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Research paper



Animation Effectiveness for E-Learning with Progressive Web App Approach: a Narrative Review

Hadi Wijaya[1]*, Rabab Alayham Abbas[2]

[1]School of Graduate Studies, Management and Science University, Malaysia
[2]Faculty of Information Sciences and Engineering, Management and Science University, Malaysia
**Corresponding author E-mail: hadi.jedank@gmail.com*

Abstract

Understanding the content of a subject is the most fundamental thing a student should do to acquire the skills and knowledge. Animation is one way to provide an interesting way of learning. ALETRIA project is the reason to support the students for use animation methods that developed in novel e-learning concept. As a first step, the study of animation and e-learning development became the basis of this narrative literature. Terms of search that used in this paper is animation for learning, engagement and learner's motivation. E-learning development with Progressive Web Apps (PWAs) were excluded from the search terms. 29 papers were selected for review as they are relevant to the criteria. The combined results of these papers recommend that there is reason to confident that the development of e-learning animations with the PWA approach might be effective to use.

Keywords: *Animation in Learning; E-Learning; Progressive Web App; Narrative Review; ALETRIA;*

1. Introduction

To produce attractive content that can accommodate student interest, multimedia such as animation, video, audio, graphics, even text even always used [1].
The use of interactivity in a multimedia presentation, in [2] suggests that interactivity is closely related to multimedia learning programs can enhance the obvious benefits of affective states. The term affective refers to the desires, intentions, beliefs, frustrating moods, emotions as well as student attitudes.
However, strong evidence to prove that multimedia such as animation for e-learning can help students' understanding and engagement has been lacking. There are still some shortcomings in the knowledge of animation features that are suitable and effective in supporting student learning.
Meet the desired learning outcomes should fulfill the essential requirements for successful animation being developed. This complex process brings together the desire and the bidding to understand their compatibility.

1.1. Animation in Learning

Complicated subject matter and concepts are difficult to explain on traditional media that only rely on still slides. Animation offers a better representation of these complex concepts. Animation can present procedural information more explicitly as it displays steps regularly.
Instructional animation can be used for several purposes in terms of learning. The first function can be used as attention tools such as device attention gaining, attracting leaners to be directed to the area that animation want to. This can be done using cues or arrows or anything else that can take the attention of the learner. Second, another function of instructional animation can be used as a tool to display a clear or abstract procedure to be remembered and performed by the learner such as the various ways of tying a shoelace or also solving a puzzle. Third, the last function is to support students to understand the dynamic functions that can change over time, analog representation, and sustain from the running of steps such as the formation of sweat and flushing system [3].
From the deficit described by [3], it can be described more clearly about animation functions as follows:

- Directional animation is used to guide the attention of participants across the screen and to help images to illustrate. Directional animations are not about to distracting the learner, it should be used guide the learner's attention to help them focus on the things on something that the content want to focus on.
- Transitional animations are used to help and guide learners through content changes, how to get learners from point A to point B and help them understand where learners are, where learners went and how learners got there. The transitional shift can change learners mind mentally understand what's changing on screen. The main purpose for using transitional animation is to reduce the cognitive load of learners to participants for their own processes.
- Instructional animation is a way that if used correctly to communicate meaning. Instructional animation is all about non-verbal communication, how an animation communicates something without additional words, showing the participants what the animation will say. Instructional animation has 2 types: concepts and technical. Conceptual instructional animation explains some conceptual ideas, something that may not be true for life. Technical instructional animation, physically showing something that may be real or physical.

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1.2. Use of e-Learning Behavior

The use of internet cannot be separated from the use of hardware or devices. Internet usage allows us to record how many traffic data and the user information in details. Generally, internet usage that used by user in the worldwide divided into 3 part devices: desktop user, mobile users, and tablet users.
The use of mobile internet is working on its way into the everyday users of smartphones and tablets, enabling users to access and share information. Mobile internet provides a good future projection, global mobile data traffic will be predicted to continue sharply up close to the years 2016 and 2021. As in February 2018 alone, recorded data for the use and access of web page views globally, mobile devices 51.95%, desktop devices 43.98% and followed by the use of tablets of 4.07% [4].
The many uses of smartphones and other mobile devices, it is necessary for mobile and user-friendly applications to create an e-learning and offer applications to support e-learning tools [5]. Each kind of devices has a respective advantage that we can see from the usage, engagement, reach, and effectiveness depends on audience and purpose of the e-learning.

1.3. Progressive Web Apps (PWAs) Approaches

Progressive Web Apps (PWAs) as the one potential learning method in lecture. At the point when utilized completely, e- learning can be a viable learning tool because students can reach the website from unlimited places as long as there is access. What is often a constraint being the availability of e-learning platform that meets the needs and stable even in a minimal internet connection or offline conditions though?
This idea incorporates the use of new innovations from web programs. PWA has the fundamental characteristics of reliable, fast, and engaging, guaranteeing clients in the best possible way to implement an application event in an insignificant or disconnected web association.
A Progressive Web App E-Learning combines the best experiences of the web and app. PWA does not require any establishment. Revealed from the relationship that the user works with the app over time. The apps stack immediately even when the user is on awful networks. It can send relevant push notices to the users and has a symbol on the home screen and loads as best level, full screen experience [6].

1.4. An Animations Approaches for E-learning

The ALETRIA project has the goal of developing an animation-based e-learning to support students in learning about computer information systems that focus on computer network subject. ALETRIA stands for Animation e-Learning Hysteria that intends to keep students engaged with learning with long duration and comfort of its use. Mastering expertise in a particular subject area is a significant challenge for many students, especially students who are just starting to learn computer network subject. Students struggle to gain a firm grasp of the logical reasoning that highlights the basis of the subject. The web app provides facilities that can accommodate students to continue to be involved in learning, no matter what device that learners use. Moreover, we know in this century, the use of smartphones has exceeded the use of desktop to access the internet, and the duration of the use of interaction between users and devices are also still surpassed by smartphone users, this is the supporting main reason why ALETRIA will be developed to meet the need.

1.5. Goals of the Paper

The purpose of this paper is to report a review of the narrative literature undertaken to establish how far animation-based learning is currently being used, especially with progressive web apps approaches. A meta-analysis carried out by [3] in 2016 demonstrated the a general beneficial outcome of animation over static graphics was found, with a Hedges's g effect size of 0.226 (95% confidence interval ¼ 0.12e0.33) from aggregate of 50 papers were considered, and successively 61 essential examinations (N ¼ 7036), yielding 140 sets insightful correlations of animation versus static graphic representations in interactive media instructional material were broke down utilizing an irregular impacts display. Be that as it may, static graphic has been around for any longer than animation and there has been an ideal opportunity to develop a confirmation base for its adequacy. Since progressive web apps in e-learning is still a considered new approach of development, it is estimated that the studies are well designed of this kind of e-learning in the domain of this subject may be rare at this stage.
Per January 2017, the Google Web Fundamentals exhibition is one of the main leading driving force behind the promotion of PWAs. They could be considered as the primary publisher of learning material [7].
For this reason, in this study will not discuss the effect size in the use of animation in learning a content, but to build the areas to be addressed in this area and to elaborate the important aspect of animation and development that can be included to the app. Therefore, the literature review is considered appropriate. While the review is an important basis for designing ALETRIA project, also related to the undergraduates' student where there is interest in learning while inside classroom or labs and outside the classroom.

2. Background of Research

Internet interconnects the PC organizes and empowers them to discuss specifically with each other all through the world. This worldwide interconnection of governments, education and organizations prompted PC systems ending up more open to the general population to give quality data, education and amusement for humankind.
Education has constantly assumed a critical part in human life and it has been directed in different courses relying upon the way of life and area. Amid the previous hundreds of years' men have flown out from nation to nation for business, relocation, war and education. Want to stay away from conventional education was constantly colossal and creation of Internet conveyed this thought nearer to reality.
With the development of computer technology and advancement, computer technology plays in modern teaching an increasingly essential role, which is primarily reflected in the use of data technology to the management of teaching and teaching itself through teaching, this new types of teaching is called computer-assisted instruction [8]. From the other perspective, throughout day by day educating, showing instructors using mixed media, the internet and different innovations to make a vivid and exuberant and fascinating learning condition for students to communicate thus to advance the nature of instructing and learning productivity. Then, in the administration of instruction, the sane utilization of computer innovation to effectively and precisely educational programs administration, showing help, work accommodation and stamping and other work, will be liberated from these perplexing human work better upgrade the quality and effectiveness of instructing.
The outcomes that have inspired institutions to use ICT in education include better learning effectiveness, access to and availability of information, benefit, stability, pliability and efficiencies [9].

3. Methodology

Regarding to the objective of this paper is to summarize and analyze the literature of animation effectiveness that possible to be developed in e-learning with the use of PWA approach. The guideline motivation behind a narrative review is to give the writer a complete diagram of the point and to feature noteworthy zones

of research, narrative reviews can distinguish holes in the research and help to refine and characterize research questions [10].

3.1. Terms of Search

Terms for this literature review will be divided into several keywords that contain evaluation of animations, which addressed the variety of learning content that might be used. Technology development (e-learning) were excluded from the search terms as this is too broad to review. Terms used for animations were:

(animation OR animated)

To narrow the search that are related to the purpose of user understanding, terms will be added as follows:

AND (learning OR engagement OR motivation)

Recent interest in animation as the type of learning content the time the period chosen for search is a span of five years from 2013 to December 2018.
It is known that the general term for search for the web app development, i.e. "e-learning", "mobile learning" and "web application" and it used extensively in reporting recent work in journal papers, it is very difficult to provide additional concentrated search terms, reviewed that a comparatively high-level paper established by search terms may be pertinent. Also about it convergence, i.e. "progressive web app", it was difficult to afford and acquire the journal papers because the numbers are little or none. The approach recently discovered in 2015, so this approach is not very well known among researchers at this present.
Back to the aim of the paper, the goals of this review is effectiveness of animation for learning, although for the outcome of the study is developing an application that will be built by progressive web apps as an e-learning development approach in order to improve engagement, ease of access, and expansion of the range of user devices in the form of desktop or mobile.

3.2. Databases of the Search

The searched databases include those identified as relevant to the area of information computer technology, education, instruction, and learning.

Science Direct; Scopus;

In addition, results were refined by categorize i.e. limited year range in 2013 to 2018 and type of documents only journal, and conference papers with English language and to narrow the search that are related to the field about animation for learning, the publication titles were filtered to the fields: "Computers in Human Behavior, Computers and Education, Learning and Instruction". Take note that each databases of Science Direct and Scopus has different syntax for using the query.

3.3. Criteria for Selecting the Papers for Review

This research is used to search for other words animation as the main topic to be used in learning with the possibly following contained e-learning (mobile or web application), simulation techniques, or static graphic to enhance or assist students' understanding and knowledge accession or engagement with the subject.
Various further criteria were indicated to choose fitting investigations for consideration. To be incorporated into the review papers needed to (a) describe an animation which aimed to be used as a learning tools, (b) contain the element of quantitative or qualitative application evaluation, (c) year span from 2013 to 2018 and (d) include an abstract.

4. Results and Analysis

4.1. Papers Identified By Terms of Search

Table 1 shows the number of papers derived from the databases along with the submitted papers.

Table 1: The amount of papers included in the review and identified from each database

	Identified from Database	Included in the Review
Scopus	112	11
Science Direct	626	14
Previously collected	62	4
Total	800	29

4.2. Papers Excluded From the Review

The titles and abstracts of the 800 papers recognized were read to choose papers which were potentially relevant. As predicted, because of the general idea of the search terms for animations, numerous papers which appeared of the pursuit were not applicable to the review that concentrated on learning enhancement. Paper excluded for the following reasons:

a) Various papers reported the use of animation in learning are of great interest for the development of the ALETRIA project, but are excluded from this review if it does not include qualitative or quantitative evaluations of the eligibility of the mediation described.
b) Some papers recognized by search terms describe a variety of animations that can be accessed to instruct and study the subject matter, but this is avoided from review if they do not include an observational evaluation of the adequacy of the tool in learning.
c) Paper should to have said its research objective obviously.
d) The impact of technology on the effectiveness of learning is the main concept of the paper. To be relevant, content mastery among the users is the goal of the paper.
e) Where possible, pre-test and post-test experiments involving technology for learning can be done.
f) The paper on quantitative approach ought to have the adequate data for calculating effect size, for example, standard deviations, mean scores, number of individuals in test gathering, and number of individuals in control gathering (if applicable) [11].

4.3. Papers Selected for the Review

Using the criteria explained in 3.3, 29 papers meet the criteria mentioned and recognized as important for this review, namely the papers explaining and evaluating animations, or other more general e-learning developments in others assisted with learning.

4.4. Categorisation of Papers

Categorizing 29 papers will be very helpful for organizing the types of papers based on the type of aspect relating to the purpose of the review, described by the paper: role of animation in learning, effectiveness of animation implementation, comparison of using animation or static graphic, instructional animation and e-learning development. Categories are shown in Table 2, beside with the various of papers in each area. Additionally, demonstrated are the number of papers which embraced a quantitative, qualitative or both methodologies. 29 papers are summarised in the table in Appendix A with credit to the authors; the databases sources; the kind or title of research; the approach and design and objective.

4.4.1. Papers on Role of Animations for Learning

Many useful functions of animation that can be used to help learners in all aspects of the field of science and needs. Studying the

characteristics and behavior of learners from any age segmentation is unlimited.

Animation is not only used to simply improve satisfaction and engagement, but more than that finds the application of new science by visualizing it first into the digital form of digital.

To address the lack of traditional education, computer simulation and animation (CSA) has received increased attention and wide application in science, mathematics, technology and engineering in couple years ago [12].

More recently, technological resources can involve learning using animation to enhance and promote cognitive processes, so that learning and understanding are possible. For example, in [13] suggested that some of the things that can facilitate such cognitive processes, especially in improving learning ability, making sense, building representational models and selecting information are a suitable inclusion of the effects of animation use.

Some study focused on the outcome of learners spatial ability and mental animation, using reaction-time and eye-tracking for the to indicate that learners check the movement of a framework segment by reviewing a particular individual segment and also the components that go before the particular segment, demonstrating a more global comprehension of the causal chain of occasions [14].

Other experimental study found the effect of differences using simultaneously and sequential animations, learners' awareness of questioning of the animation as well as their procuration of higher-order relationships. Up to 60 students participated this study, with the eye-movements of 8 students among others are recorded with SMI Video Analysis Package. The evidence shows that learning of higher-order relationships was essentially more fruitful from simultaneously displayed scenes than from sequentially exhibited scenes [15].

Not only about the material content based on the non-verbal or verbal understanding. Animation is also effectively used in improving learners' comprehension and recall in generated-drawings material. In [16] took the investigation in the case of drawing can likewise enhance learning from animation. The outcome of these studies are promising, it remains an open inquiry of in the case of drawing is additionally a viable technique for learning from visuospatially and spatiotemporally more intricate animations that are not conducted by spoken or text explanations.

Learning with gestures is one of the way to improve about non-biological movements with animations. Learners were given these submerged recordings one by one and needed to decide for everything, which of the four to-be-scholarly movement designs was utilized by the fish in the video. To choose for everything which sort of movement design was delineated, learners needed to recognize the body parts important for impetus and the way of how these parts move [17].

4.4.2. Papers on the Teaching Effectiveness of Animation Implementation

Few papers describing experimental results of the value of animation for learning showed the effectiveness of interacting with scientific animations in chemistry using mobile devices on grade 12 students' spatial ability and scientific reasoning skills. The discoveries displayed that there were noteworthy statistical differences between the two experiment classes in terms of spatial ability in commendation of the group. Most likely, this diminished the level of relevancy that normally goes with chemical entities and phenomena and helped the understudies to imagine the interactions between submicroscopic elements spatially [18].

In [19] taking an experimental on reducing transient effect of animations. Many papers presented that reducing transient effect on animations make the learners, for this case the 10 ten-year-old children, get a better enhancement on learning content. The findings show that long-segment animation did not generally lose its prevalence over static graphics in this kind of learning errand. Notwithstanding, the transient data impact of the cognitive load hypothesis, integral clarifications regarding hindrance forms, attentional congruity and assignment affordance are proposed.

In other study, investigates teaching materials combining dynamic graphic and multidimensional concept maps improve learning achievement, retention, and satisfaction at one private university in Taiwan. The experimental took 6 weeks with the 114 of total student who participated [20].

There is a lot of research reported the effectiveness of using animation in undergraduate course. For example, in [21] recently investigated that compared with traditional textbook instruction, CSA (Computer Simulation Animation) significantly improves student activity in understanding Bloom's taxonomy. Results showed an impact on the way humans interact in dealing with a problem with a CSA learning module. This finding enhance the student cognitive thinking of study.

Teaching with animation is not always associated with images and dead symbols that cannot interact live (active) with the learner. Animated Pedagogical Agent (APA) is a practical solution that can replace the role of the teacher digitally. Using an animated pedagogical agent also has advantages and disadvantages, proved in a research found that the viability of visual signaling techniques and the visual nearness of an APA is dependent to student attributes, including prior domain knowledge [22].

Many applications that can be implemented with animation as an effective breakthrough to help improve academic achievement. For several example, Jigsaw Cooperative Learning and Animation Techniques [23] which focuses on chemical bonding and conceptions, whiteboard animations on retention and subjective experiences [24] when learning advanced physics topics, an Animated Tutoring System [25] for interactive learning of nonlinear data structures, simultaneously observing and making gestures [26] while studying grammar animations on cognitive load and learning, and Educational Programming Course using animations for the effectiveness of student engagement [27].

But, in some other papers, the effectiveness of the use of animation is also highly determined by the circumstances and also the characteristics of the learner itself. For example, in the research done by [28] in learning soccer with animation, suggested that the effectiveness of instructional strategies depends on levels of soccer players' expertise.

4.4.3. Papers on Comparison of Using Animation or Static Graphic

Not only are the characteristics of the learner affecting the effectiveness of animation in learning, not all dynamic graphics always excel at static graphics. Each has an advantage in improving the quality of student learning.

The number of studies on comparisons between dynamic and static graphics that result in dynamic graphic outperformed static does not use the correct variables in experiments. Cannot equate the variables of comparison to apples to oranges. It is necessary to determine the difference of controlled variables between curricular topics (science, etc.) and extracurricular tasks (human movement task, etc.) in order to create boundary conditions between animation and static graphics that are more suitable for educational purposes, both curricular and extracurricular tasks [29].

For example, in a study conducted by [30], the research of comparisons of studying material through concept maps using spoken narrations, showed that the dynamic graphic concept map assumed no advantage than the static graphic concept map because participants, the hypothesize is possibly the participants is interrupted by spoken narration influenced by prior knowledge.

Another studies describing the research into animation and static graphic on non-manipulative task of memorizing arrays of abstract symbols that showing the pictures of hand would be resulting the positive presentations. Perhaps, the findings revealed showing static hand picture in the static presentation was enhanced, than using animation [31]. This evidence showed that animation is not always give better performance in different condition.

In [32] described the role of graphic in students' knowledge by measuring cognitive load. This test followed by 3003 7th-grade students were randomly divided into 2 groups. The result showed that animating graphics increased the response time and secondary task scores of the students, but did not have any significant effect on their test success. From the evidence proved that animation is not always able to increase the value of students, but there are aspects that can still be maximized besides.

4.4.4. Papers on Instructional Animations

Instructional animations are the kind of animation that provides instruction to learners to support more permanent learning of subject matter. Mostly, instructional animations using non-verbal for communications with the learners.

Few papers described about the different result in learning with instructional animation, comparing low prior knowledge and high prior knowledge learners with the type content that conducted with visual cues and no cues. The findings revealed that the effects of cueing in an instructional animation change depends on the learner's level of prior knowledge. High prior knowledge will get better benefit if the content does not contained visual cues, otherwise visual cues facilitate learning will benefited low prior knowledge learners [33].

Speaks of the inherent behavioral performance of learners in learning, a study conducted by [34] found that verbal redundancy in which case an on-screen labeling of an instructional animation coincided with spoken text may increase retention but not its performance behaviors.

About gesturing on a learning using instructional animation, there are 2 differences, mimicking the gestures has been done on 2 teaching content about mandarin and Persian character. With the result of trial 1, gesturing performed by college student is more useful using static graphic than animation, on the contrary in test 2 followed by young participants more effectively used animation than static graphic [35].

Different with the research that Castro-Alonso mentioned above about using the hand on static graphic presentation is more effective than using animations. The study investigated by [36] showed the result about using hands instructional animation had more further advantage in that it had higher instructional efficiency than the no-hands animation. It can be reasoned that for this specific motor assignment (hitch tying) an animated guideline without hands is more viable in helping students get paired than an equal static arrangement without hands. Moreover, it additionally showed that while learning execution isn't straightforwardly influenced by inclusion or exclusion of hands, there is by all accounts some productivity points of interest by incorporating the hands in the animation.

4.4.5. Papers on E-Learning Development Using Animation Methods and PWA Approach

Few papers describing about using e-learning environment to implement the way of using animation for learning in subject matter. The purpose of using e-learning is as a means of reaching the learner unlimited by distance. Learning is not only in the classroom, but beyond that, students or learners can acquire knowledge material freely.

From experiments conducted at Suan Sunandha Rajabhat University, Thailand, on course JAVA programming language can improve students' understanding and also reduce the consumption of study hours [37].

Another study is using modern technology called Web 3.0-based for e-learning environment for studying the programming language, the researcher not only tests effectiveness of enhancement, but more than that the reports showed student personalized and emotions including (frustration, boredom, engagement, and excitement). This finding found that students feel the enjoyment and desire to use the tool rather than using traditional methods in the teaching and learning system [38].

Narrowing the categorization of e-learning with animated approach in it, in [39] investigate learning using web-based and educational animations approaches on content of sensory organ subjects to 7th grade students, experiments were performed using pretest and post-test to test the effectiveness of using the approach. It was found that the achievement in this experiment had significant differences, but not with the attitudes.

Many ways to develop an e-learning. Some studies describing and mentioned how e-learning platform based on mobile or desktop have advantages and disadvantages of each [40]. With this reasoning, there is a need for an approach that can accommodate both of advantages, emerging a new approach called Progressive Web Apps (PWAs) that can create the best user experience that can be taken from the desktop and mobile [41].

PWAs were created to reduce the burden of browsers to process data from servers in the role of service worker, as evidenced by research conducted by [42] showed that the PWA and service workers technology is promising in terms of energy efficiency. This is a good way to get users to gain knowledge in an e-learning even in a bad connection.

5. Discussion

This review is focused on papers conducted by evidence that contained the value about animation for learning in general, perhaps in Table 2 the topic categorized in 4 parts such as role of animation in learning, teaching effectiveness of animation implementation, comparison of using animation or static graphic, instructional animation, and the last one describing some papers about e-learning development using animation methods and PWA approach.

Table 2: Number of papers covering each topic and research approach

Paper's Kind Elements	Amount of Papers	Qualitative	Quantitative	Both
Role of animations in learning	6	2	2	2
Effectiveness of animation implementation	11	2	6	3
Comparison of using animation or static graphic	4	1	2	1
Instructional animation	4	0	2	2
E-learning development using animation methods and PWA approach	4	2	2	0
Total	29	7	14	8

Although many papers irrelevant with the main topic about animation in learning, finally selected papers are become narrower to be 29 relevant papers. Credited to the research approach of those studies, 14 papers acquired a quantitative approach, 7 with qualitative approach, and 8 papers adopted both qualitative and quantitative (see Table 2). Some papers which adopted quantitative approach reported about comparison of what is the better, using animation or using static graphic in many different experimental methods.

The key to the problem of designing and developing a learning content with effective animation is how the quality of students in terms of improving understanding for the better results. If talking about animation in learning then the subject is still too broad, because not only improve the achievement of students, but more than that animation research is about understanding learners cog-

nitive thinking [13, 19, 27, 32], attitudes [39], engagement [27, 38], reasoning skills [18], behavioral performance [14, 15, 19, 26, 28, 34, 36, 37, 39], retention [20, 23, 24, 34], prior knowledge domain [22, 33], and satisfaction [20].

In addition to supporting some of the key issues above, therefore the best review that can be used to select suitable content matches the characteristics of the learner. It has been said that most of the results reported in papers that discuss the comparison between static graphics and animation do not always win an animation to be superior than static graphics. As we discussed in previous section, in [36, 31] talking about showing the hands static pictures in the instructional that can give a good guidance for learners to interact with the content, the results showed that animation with hands is giving no different results on content that contained no-hands.

To present the various components of effective animation for learning, The ALETRIA project is proposed to be developed as a web-based platform that contains all features of animated content to achieve any goal. Not only the method of animation that has been learned through the review above, but the technology approach that will be in use will also use renewable technology. As we know that flash animation is the one of trend previously on e-learning platform to develop animation content, perhaps there is various issues that platform cannot be solved. Therefore, many studies looking for novel other approaches, such as using HTML5, CSS 3.0, and JavaScript to develop pure animation without using additional installation. This way is better in reaching leaners in any platform, such as mobile, tablet, and desktop [43].

A lot of e-learning developed in any features such as assessment, discussion, grouping, chatting class, streaming, and so on. Perhaps, not many e-learning focused on the quality of content. This reason the ALETRIA project will be developed to focus on quality content, to ensure the learner gets an understanding of what exactly the animation is being used for that purpose. Although, in the development of advanced research will be conducted survey to determine the results to be obtained.

ALETRIA is an e-learning containing the concept of animation as a key feature developed with progressive web app to improve ease of access for students. E-learning includes content related to computer information systems, especially computer network subject. Animation types that will be developed in the future will probably be added like simulation or animation with gamification approach, by doing additional review research on the aspect to be done.

6. Conclusion

This review presents some evaluations of the use of animations that researchers have done in various aspects. From the papers reviewed were for the most part positive about the impact of any type of using animation in different needs and different leaners characteristic while static graphic was over performed than animation in few aspects of use. Clearly described types and case studies that complement the positive proof of the resulting impact. Progress will be made by searching for details of subject that suitable provide material in the field of science that lead to more effective learning. To make the most effective use from the use of animation in teaching and learning activities, need to get better curricula which well-developed and coherent.

The ALETRIA animations e-learning were initially purposed at information and science engineering students in fresh undergraduate level. With the focus on competences in accordance with the standards set by the university. Future research will benefit from detailed experimental studies that systematically explore, which animation e-learning development highlights are most engaged in advancing engagement and supporting learning. Examination of engagement and informal learning with animation can likewise give profitable bits of knowledge into amusement systems that would then be able to be connected to diversions for learning.

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Appendix A. Summaries of the 29 selected papers

	Research Approach, Study Design, Aim	Authors	Use of Animation	Results
Role of animations in learning (N = 6)				
1	**Quantitative:** A quasi-experimental pretest–post-test investigate configuration including an examination group (n = 65) and a mediation group (n = 77) was actualized.	Fang and Guo (2016) **Science Direct**	CSA for learning particle kinetics for student	The results of the improvement prove asymmetric to the students' procedural skills. CSA can be used to complement traditional lectures, but cannot replace the function of human (teacher) in teaching.
2	**Both:** The examination included 255 understudies in the second and third years of the Spanish optional instruction who got a lesson in video about rudimentary occasion likelihood.	Luzon and Leton (2015) **Scopus**	Animated text for learning basic mathematics	The cognitive process becomes facilitated by the use of animation, specifically selecting information, model representation and making sense, the ability of students' abilities can increase.
3	**Qualitative:** A group of secondary school understudies (N ¼ 94) found out about a science theme through learner paced media direction.	Park et al. (2016) **Science Direct**	An ATI-study for spatial ability and mental animation	Low to medium spatial abilities have low production capability in processing information, mediated deficiency of learners with very low spatial abilities, and stable learning performance of learners with high spatial abilities regardless of the learning situation offered.
4	**Quantitative:** 30 contemplated the animation scenes introduced all the while and 30 examined similar scenes exhibited successively.	Ploetzner and Lowe (2014) **Scopus**	Simultaneously and sequentially animations experiment	Animated episodes are shown simultaneously far more successfully than the animated episodes that are shown sequentially in the of higher-order relationships learners.
5	**Qualitative:** One group of 26 understudies needed to draw what they had seen in the animation. A moment group of 26 understudies needed to consider what they had seen in the animation.	Ploetzner and Fillisch (2017) **Scopus**	Animation for learning drawing	Drawing is not suitable for animation for learning for visuospatially and spatiotemporally complex animations.
6	**Both:** Showing signals that relate to the portrayed developments upgrades finding out about non-human natural developments with dynamic	Brucker et al. (2015) **Science**	Animation with corresponding gestures by activating human mirror-	Actuating the hMNS appears to encourage finding out about natural developments, and fortifying the hMNS by methods for relating signals may be a

	perceptions contrasted with showing non-comparing motions.	**Direct**	neuron	satisfactory instructional system to help low-visuospatial-capacity students.
Effectiveness of animation implementation (N = 11)				
7	**Quantitative:** A quasi-experimental plan was utilized with an experimental group of 32 understudies and a control group of 28 understudies.	Al-Balushi et al. (2016) **Science Direct**	Chemistry scientific animations using mobile for student	There were critical measurable contrasts between the two gatherings regarding spatial capacity for the trial gathering. Notwithstanding, there were no contrasts between the two gatherings regarding thinking capacity.
8	**Both:** 103 ten-year-old youngsters learnt to tie complex nautical bunches from either a video of hand developments or from a static graphics introduction.	Boucheix and Forestier (2017) **Science Direct**	Reducing the transience effect of animations for better performance in children learning	Long-segment liveliness did not generally lose its prevalence over static designs in this sort of learning errand.
9	**Quantitative:** Quasi-experimental In complete, 114 understudies from two classes at one private college in Taiwan partook in this 6-week instructing test.	Chiou et al. (2014) **Scopus**	Learning of multidimensional concept maps with multimedia animation	Learning accomplishment, learning fulfillment, and learning maintenance of the MAMCM assemble were superior to those of the MCM gathering.
10	**Both:** Information were gathered through a think- aloud convention including two groups of understudy members: One group took in a worked illustration issue with a CSA module, and the other group took in a similar issue with customary textbook- style guideline.	Fang and Tajvidi (2017) **Scopus**	Animation for undergraduate engineering course	Learning through CSA profoundly affects ensuing problem- solving is credited to escalated human–PC associations worked in the CSA learning module.
11	**Both:** The experiment was a 2 (visual signaling, no visual signaling) × 2 (visual APA presence, no visual APA presence) between-subjects outline.	Johnson et al. (2014) **Science Direct**	Pedagogical: visual signaling and animated agent in prior knowledge	Demonstrate that the viability of visual flagging procedures and the visual nearness of an APA is reliant on student qualities, including earlier area learning.
12	**Quantitative:** Comprised of 115 first-year science education students who attended the classes. The information acquired with the instruments were assessed using descriptive statistics, one–way ANOVA, and MANCOVA.	Karacop and Doymus (2013) **Scopus**	Jigsaw effect animation techniques for student understanding in chemical bonding	Demonstrate that the educating of compound holding by means of the liveliness and jigsaw procedures was more compelling than the conventional showing strategy in expanding scholastic accomplishment.
13	**Quantitative:** Give concrete logical proof to the effect on retention and subjective experiences of enjoyment, engagement, and challenge. We recruited members from Amazon's Mechanical Turk (N ¼ 621; 239 females).	Turkay (2016) **Science Direct**	Animation effect on whiteboard for physics topics: retention and experiences	Whiteboard movements positively affect maintenance, commitment and delight, in spite of the fact that we do not decide out the likelihood that a portion of this outcome is because of oddity.
14	**Qualitative:** An animation-based approach has been created to give a well ordered representation of how different traversal systems are performed with regards in the context of binary search and AVL trees data structure.	Wang et al. (2015) **Scopus**	Animated nonlinear data structures tutoring system	This framework can be utilized as a viable supplement to customary educating strategies.
15	**Quantitative:** Hypothesis, comes about demonstrated that children in the gesturing condition performed worse on the posttest than children in the non-gesturing, control condition.	Post et al. (2013) **Science Direct**	Cognitive load and learning with simultaneously observing gestures for grammar study animations	The blend of watching and making signals may have forced incidental psychological load on the lower capacity youngsters.
16	**Qualitative:** Systematically compared this approach and two instructional situations, in light of review animations and on the conventional instruction without deliberate use of animations.	Urquiza et al. (2013) **Science Direct**	Effect use of educational program animations: engagement	Enhance learning as far as some instructive perspectives: here and now and long haul information securing, and drop-out rates.
17	**Quantitative:** In two experiments, researched how animation of play (soccer) should be designed in order to avoid the high cognitive load because of the transitory idea of data.	Khacharem et al. (2014) **Scopus**	Animated soccer scenes for learning improvement evidence	The adequacy of instructional methodologies relies upon levels of soccer players' ability.
Comparison of using animation and static graphic (N = 4)				
18	**Qualitative:** Provide a categorization of these confounding variables and offer some possible solutions to generate more tightly controlled studies.	Castro-Alonso et al. (2016) **Science Direct**	Research look: animation and static graphic should be apple to apple not orange to apple	More decisive proof could be gotten distinguishing the limit conditions for when static or dynamic pictures are more reasonable for instructive purposes, crosswise over both curricular and extracurricular assignments.
19	**Quantitative:** The study used a 2 x 2 factorial design in which an animation factor (animated vs. static) was crossed with a representation factor (concept map vs. text). Students (N ¼ 140) were randomly assigned to study one of four presentations on the hu-	Adesope and Nesbit (2013) **Scopus**	Spoken narration effect in learning concept maps with animation and static graphic	Speculate that the enlivened idea delineate no preferred standpoint over the static idea outline members in the two conditions could utilize the talked account to succession their perusing.

E-learning development using animation methods and PWA approach (N = 6)				
26	**Quantitative:** The experimental results showed that rule-based and student profiling approaches can help student learning and reduce time consuming study.	Kularbphettong et al. (2014)	Adaptive web-based intelligent tutoring system development using technique of mastery learning	Satisfactory as took after: Means for instructor and understudies were 4.15 and 4.23, and standard deviation for authorities and clients were 0.645 and 0.714 individually.
27	**Qualitative:** Conducted two evaluations: one evaluation used the Technology Acceptance Model to assess the impact of our software tool on student behavior. The second evaluation calculated the student's t-test to assess the learning gain after a student used the tool.	Cabada et al. (2018)	Programming language learning with web 3.0 e-learning effectiveness	The evaluations demonstrate the understudies' apparent delight and will utilize the apparatus. The examination likewise demonstrate that understudies utilizing the apparatus have a more prominent learning pick up than the individuals who master utilizing a customary technique.
28	**Quantitative:** Quas-experimental research method was applied in this study. as a means of measuring, Science and Technology achievement test consisting of 30 questions and 15-itemed Science Course attitude scale developed.	Ercan et al. (2013)	Sensory Organs Subject with web-based educational animation content for student	There is a significant contrast for exploratory gathering on the scholarly accomplishment pre-test/post-test checks between test amass trained with online instructional materials with instructive animation substance and control aggregate educated with customary address technique. It is discovered that there is no noteworthy distinction on states of mind towards science and innovation.
29	**Qualitative:** Designed an empirical experiment with two main factors: the use of service workers and the type of network available (2G or WiFi).	Malavolta et al. (2017)	Progressive web apps efficiency of energy impact using service workers	That the PWA and service workers technology specialists' innovation is promising as far as vitality proficiency.
	man nervous system.			
20	**Quantitative:** Comparing animations with statics using a Lego task shown to university students, by examining three potential moderators of effectiveness.	Castro-Alonso et al. (2015) **Science Direct**	Non-manipulative task by observing hands in animation and static graphics	Transient visual data, for example, movements, might be additionally testing to learn than static representations.
21	**Both:** Three hundred and three 7th-grade students were randomly split into two groups and given the test questions either with static graphics or with animated graphics accompanied with text.	Dindar et al. (2014) **Science Direct**	Animation and graphic in measuring cognitive load	Animation graphic designs expanded the reaction time and auxiliary errand scores of the understudies yet did not have any noteworthy impact on their test achievement.
Instructional animations (N = 4)				
22	**Quantitative:** Employed a 2 (no cueing vs. visual cueing) × 2 (low vs. high prior knowledge) between- subjects factorial design.	Ari (2017) **Scopus**	Visual cues effect on type of prior knowledge level	The impacts of signaling in an instructional animation change contingent upon the students' level of earlier information.
23	**Quantitative:** The experiment had a 2 x 2 x 2 between-subject design (N ¼ 129) with the factors spoken text (yes vs. no), written text (yes vs. no), and on-screen labels (yes vs. no).	De Koning (2016) **Scopus**	Retention improvement and behavioral performance reduction of using on-screen label on procedural animations	On-screen marks enhanced maintenance exactness (however not behavioral execution precision) of the method, particularly when given together talked content.
24	**Both:** In Experiment 1, 48 university students learned to write Mandarin characters, and in Experiment 2, 44 young children learned to write Persian characters.	Lajevardi (2017) **Science Direct**	Facilitating instructional animations and static graphic with gestures mimic	Results from the two examinations showed an introduction motioning collaboration, where signaling was leeway for static graphics however not animations. Examination 2 found favorable position for animations over static graphics, and signaling contrasted with not motioning.
25	**Both:** 36 adults were randomly assigned to three groups (With-hands animation, No-hands animation, Statics graphics) and were required to learn how to tie two knots.	Marcus et al. (2013) **Science Direct**	Learning hand motor skills by observing hand actions with instructional animations	The two animations prompted better learning thought about than the static introduction. Be that as it may, the With-hands animation procedure had a further favorable position in that it had higher instructional productivity than the No-hands animation.