaire.

In addition, data was gathered using a recorder application in addition to hand-written notes. Children's interviews were held in one of the meeting rooms of the educational institutions. In-depth semi-structured interviews were conducted to allow the children to express their ideas freely. For the analysis, observing children’s gesticulations and reactions during the interview is important too.

The educational institute management provided the contact information of parents to inform them of the study issue and help them trust the interviewer. The interview lasted for about 15 minutes. Straight after the interview has concluded, it’s important to read and listen to the interview several times to write down any perception or impression from the data relevant to the study objective. These perceptions and impressions could be useful for later. Moreover, it’s significant to take into consideration the need to show the responses in a sequential and coherent form to actualize the objective of the interview.

4. Research Analysis:

4.1. Findings of the pre-and post-conceptual understanding test and post-attitude questionnaires (Quantitative Findings):

4.1.1. Normality test

The normality test is used for the calculation of *p*-values for significance testing and constructing confidence intervals. The normality test is only considered when the sample size is small and not sufficiently large (< 200) (Krathwohl, 1998). Because of the low size of the sample, the Shapiro-Wilk test for normality is most appropriate.

According to pre-test results of the control group and post-test results of the experimental group, the *p*-value are (0.026) and (0.000). As shown in *Table (2)*, the results are significantly different from the standard normal distribution for the taught topic. (Cohen et al., 2013)

According to pre-test results of the experimental group and the post-test results of the control group, the *p*-value are (0.116) and (0.160). As shown in *Table (2)*, they are normally distributed for the taught topic. When the tests are not fully satisfying the standard normal distribution, it is popular to conduct both parametric and non-parametric tests. However, in both types of tests, the outcome is the same (Norušis, 1992). Therefore, the parametric test is used because it is easier to be understood and interpreted.

According to the children’s attitude questionnaire, the Kolmogorov-Smirnov/Shapiro-Wilk statistic was conducted for the same reason as in the conceptual understanding test. As shown in *Table (3)*, there is a significant difference in the experimental and control groups. The *p*-values for children’s attitude questionnaire are (.000) and (.002). the *p*-value is smaller than (0.05). Consequently, the groups can’t be normally distributed. As similar to the conceptual understanding test, it is possible to conduct a parametric test.

4.1.2. Comparing the pre-tests between groups

Children’s total scores of pre-tests for the topic are analyzed using the “Independent Samples T-test of SPSS”. Then, mean scores of pre-tests are compared between the control group (Cg) and the experimental scores (Ex). As shown in ***Table (1)***, none of the scores is significantly different. Thus, the study concludes that children in the groups are equal at the baseline.

Table (1): Multimedia Learning Vs. Traditional Teaching:

Topic	Groups	N	Mean	Children Deviation	Children Error Mean	P-value
Topic | Future Innovation pre-test	Experimental Group	56	8.2500	2.42899	.32459	.691
	Traditional Group	56	8.4286	2.31875	.30986	

4.1.3. Results in conceptual understanding post-tests

As shown in ***Table (2)***, the means scores of the post-test are significantly different in favor of the experimental group for the topic. Consequently, the mean score difference between the experimental group (EXG) and the control group (CG) is

(13.3214) for the first group and (9.9286) for the second group. Therefore, the animated simulation in the Multimedia Learning environment is found to be much more efficient than the method of traditional teaching.

Table (2): conceptual understanding post-test score comparison

Topic	Groups	N	Mean	Children Deviation	Children Error Mean	T statistic	P-value
Topic | Future Innovation post-test	Experimental Group	56	13.3214	1.47842	.19756	9.124	.001
	Traditional Group	56	9.9286	2.35763	.31505		

4.1.4. Effect size of children's conceptual understanding

The objective of using effect size is to complement the testing of significance, support its results, and explore how enormous the differences are (LeCroy & Krysik, 2007). For the current study, the effect sizes of differences are analyzed within groups and between groups.

- **Effect size within groups from pre-test to post-test**

As seen in ***Table (3)***, the experimental group (EXG) has a large effect size (2.52) and higher than the effect size of the control group (CG).

***Table (3): The Effect Sizes from pre to post-test results within groups*:**

(EXG vs. CG)	Data Entry						Standardized effect size		
	Post-test			Pre-test			Cohen's *d* Effect size	The confidence interval for effect size	
	Mean	N	SD	Mean	N	SD		Lower	Upper
(EXG) pre-to post-test	13.32	56	1.48	8.2500	56	2.43	**2.52**	-5.64	-4.50
(CG) pre-to post-test	9.93	56	2.36	8.4286	56	2.32	**0.64**	-1.82	-1.18

- **Effect size between groups in the post-test:**

As shown in ***Table (4)***, the experimental group (EXG) score significantly higher on the post-test than the control group (CG). According to Cohen's standard scale, the effect size is (1.72), which is high. Consequently, the result reveals that using animated simulation in the Multimedia Learning environment has significantly high effect compared to traditional teaching.

Table (4): The Effect Size between the experimental group (EXG) and the control group (CG) in the post-test:

(EXG vs. CG)	Data Entry						Standardized effect size		
	Experimental Group (EXG)			Control Group (CG)			Cohen's *d* Effect size	Confidence interval for effect size	
	Mean	N	SD	Mean	N	SD		Lower	Upper
post-test	13.32	56	1.48	9.93	56	2.36	**1.72**	2.66	4.13

4.1.5. Result of attitude toward learning about future innovation

Table (5) presents the results of the attitude questionnaire for the groups. The t-test reveals a statistically significant *p*-value for both scales (>0.05). For the experimental group, the mean value is (4.69) for children's attitudes towards learning about future innovations and (4.73) for children's attitudes towards learning more about the future innovations in the future.

However, the mean value for the control group is (3.39) for children's attitude toward learning about future innovations and (3.13) for children's attitude toward learning more about the future innovations in the future.

Effect sizes are (**1.82**) and (**2.07**). According to Cohen's categorization (Hall & Cohen, 1988), the first scale has a large effect size and the second scale has somewhat a smaller effect size, but still at a medium level in Cohen's categorization.

Table (5): Children's Attitude Comparison between the Experimental group (EXG) and the Control group (CG) toward Learning about the Future Innovations:

Post – Attitude scales	Type of group	Mean	N	Std. Deviation	Std. Error Mean	t statistic	p-value	effect size
Learning about future innovations	Experimental group (Exg)	4.69	56	.260	.035	15.68	.00	**1.82**
	Control group (Cg)	3.39	56	.562	.075			
Learning more about future innovations in the future	The experimental group (Exg)	4.73	56	.36	.04	11.01	.00	**2.07**
	Control group (Cg)	3.13	56	1.03	.13			

4.1.6. Children's In-depth Semi-structured Interviews (Qualitative Findings)

After the completion of the intervention, distribution, receipt of the conceptual understanding test and attitude questionnaire, in-depth semi-structured interviews were conducted with five (5) children from each experimental group (15 students as a total).

Children's interviews were conducted in Arabic and then their responses were translated into English. Each interview took around 15 minutes. During these interviews, three topics were discussed:

1. Children's conceptual understanding of and opinion about Robots as a future innovation, their role, and functions in human society.
2. Children's impressions regarding human workforce displacement as a future challenge.
3. Children's tendencies and attitudes toward using animated simulation in Multimedia Learning environment.

There was a list of previously prepared questions under each of the three topics above. During children's interviews, new questions have emerged and were elaborated to figure out more information to be incorporated with research results. Words in bold indicate codes.

After being presented with the animated simulation, most of the interviewed children have realized and stressed that robots perform their roles and functions in smarter ways. They perform more efficiently, effectively, productively, economically, accurately, and safely. In comparison to humans, children express that Robots deliver better services and perform at higher and more quality consistent levels. Children, also, realize that Robots would use their time and effort more efficiently. Most of the children believe that Robots could help humans to devote themselves to other roles. Despite their acknowledgment of the information presented in animated simulation, yet, some of the interviewed children expressed their hesitancy to trust their lives with Robots. The majority of the interviewed children understand and accept that one-day Robots could replace their jobs. They already started to consider studying a major that could help them find a good job and generate a good income in the future. On the other hand, few of the children refused the idea of human workforce displacement.

Generally, the semi-structured interviews show that children's impressions of using animated simulation in multimedia learning are positive. The animated simulation helped them to understand in clear practical ways the roles and functions of Robots in human society, and to be able to focus on and follow the objectives of the experiment. This was proven by the fact that the animated simulation has evoked many questions from many of the interviewed children, many were smart and deep questions for children of their age. What is interesting that some of the children's answers were guided by their social and cultural norms, traditions, norms and customs.

As a result, most of the interviewed children confirm that displaying the animated simulation on the screen makes the taught topic of the concept of Robots clearer to children. It makes them more interested, focused, and motivated to engage in the class. Interviewed children are also able to understand, imagine, and describe the concepts clearly and quickly at the end of the class discussion using the animated simulation.

To wrap up the main findings from the data analysis, the current study concludes the following:

- To respond to the first and fourth questions in a given area of research, the ***first*** and ***second objectives*** of the study were investigated. As a result, children who used animated simulation in the Multimedia Learning environment (EXG) score significantly higher on the post-test than the children who were taught using traditional teaching methods (CG).

The data analysis shows that children in the groups are equal at the baseline. With regards to the results of the post-test of children's conceptual understanding of the roles and functions of future innovations in human society, it is concluded that creating and using animated simulation in the Multimedia Learning environment makes a notable difference overall. There is a statistically significant difference between children who learn using it and children who learn through traditional teaching methods.

Regarding children's conceptual understanding of the future challenges associated with human workforce displacement, the study concludes that creating and using animated content appropriately in the Multimedia Learning environment will increase their conceptual understanding of the taught topic more effectively and efficiently than the Traditional Teaching method. Moreover, the effect size is higher for the experimental group (EXG) than the control group (CG).

- To respond to the second and third questions in a given area of research, the ***third objective*** of the study investigates children's attitude toward learning about future innovations, in terms of using a Multimedia Learning environment compared to traditional teaching methods.

With this regard, this study concludes that there is a statistically significant difference between children who learn through animated simulation, compared with those who use traditional teaching methods. As a result, the current study shows that children prefer Multimedia Learning more than Traditional Teaching.

5. Discussion of the Results: This study is designed to investigate the effectiveness of using animated simulation within the Multimedia Learning environment on learning about future innovations. In addition, it is designed to compare the results with the matching control groups (CG). Knowing that the experimental group (EXG) uses animated simulation in the classroom within the Multimedia Learning environment in support of traditional education. Moreover, the control group (CG) sufficed to use a Traditional Teaching method.

The effects of the intervention conducted within Multimedia Learning and Traditional Teaching environments are investigated and determined by conceptual understanding test and attitude questionnaire toward learning about future innovations. In addition, the study investigates the opinions and experiences of children who participated in the experimental groups using in-depth semi-structured interviews. The intervention consists of the following topic:

"The roles and functions of (ROBOTS) in human society, as one of the most important future innovation, with specific reference to the future's challenges associated with human workforce displacement by Robots."

After the completion of data analysis, the findings show that the hypotheses of the study are reasonable and accepted. Particularly, in terms of improving children's conceptual understanding of and attitudes towards learning about future innovations. The data analysis proves statistically significant differences in the results between children in the experimental and control groups. Through using animated simulation, the analysis reveals that there is a particularly noticeable advancement in favor of the experimental group in terms of their understanding of the functions and roles of Robots as a future innovation with specific reference to human workforce displacement. Consequently, the findings support the claim that children who used animated simulations performed better and showed improved results in their conceptual understanding test than the children in the control group who were exposed to the traditional teaching method.

Moreover, the analysis reveals that there is a difference in the effect size within the experimental group (EXG), who used animated simulation, and the control group (CG), who followed traditional teaching methods, from pre-test to post-test. The analysis reveals that there is a difference in the effect size between the experimental group (EXG) compared to the control group (CG) in the post-test. The effect size within the groups is higher for the experimental group (EXG) than the control group (CG). According to Cohen's standard scale, the experimental group (EXG) has a large effect size (2.52), while the control group (CG) has (0.64), which is Medium effect size. Moreover, the effect size between the experimental group (EXG) and the control group (CG) in the post-test, after the intervention, is children who used animated simulation in Multimedia Learning environment (EXG) score significantly higher on the post-test from the children who were taught using traditional teaching method (CG). According to Cohen's standard scale, the effect size is (1.72), which is high. This is consistent with Hattie's (1999) meta-analysis.

Therefore, this hypothesis is supported because there is a statistical difference in the findings. To support the post-test results of children in the experimental group, interviews were conducted with some of them. Interview results support the findings of the post-test. For example, most of the interviewed children have realized, stressed and accurately expressed that Robots perform their roles and functions in smarter ways. They explained that Robots perform more efficiently, effectively, productively, economically, accurately, and safely. It is highly proved and observed that, when the animated simulation is used, children enjoy learning about future innovations, and their conceptual understanding of such a topic is delivered effectively and efficiently using Multimedia Learning.

The results of the data analysis of the attitude questionnaire indicate that the differences are significant enough to support this hypothesis. The *t*-test reveals a statistically significant *p*-value for both scales (>0.05). For the experimental group, the mean values are (4.69) and (4.73) for children's attitudes towards learning about future innovations currently and in the future. Effect sizes between the experimental group (EXG) and the control group (CG) regarding their attitudes towards learning the topic currently and in the future are (**2.07**) and (**1.82**). According to Cohen's categorization (Hall & Cohen, 1988), the first scale has a large effect size and the second scale has somewhat a smaller effect size, but still at a medium level in Cohen's categorization. In-depth semi-structured interviews also prove that using animated simulation in the Multimedia Learning environment positively affected their attitudes towards learning about future innovations.

Attitude questionnaire and interviews reveal that children prefer Multimedia learning more than Traditional Teaching.

The analysis proves that children's responses regarding their opinions, impressions, and satisfaction with using animated simulation within Multimedia Learning simulation and its benefits in learning about future innovation were very positive. In addition, their responses demonstrate a high level of information possessed regarding the taught topic. For example, at the end of the intervention, children were able to give examples of the future innovation roles and functions in human society, give reasons explaining human workforce displacement by future innovations and distinguish between human workforce and the digital workforce

In order to support the attitude questionnaire results, interviews were conducted with some of the children in the experimental groups. Interview results support the findings of the attitude questionnaire. It is highly proved and observed that, when the animated simulation is used, children's conceptual understanding of the future's challenges associated with digital workforce transformation is increased, their perception of the roles and functions of the future innovations in human society is changed and enhanced, and their attitudes towards learning about the future's innovations are improved.

Beydoğan & Hayran (2015) also acknowledged that using multimedia-based learning significantly affect students' conceptualization and attitudes towards learning. They postulated that if students in primary education lack sufficient experience and knowledge received by more than one sensory organ, such as hearing, vision, and touch elements, they will encounter difficulty with conceptual understanding. Their attitudes towards learning may be negatively affected as well. Moreover, Beydoğan & Hayran (2015) choose to teach 24 concepts covered in the fifth-grade science curriculum. They developed a 28-item concept test. Students' conceptual understanding in both the control and experimental group were examined via pretest-posttest model. The experimental group was taught new concepts using multimedia-based learning and the control group was taught the same concepts using traditional teaching. They also designed a 28-item attitude scale. The results of the current study favor children in the experimental group over those in the control group. This view was also endorsed by Beydoğan & Hayran (2015).

Another study conducted by Unterbruner, Hilberg & Schiffl (2016) endorsed the same view as well. They educated seventh-grade students on an important subject using a multimedia learning environment. The study uses a quasi-experimental model involving both experimental and control groups. Compared to the control group, the knowledge of students in the experimental one were significantly increased. The acceptance of the taught topic was also very high. Their evaluation consists of a pre–posttest design to evaluate students' knowledge, preconceptions and attitudes regarding the taught topic. Kumar & Sherwood (2007) also confirmed through their study that using multimedia in learning programs affect students' conceptual understanding positively. Their Paired t-test of pre- and post-tests showed significant ($p<0.05$) gains. The Multimedia Learning method had a significant effect on the students' conceptual understanding.

Other findings of a series of three experimental studies conducted by Urhahne (2009) postulated that the use of multimedia simulations facilitates and paves the way for the acquisition of conceptual knowledge. These experiments derive three-dimensional simulations from Mayer's Cognitive Theory of Multimedia Learning. All the three experimental studies concluded that there is a significant relationship between multimedia simulation and improving students' conceptual understanding (Urhahne et al., 2009). Moreover, Crosier, Cobb, & Wilson (2002) are of the view that it is critical to involve an educational virtual environment. Their study concentrates on students' interaction with and attitudes towards it. They have developed a framework as a recommendation for a convenient method for the selection, design, development and evaluation of an educational virtual environment. Otherwise, the virtual environment could result in low attitude scores for children and they may comment that it was "boring". Their framework includes evaluation phases using a combination of quantitative and qualitative methods.

Except for Urhahne' study namely "The Effect of Three-Dimensional Simulations on the Understanding of Chemical Structures and Their Properties", none of these studies mentioned above develop the multimedia-based learning environment based on the principles or elements of any of the Cognitive or Multimedia Learning theories to ensure that concepts or topics were taught perfectly, completely and of high quality. In addition, the experimental models mentioned included a pretest-posttest design or attitude questionnaire or both. Their quantitative data analysis involved calculating standard deviations and means, as well as one-way analysis of variance and t-tests. However, the current study adopts a qualitative experiment design to investigate children's conceptual understanding and attitudes towards learning about future innovations and human workforce displacement. There are three measurement tools used within 3 phases covered in this study to verify the current study's hypotheses: conceptual understanding pretest and posttest, post attitude questionnaire and in-depth semi-structured Interview. In addition to the quantitative measures used by many authors, such as Beydoğan & Hayran (2015), the current study uses (Effect Size) between and within, before and after the experimental and control groups in the study. It is not an isolated test. It is a complementary one to previous significant statistics. Moreover, the effect size test supports the results of the study and explores how enormous the differences between and within groups are.

Consequently, this type of design was constructed because educational studies are complicated in nature. It is difficult to adequately validate the results of the study in quantitative measurements alone. At once, the qualitative approach gives a wealth of detailed information involving much smaller samples or cases. Therefore, the study combined quantitative measures and qualitative data to highly validate the experimental design (Patton, 1990). Therefore, there are at least two critical justifications behind this study design. The first is to have accurate and comparable measures of the intervention's effect. The second is to have rich and authentic data.

6. Conclusion of the Study:

After conducting the qualitative experiment using the measurement tools to gather the required data, the results reveal that there are statistically significant differences between children in the experimental group who used animated simulation within the Multimedia Learning environment and children in the control group who used Traditional Teaching method. The first group performed better on their conceptual understanding of the roles and functions of future innovation, with specific reference to human workforce displacement. In addition, their attitudes were more positive towards learning about future innovation than children who were exposed to the traditional teaching method.

In-depth semi-structured interviews show that animated simulation makes children more involved and motivated during the session. Their conceptual understanding of Robots as a future innovation and their role and functions in human society are ascertained. Their perceptions and impressions regarding human workforce displacement as a future challenge are verified. Moreover, their persevering tendencies and positive attitude toward using animated simulation in Multimedia learning environment to learn about future innovations are reinforced and supported.

References

Baguley, T. (2009). Standardized or simple effect size: What should be reported? British Journal of Psychology, 100(3), 603–617.

Barcevičius, E., Cibaitė, G., Codagnone, C., Gineikytė, V., Klimavičiūtė, L., Liva, G., Matulevič, L., Misuraca, G., & Vanini, I. (2019). Exploring Digital Government transformation in the EU.

Beydoğan, H. ömer, & Hayran, Z. (2015). The Effect of Multimedia-Based Learning on the Concept Learning Levels and Attitudes of Students. Eurasian Journal of Educational Research, 15(60), 261–279.

Carrington, W. J., & Fallick, B. (2017). Why Do Earnings Fall with Job Displacement? Industrial Relations: A Journal of Economy and Society, 56(4), 688–722.

Cohen, J. (2013). Statistical power analysis for the behavioral sciences. Academic press.

Cohen, L., Manion, L., & Morrison, K. (2013). Research Methods in Education. Routledge.

Cornelio-mar, E. M. (2015). Mexican Children and American Cartoons: Foreign References in Animation. 125–132.

Crosier, J. K., Cobb, S., & Wilson, J. R. (2002). Key lessons for the design and integration of virtual environments in secondary science. Computers & Education, 38(1), 77–94.

Draper, S. W., Brown, M. I., Henderson, F. P., & McAteer, E. (1996). Integrative evaluation: An emerging role for classroom studies of CAL. Computers & Education, 26(1–3), 17–32.

Gartner. (2015). Media Alert: Gartner Announces Customer 360 Summit 2015. Business Wire (English). http://search.ebscohost.com/login.aspx?direct=true&db=bwh&AN=bizwire.c62988978&site=ehost-live

Geissbauer, R., Vedso, J., & Schrauf, S. (2016). Industry 4.0–Building the digital enterprise (2016). PWC 2016 Global Industry 4.0 Survey.

Hall, G. F., & Cohen, M. J. (1988). Dendritic amputation redistributes sprouting evoked by axotomy in lamprey central neurons. Journal of Neuroscience, 8(10), 3598–3606.

Held, C., Vosgerau, G. M.-G., & Knauff, M. (2006). Mental Models and the Mind: Current developments in Cognitive Psychology, Neuroscience and Philosophy of Mind. Elsevier.

Higgins, S. J., Higgins, S., Packard, N., & Race, P. (2000). 500 ICT Tips for Primary Teachers. Psychology Press.

Jackson, I. (2018). The future of technology integration. Electronic Product Design, 20(2), 51.

Krathwohl, D. R. (1998). Methods of educational and social research. An Integrated.

Kumar, D. D., & Sherwood, R. D. (2007). Effect of a Problem Based Simulation on the Conceptual Understanding of Undergraduate Science Education Students. Journal of Science Education and Technology, 16(3), 239–246.

LeCroy, C. W., & Krysik, J. (2007). Understanding and interpreting effect size measures. Social Work Research, 31(4), 243–248.

Lee, S. M., & Trimi, S. (2018). Innovation for creating a smart future. Journal of Innovation & Knowledge, 3(1), 1–8.

Mayer, R. E. (2008a). Applying the Science of Learning: Evidence- Based Principles for the Design of Multimedia Instruction.

Mayer, R. E. (2008b). Applying the science of learning: Evidence-based principles for the design of multimedia instruction. American Psychologist, 63(8), 760.

Mnguni, L. E. (2014a). The theoretical cognitive process of visualization for science education. SpringerPlus, 3(1), 184.

Naber, A. (2015). Qualitative experiment as a participating method in innovation research.

Norušis, M. J. (1992). SPSS for Windows: Base system user’s guide, release 5.0. SPSS Inc.

OECD (Ed.). (2015). Better skills, better jobs, better lives: A strategic approach to skills policies. OECD.

Patton, M. Q. (1990). Qualitative evaluation and research methods. SAGE Publications, inc.

Richert, R. A., & Schlesinger, M. A. (2017). The role of fantasy – reality distinctions in preschoolers ’ learning from educational video. September 2016, 1–18.

Robinson, S., & Mendelson, A. L. (2012). A Qualitative Experiment: Research on Mediated.

Schryer, E. (2015). Effects of an Animated Book Reading Intervention on Emergent Literacy Skill Development: An Early Pilot Study.

Sharkins, K. A., Newton, A. B., Essa, N., & Ernest, J. M. (2016). Preschool Children's Exposure to Media, Technology, and Screen Time: Perspectives of Caregivers from Three Early Childcare Settings. 437–444.

Sorden, S. D. (2012). The cognitive theory of multimedia learning. Handbook of Educational Theories, 1, 31.

Swerdloff, M. (2016). Online learning, multimedia, and emotions. In Emotions, technology, and learning (pp. 155–175). Elsevier.

Tayo, O., & Oluwakemi, O. (2015). Educational Multimedia and Learning Style Preferences. British Journal of Education, 3(12), 29–42.

Tyner, K. (2014). Literacy in a digital world: Teaching and learning in the age of information. Routledge.

Unterbruner, U., Hilberg, S., & Schiffl, I. (2016). Understanding groundwater – students' pre-conceptions and conceptual change by means of a theory-guided multimedia learning program. Hydrology and Earth System Sciences, 20(6), 2251–2266.

Urhahne, D., Nick, S., & Schanze, S. (2009). The Effect of Three-Dimensional Simulations on the Understanding of Chemical Structures and Their Properties. Research in Science Education, 39(4), 495–513.

Vratulis, V., Clarke, T., Hoban, G., & Erickson, G. (2011). Additive and disruptive pedagogies: The use of slow motion as an example of digital technology implementation. Teaching and Teacher Education, 27(8), 1179–1188.

Williams, D., & Allen, I. (2017). Using artificial intelligence to optimize the value of robotic process automation. NY: IBM Corporation.

Williams, P. J., Jones, A., & Buntting, C. (2015). The future of technology education. Springer.