

Dissertation

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Usability Study of the Application of Web Animation for e-Learning

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(Hons) Web Development

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DECLARATION FORM:

I, ...(FULL NAME)..... declare that I am the sole author of this Project; that all references cited have been consulted; that I have conducted all work of which this is a record, and that the finished work lies within the prescribed word limits.

This work has not previously been accepted as part of any other degree submission.

Signed:

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FORM OF CONSENT:

I(FULL NAME)..... hereby consent that my Project, submitted in candidature for the B.Sc.(Hons) Computing & Information Systems degree, if successful, may be made available for inter-library loan or photocopying (subject to the law of copyright), and that the title and abstract may be made available to outside organisations.

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ABSTRACT:

The use of animation and graphical illustrations are becoming more popular, there are more interactive websites that can currently be accessed and used as part of a person's learning methods. The main aim of the project is to evaluate the usability and effectiveness of applying animations within an interactive web-based e-learning environment, and a website application which contained animated and interactive contents was then developed in order to help in demonstrating its effectiveness.

The study involved researching various fields that relate to e-learning and animation, which then moved on to the discussion of how animation can be applied as part of an e-learning element and have analysed its advantages and disadvantages. The study explored how the use of animations can be effective for use in e-learning, whether animations have helped in enhancing a student's learning and why people may choose to learn with animated illustrations over the use of static illustrations.

Research has been conducted on the various tools and software which helped in gaining further knowledge on what can be used to implement a website prototype. The website application was tested through following a usability testing technique, which helped in coming up with a conclusion to iterate the discovery of the study. The website prototype demonstrated that the use of interactive animated illustrations can help in enhancing learning, but these results can also depend on people's perception.

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CHAPTER 1: INTRODUCTION:

“Recently, e-Learning has been going through new transformations into what is referred to E-learning 2.0, with reference to Web 2.0. The drive behind this change is shift in education from being tutor-centred to becoming more learner-centred along with the support of Web 2.0 technologies.” Hage & Aimeur [1].

The current changes in e-Learning present a set of professional development courses that are created to help anyone to fulfil professional advancement and personal enrichment, these changes include mobile learning or web-based collaborative accessible environments [2].

Lecturers can develop their teaching methods to boost students’ enthusiasm in learning, this can be done by promoting new learning environments such as incorporating new technologies in the teaching and learning process which can aid in improving the relationship with students [3].

1.1 E-LEARNING:

As a result of the fast changing technologies, a progression of an individual’s learning experience can move along with these changes, this can be done through an approach that will model and prepare students for an interactive working lifestyle [4].

Clark and Mayer [5], defines e-Learning as a form of instruction that is administered on a digital device such as a computer or a mobile device to give support in learning and there are elements that identify the *what*, *how* and *why* of e-learning:

- *What*: e-learning courses include the content (information) and instructional methods (procedures) needed to help the people to study the content [5].
- *How*: e-learning courses are delivered digitally through devices such as computers and smartphones using words that is shown through spoken or printed text and images such as illustrations, photos, animation, or video [5].
- *Why*: the main objective of e-Learning is to help learners achieve personal learning goals or carry out their work in ways that will develop the bottom-line goals of the organisation [5].

1.2 ANIMATION:

“Web Animations defines a model for supporting animation and synchronization on the Web platform. It is intended that other specifications will build on this model and expose its features through declarative means” W3C [6].

Animations can be used to interpret processes that are impossible to describe through text, it is not used just for decoration, but it is also used to convey content and have the ability to support the user's goals and tasks [7]. The use of animation has gained the attention and interests of people and is becoming more well-known in computer and web-based instructions. However, there is still not enough evidence that animation can promote learning, even if animations capture the learner's attention [8].

1.3 AIMS AND OBJECTIVES:

The main aim for this project is to evaluate the usability and advantages of applying animations within an interactive web-based e-Learning. This will be achieved through researching the factors and features of using animation in the web and conducting usability testing on a produced website prototype to determine the efficacy of an animated/interactive e-learning website.

In order to meet the aim pointed out in this project, three objectives have been identified:

- Research the application of animation in e-learning and the factors that determine the effectiveness of animations in interactive environments.
- Exploring the use of tools and technologies for producing animations by constructing an interactive e-learning website.
- Conduct usability testing of the website to determine whether applying animation in e-learning can be better than using static graphics.

1.4 BRIEF PROJECT DESCRIPTION:

Following the chapters for this project, it will first discuss the literature review of the proposed project that is stated in the aims and objectives in order to give support and clear understanding of the topic. Secondly, a research and development methodology will describe the methods that will be applied, along with some researched content. Thirdly, the design and implementation chapter will be presenting the solutions and codes of design of the created website application along with annotations and including the results obtained from the usability test.

The following chapter explains the evaluation of the project, this will give an evaluation of the objectives stated with the research and tests conducted. The next chapter will contain the conclusions of the whole project and recommendations for future work. Lastly, the reflection chapter will give a statement on the learning outcomes of the project.

CHAPTER 2: LITERATURE RESEARCH & REVIEW.

The aims for this chapter is to demonstrate background knowledge on e-Learning, animation on the web, the use of animation for e-Learning and the implementation of usability testing.

These aims will be achieved by reviewing and evaluating books and research papers that are related/relevant to the areas mentioned, and to explore the different approaches of e-Learning, to identify the factors and features, and the solutions that have been produced by other developers.

The main objective for this literature review is to achieve a better understanding of the effectiveness of an interactive e-learning application/website.

The first topic to be researched is the use of e-Learning as a teaching method and explore its effectiveness. This will then move onto researching the recent animation tools and technologies that can be applied to creating an interactive e-Learning website.

Below are the following topics that will be illustrating an in depth review of researched topics:

- e-Learning.
- Animation on the Web.
- e-Learning and Animation.
- Usability Testing.

2.1 E-LEARNING:

There are different design approaches recommended for printed and e-Learning materials. Students/learners that view text images through a computer screen have a more indirect impact to them, compared to when students/learners view text images through a textbook. The principles used for printed materials are not suitable to apply on web materials. Digital technology has improved and unfolds new aesthetic where the basic principles of contrast and tempo are still administered [9].

Various meanings on e-Learning can be found, these definitions depend on the particular approach of e-Learning and the individual to give a more in depth explanation of the definition of e-Learning [10]. According to *Piskurich* [11] e-Learning is defined as a learning method that use computer networks or websites through a delivery or mediation structure. e-Learning is a subset of technology-based training that have different learning activities created in order to be accessible through the internet [12].

e-Learning consists of different learning and teaching methods that are supported electronically, there are different ways in carrying out an e-Learning lecture; for example, *self-paced*: where the student can study and learn at their own pace and also *instructor-led lectures*: where the teachers are the ones carrying out the lectures online. The features of e-Learning can include different types of media such as text, images, animation, video streaming and audio [13].

There are numerous e-learning systems that can currently be accessed, there are some systems identified that contain different limitations, which resulted in the e-Learning's higher effectiveness and greater societal potential to be affected [14]. The different problems of e-learning identified are:

- *Text-based learning materials*: some e-learning systems only display contents that are text-based, therefore the learners may feel less interested when learning online [14].
- *Insufficient content for good understanding*: various e-learning systems do not provide enough learning materials that aid in understanding the subject. As a result, more e-learning systems are currently introducing online environments that works similarly like a classroom setting by implementing synchronised instructional videos, PowerPoint slides, and lecture notes [14].

- *Less interaction and user flexibility*: compared to traditional lectures, where students can communicate and interact with teachers and fellow students, whilst online learning environments reduces the ability to physically communicate with students and lecturers physically. Thus, a solution would be to allow the students and teachers to learn online and to have the ability to communicate with each other [14].
- *Multimedia content is unstructured and isolated*: currently the multimedia content included in e-learning systems are presented statically, passively, or in an unstructured way. Therefore, learners may find that the content that they are viewing to be confusing or maybe misinterpreted [14].

According to *Capuano et al* [15], because of the majority of the e-learning tools available can be too complex for most educators to use, some debates are raised on whether it is the teachers or the knowledge engineers should be the ones to use the tools. And they also suggest a need for e-Learning authoring tools to be easier to use, and the tools should be able to reduce the skill barrier and enable lecturers to get involved in developing and customising process of the tools.

There are two terms used in e-learning that can be identified and they are called: synchronous and asynchronous e-learning [16]. *Romiszowski* [17], states that synchronous and asynchronous communication are represented through contrasting communication features, and suggests that synchronous and asynchronous communications can be used as a method for various pedagogical purposes.

2.1.1 Synchronous E-learning:

“ Real-time, instructor-led, online learning in which all participants are logged on at the same time and communicative directly with each other and the instructor through the computer and possibly other means as well “ Piskurich [11].

Synchronous systems are regularly applied or embedded within an asynchronous learning management system, these two features are used as a way to expand teaching beyond lectures, where the communication between lecturers and students are expanded [18].

Hrastinski et al [19] discloses that synchronous e-Learning is researched less compared to asynchronous e-Learning, and suggests that anyone that consider using the synchronous e-Learning method would need to be guided through. Using a synchronous system can be limited to synchronous communications, as the system is generally used to give assistance by

replaying a recording after a real-time lecture and this can result in the synchronous system to be unused for asynchronous communication [7].

Face-to-face discussions is identified to be a much preferred approach for relaying lectures because they can be easily carried out compared to a synchronous type of discussions, but there can be some cases to show the benefits in using synchronous discussions that are identified such as:

- There is not a need for students to discuss a time and date for a group meet up because they will be able to contact each other online through the system created and it would be part of the online e-learning approach [20].
- Some circumstances will require group work carried out outside of lectures and meeting times, so students might suggest a different approach in discussing the work: such as having discussions online where everyone is available. This approach can aid in the prevention of setbacks that can occur for group works [20].
- Synchronous e-learning can be used as an addition of real-time lectures and teaching techniques, but this does not necessarily mean that real-time lectures would be replaced with online learning lectures/courses [20].

In summary synchronous e-Learning can be identified as a good approach to be used if the user's aim is to communicate, have discussions and receive/deliver learning resources with groups online and in the time that is suitable for them, as the synchronous e-Learning tool can be used to achieve this.

2.1.2 Asynchronous E-learning:

"A more or less self-paced learning event in which learners are accessing programs online at different times, and cannot communicate without a time delay " Piskurich [11].

The main aim for using asynchronous e-Learning is to make courses flexible, easy to access and to be cost-effective. Asynchronous e-Learning applied to help in situations such as lecturers interacting with students to inform them that there is a delay in delivering a lecture. For an asynchronous learning arrangement there are a variety of tools and applications which can be used such as emails, discussion board, group work, social networks, etc. [21].

It is perceived that asynchronous e-learning platforms enables the access and management of different types of information and learning content about the courses. Although some might perceive / raise concern that the use of asynchronous learning may make some students to

misinterpreting the lectures as a way of skipping lectures, this would not be the case as it enables students to study in a more convenient time and place should they be unavailable [22].

The benefits of the asynchronous approach are:

- A person's ability in processing information can increase with the use of asynchronous communication, this will help the student/person in comprehending the message given at a longer time because a response will not be needed instantly [23].
- Students that learn through using asynchronous technology enhances the learning experience and knowledge construction, it has been stated that students that are part of a discussion group become more task-oriented and there was an increase in the cognitive interaction of students [24].
- There are various ways that students can choose the use of an asynchronous technology e.g. through emails as a form of direct communication with other associates and lecturers [25].

On the other hand, *Koutsabasis et al* [22] points out that there are some disadvantages with the use of asynchronous e-learning such as:

- Asynchronous communication can face competition with other open systems, which are generally used for social networking and collaborations. Therefore, some might view that using an asynchronous approach may not be needed.
- Support in taking notes and annotations on the content of the course should be given.
- The tools and services can be developed further through the collaboration with the synchronous learning method.

To summarise asynchronous e-Learning is a good approach if the user's aim is to conduct lessons online in a way that students will be able to interact with others and to enhance the student's learning experience. Just like the synchronous e-Learning, students will also be able to access the lectures given in a time that is suitable for them.

This project can also be linked to the asynchronous e-learning approach because the aims noted in this project is relevant with the proposed aim for the interactive website that will be produced. Other identified reasons are:

- If the website is created in a way that the student will be able to engage with the given task in the website, then it can be identified that it is suitable for the student's needs and the website can be accessed in a time convenient for the student [26].
- The contents that will be included within the website may contain and provide a more detailed information of the topic chosen for the website [26].

2.1.3 Technology Enhanced Learning

According to *Bratina et al* [9] It can be identified that the influences of applying multimedia and ICT when developing learning contents can consecutively raise the level of students' likeability and/or aesthetical satisfaction towards learning.

e-Learning has helped in developing the styles and approaches of the type of learning that has been used during the years, it is like a new type of learning method which provides students in learning through the use of technology and with features that will allow student into learning anytime and anywhere. This technique uses various methods such as using web resources, e-Learning applications and online services which aids in promoting in an e-Learning setting [27].

"Measuring the effectiveness of e-Learning can be regarded as an important and difficult task, since it involves such many components in e-Learning as student's engagement and studiousness" Tenriawaru et al [28].

Suryani et al [29], argues that all learners have different speeds in learning successfully, which can depend on the approach, environment, and style of the lecture; through personalised learning it can offer active learning procedures which can help to enable the students to achieve successful learning.

On the other hand *Tabak & Rampal* [20], also contends that due to the small considerations made in context of the variety of success factors that contributes in the initiation and design stages of development numerous innovations and new practices are likely to fail in achieving their goal in teaching that they want to achieve. There can be different reasons why the some of the new practices fail such as: the new practices can be perceived that they are too

complicated or risky, there is no significant advantage, or compatibility that can be identified for the systems [20].

According to *Pullen* [30], there are two answers identified that can aid in the delivery of the best teaching approach to learners in regards to the question of what is the most efficient way in helping students to learn;

1. There is not a significant difference with the educational outcomes, which is generally based purely on the mode of delivery. It can be considered that educational processes should be designed to enhance factors such as minimising the duration of students commuting to class and reduce the required time for the faculty to construct online teaching materials [30].
2. With the numerous types of technologies developed today, it is identified that the most effective way in presenting material to promote student learning is to develop a hybrid or blended approach; which can be done by combining classroom learning, online synchronous delivery and online asynchronous learning materials [30].

There are pros and cons that identified with implementing e-Learning as a teaching approach.

The pros identified are:

- With the development technologies, it enables the delivery of learning information to be more easily accessible electronically; which can be done through the web, sending and receiving e-mails, signing up to online courses, or participations in online discussions etc. [31].
- E-learning can be cost-effective, as it can be more easily accessible the costs of productivity and delivery can be cut down to almost half the amount of the normal cost [31], [32].
- Enables a flexible educational delivery; students will be able to learn in a more convenient time and place e.g. situations such as enabling student to learn through the summer holiday and to enable them to access any learning materials when needed [30], [32].

The cons of e-Learning identified are:

- e-Learning developers may be too engaged in to promoting e-Learning and push the information to the learner and forget about the different needs an individual would need as a learner, which results in perceiving that there is little consideration towards improving a student's learning skills [31].
- Online learning can deem to be less interactive, it can seem that there is some elements missing such as getting direct support and provisions from lecturers when learning in a classroom environment [31], [32].
- There can be problems that can occur with the technology used (the computer, software or network connection), can disrupt the delivery of the lecture [30].

To conclude e-Learning can prove to be beneficial as another approach in delivering learning materials to learners/students, it can be a great way in promoting people into learning more independently and can be helpful should a student need to communicate with their lecturer or access lecture materials that was missed.

2.2 ANIMATION ON THE WEB

“Animation has been the focus of recent attention and interest and has become more popular in computer and web-based instruction” Zhu & Grabowski [8]

The main aim for animation on the web is to relay images or an object to move from one space to another, other features with animating an image can include hinging, pivoting, and rotating. Adding an animation to a website does not need to fit the whole computer screen, the developer chooses which part of the web page the animation can be placed [33].

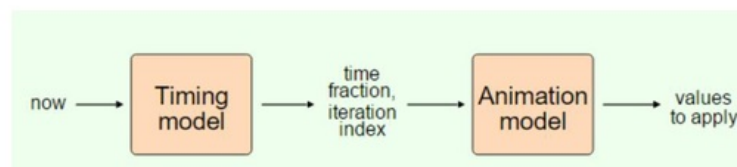
Images that involve movement have the potential to transmit a large amount of information to people in a short period of time; when a sequence of images are put together and displayed in the way it was planned to be, it can be perceived that these images are a single moving image [34].

The process of animation can vary in types and would normally depend on how data is handled and identifying the type of calculations needed to apply to the animation, for example:

- *Animation of Static Objects*: images or objects are generally animated/manipulated through applying a series of transformations to a camera or by numerically merging the properties of the image or object over time depending on the parameters placed [35].
- *Animation of Deformable Objects*: this is done in context of changes in a shape or volume through applying external forces to an object, shape or image and deformable objects generally have their own set of physical properties that can be identified [35].

Following the web animation model can also be used to provide the features that are needed to express CSS transitions, CSS animations, and SVG and it is used to put together for the application of use cases on the three specifications indicated [6].

As shown on Figure 1, it can be identified that the web animation model consists of two processes: *Figure 1 Web Animation Model*



- *Timing Model*: a fraction of time is taken and is converted to a proportional distance through a particular iteration of an animation, this is also known as the iteration progress [6].
- *Animation Model*: Values are obtained from the iteration progress and iteration indices through the timing model and they are converted into sequence of values which is then applied to the target properties and attributes [6].

Storyboarding is a great way of planning a project for a website. It can help in managing the continuity of multi-scene animations in web pages and notes are written down to gather ideas on the features needed within the web pages, e.g. changes in the background, when an animation will occur and placements of elements or objects within the web pages [33].

Hong et al [36] contends that most of the user's attention will be on the animation that is displayed within a website, which can result in the user's attention to divert from the main task that should be carried out.

2.2.1 CSS Animation

According to *McFarland* [37], Compared to using CSS transitions, CSS animations has its benefits when adding animations to websites, as they do not have to include an action for the animation to start and some animation features can be controlled in different ways. There are two steps identified to create an animation: definition of the animation and animation is applied to an element of the web page.

The new CSS features added allow the developers to alter the display styles of HTML elements dynamically, where users can alter the position and orientation of the chosen elements. CSS also allow developers to create animations without the use of JavaScript codes to update any changes, this is achieved through the use of CSS transition, transform and key frames to animate elements within web pages [38].

"A CSS animation, in other words, is an instruction to progressively update one or more CSS property values over a period of time. The values change from an initial state to a final state through various immediate states defined by a set of keyframes"
Brockschmidt [39].

The production of multiple key frames is enabled with the use of CSS animations, to illustrate the occurrence of an animation. CSS animations are supported by most browsers and vendor prefixes are not required, and can occasionally operate better compared to a similar animation created in JavaScript [40].

The aim of CSS animation is to animate between one style configuration to another with the use of animation techniques and scripting and plug-ins are not required to create the animations [41], [42]. According to *Storey* [43], although CSS animations is used to change HTML elements, the best way in adjusting the appearance of web pages resides in the CSS transforms and Transitions. Unlike transitions CSS animations enables developers to manipulate every step of the animation by using key frames; multiple key frames can be added in between in order to enhance the animation in a more complex way [44]. CSS3 animations have two components that makes an animation: the first component is when the key frames are declared and the second component is when the declared key frame is used in an animation property [45].

There are some advantages with using the CSS animation approach, such as:

- JavaScript is not needed in order for the animation event to run and because of this the responsiveness of web applications are increased [46].
- The CSS syntax used are established, so it is simple to understand [43].
- Semantic information on the animation to the web user-agent is provided, this will give a decision to determine which is the best way to run the animation [46].

There are also some disadvantages with using CSS animation identified:

- There is a lack of flexibility when animations are defined, the CSS animation limits the combination of the features of CSS transitions and transforms [46].
- Although most browsers support the animation standards, there are still limitations with the compatibility of mobile browsers [43], [46].

To conclude, the use of CSS animation features is chosen to be implemented to help in creating the required animation features needed for the proposed interactive e-Learning website prototype. The CSS animations will be used to create animations within the contents placed on each web page, certain areas of the web page will have a particular animation feature added to create the interactivity features needed.

2.3 E- LEARNING AND ANIMATION:

The use of animation objects contains different kinds of features which can be applied to various fields, and is generally based on its capabilities to illustrate dynamic processes and moving devices when used in a learning setting, on circumstances where a slow, safe, simplified, speed, complexity and other identified features are not provided [47].

Wong et al [48], suggest that animations is more preferable on situations where transient information are presented in short sections because of people's innate ability to learn through observation. But also animations can become less desirable for use over static graphics when transient information is used for long sections because of people's working memory overload when an extensive amount of temporary information is taken in.

Animations can clearly illustrate events that changes over time which cannot be illustrated well by static graphics, these are actions such as motion, processes, and procedures; additionally animations can provide external support for the learners to construct their dynamic internal image than the use of static graphic [49]. On the other hand, *Fadel & Dyson* [50] views that one of the down-side of the current e-learning lectures/studies enforced, is the low communication presence compared to face-to-face communication. They suggest that if the aim is to increase the social presence towards each other, designers should produce more features that to e-learning environments, such as using a combination of images, animation and text to transmit information.

Computer animation can be identified to be a more convenient way to teaching than using videos because producing videos can be a tedious process and covering the different needs and relevant content for each age groups of students would require a big amount of investment, according to *Adamo-Villani et al* [51].

Pinter et al [52] states that the visualisation of learning materials can help in easing and shortening learning processes and it can be used as a way to simulate system from life. A student's learning experience can be more interesting because play and experimentation combine materials together and simulations can enable students to be more aware of the illustrated system and can make alterations in the parameters without the additional costs or risks. Animations can offer a better advantage than static graphics because animations have the ability to illustrate a content that can be difficult to visualise, the animations explicitly depict dynamic information instead of needing the learner to infer change [53].

“Although animation did not affect learning, it helped decrease the time necessary to retrieve information from long term memory and then subsequently reconstruct it in short-term memory” Rieber et al [54].

Figure 2 illustrates the adaptation of Garrison Anderson’s model of e-learning, the model presents the four interface features identified to help in enhancing social facilities: visibility, images, animation and text. Visibility is applied to indicate the interaction facilities which is determined that it boosts students’ participation; and the images, animation, and text are used to interpret the social information, animations are also used to show the feedback given for the system [50].

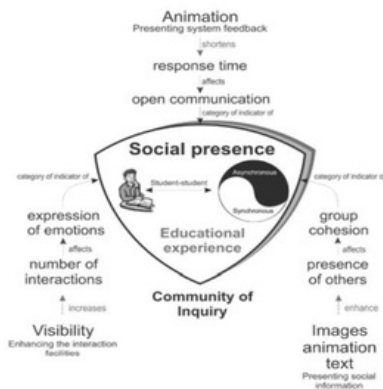


Figure 2: An adaptation of Anderson's model of e-learning (Fadel & Dyson [42]).

According to *Otoo & Osikoya* [55], using animations as a form communication has turned out to be commonly applied to help in explaining the subjects in health and physical sciences and engineering. They suggest that students gain a better understanding of the subject when the presentation contains a combination of animation and text, rather than text alone and that animated learning can give students an idea of what procedures should be taken with the help of illustrations of the animation.

Jones [56], suggests that there are various animation requirements when applying animation for presenting educational contents such as: the animation should move smoothly and interactively to aid in encouraging students to learn independently because users may find it hard to focus on what is really happening if the animations do not run smoothly. Another way of illustrating animations is the use of collaborative 2D animations, the benefits of using these types of animation is that it can be useful in explaining concepts and ideas through the use of online interactive classes for students that learn through online courses [57].

"Interactive Animation presented in a lecture it should also be offered on the web: that way students get the chance to make experiments by themselves, which is a motivating but also a very effective way to deepen and to increase acquired knowledge" Syrjakow et al [58].

There are also some disadvantages identified when using animations for e-Learning, regardless of the benefits that animation has. *Mayer* [59], argues that most animations are not always as effective as using static diagrams when promoting learning because people may find that learning with animation can be challenging to the human information processing system and may even be less effective to static diagrams. *Ruiz et al* [53] also points out that the effectiveness of animations towards learners can vary depending on the learner's knowledge and spatial ability. They contend that learners with lower knowledge would find that they may learn and understand better with the use of animations rather than static graphics; whilst, learners with a higher domain-specific knowledge would find that animations can be unnecessary and may distract them with their learning. Additionally, current research made on animations suggests that animations do not present sufficient support to agree with this assumption, but animations can be more effective when it is used to portray processes that can be difficult to interpret in the real world [66].

Even when animations are used to increase the learner's motivation and can attract their attention, there is still not enough evidence that using animation can facilitate learning, the use of static web graphics would still be viewed to be better and animations should be used on circumstances when it is essential to learning the objective [8]. In many circumstances learning from animation can offer numerous opportunities for learning and can also give out specific requirements towards the learner's learning processes; for example, students not only have to process information that change constantly, students also need to identify and relate the separated graphical images displayed spatially and temporally. Therefore, it can be viewed that animations can be successful when learning if it is illustrated realistically and is representational [60].

Wang et al [61] proposes that developers need to identify the balance animation interactivity and program complexity, they point out that animation which contain high interactivity does not always improve student learning. They also suggest that Instructors should be aware of the different preferences of each student when merging animation to the learning setting, and

animation elements can have different effects on the student, which would depend on the student's cognitive skills, prior knowledge or individual differences.

On the feedback obtained from a previous study conducted by [62] *Hwang et al.*, have discovered that the group of students included in their study has stated that animation can be beneficial in learning; it was stated that animations is a good approach to use when concepts are hard to represent through the use of static images or text can be explained clearly, and animation can also improve a student's understanding of the contents of the topic. Additionally, when students were asked if they prefer the use of animation over static interfaces, the student's responses were divided because the students that preferred static images have reasoned that animations did not provide enough information.

Unlike systems/tools that contains static images and texts, animations have the advantage of being able to illustrate procedural information more accurately because animations display each steps thoroughly. A limitation identified when using animation is that the animation quality of the design and development used for teaching and learning can occasionally be difficult to implement [62].

On a research conducted by *Mayer and Anderson* [63], on investigating the effectiveness of animation for learning has suggested that the use of animation does not always improve the student's understanding of a topic given to them. They also hypothesize that learners make connections between the verbal and visual illustrations of information when there is contiguity with words and pictures when instructed, which can also support problem-solving transfer. The use of directive animation promotes learners to combine aural and visual components of multimedia presentations together, directive animations supports the processes of exploring the images that refers to the narration. As a result, it is suggested that directive animation can aid in increasing the cognitive efficiency of visually identifying an image element noticeably, which enhances learning [64].

"One would expect that animation, like any graphic or picture, would facilitate learning tasks that require or could benefit from external visualization. However, animation additionally brings the attributes of motion and trajectory to a given learning situation." Rieber [65].

Clark and Mayer [67], suggests that the use of animations and related texts should be avoided because when an animation is running at the same time as a text id being displayed, then learners can only focus on one area: either the descriptive text or the animation. A solution

can be showing the text for reading and to give instructions to the learner to play or pause a button to start or stop the animation in order for them to view the animation before or after reading the text [67].

In a study conducted by *Lin & Atkinson*, identified that those that were provided with animations to study had obtained more understanding of the topic than those that were given static graphics. However, it is also stated that overall there was an insignificant pattern on participants that studied using animations had scored higher than those who studied with static graphics because animations highly depend on how it would be perceived [49].

This statement is also backed up by *Höffler & Leutner* [68], they expresses that differences of individuals can influence on whether static or animated pictures within a particular domain of knowledge or skills would be preferable, for example an individual's spatial ability and prior knowledge of the topic can play a role in identifying the effectiveness. Additionally, in order for animations to be effective, instructional design.

A possible reason for the inadequate learning benefits when studying from animations would be that learners may require a greater level of mental abstraction and combination of the procedures formed, which results in the learner's cognitive capacity to be overloaded, in particular to the learners that lack sufficient domain knowledge to guide their attention [69]. It is interpreted that learners which have a lower spatial ability show that their learning can be enhanced when animation for procedural knowledge is used; But on the other hand learners that have a higher spatial ability show that the use of animation for learning did not improve their performance [70].

In conclusion, with the majority of the research made on the application of animations for e-Learning, it shows that there is various evidence that iterate the effectiveness of animation in e-Learning; most research suggests that animations can be effective for use, but may not always be as effective as using static images as part of a student's learning and imply that animation can be used, but only on certain circumstances when animation is necessary and it would also depend on the student's spatial abilities.

For the implementation of the website prototype the combination of animation features and e-Learning has been chosen, to help in demonstrating how the use of animated features can aid in promoting students' learning.

2.3.1 Multimedia Learning

"Multimedia learning refers to learning from words and pictures. The case for multimedia learning rests on the premise that learners can better understand an explanation when it is presented in words and pictures than when it is presented in words alone." Mayer, [71].

Multimedia is currently becoming more associated with the internet, it can offer advantages, as well as challenges to the users; the advantages occur from the internet's vast ability to link and interconnect. However, there are also some potential problems identified such as the lack of fundamental structure and tutor control [72]. The use of multimedia contents for e-Learning has been pointed out to attract a learner's attention and interests, but it has also been identified that the use multimedia content alone does not effectively result in a significant positive learning performance and satisfaction. A big obstacle that can occur when designing multimedia contents for e-learning would be the lack of knowledge with regards to the links between instructional media and learning content [73].

According to *Eitel* [74], on the cognitive theory of multimedia learning (CTML), learning with the use of multimedia result in the selection and organisation of information from text and pictures into two different mental models in the working memory. The CTML views that learning from text and pictures information is stored in verbal and nonverbal code and can obtain a higher level of recall and understanding of the subject [74].

Every individual have different learning preferences, and because of this it can be favourable to present more than one medium [76]. There are various advantages and disadvantages when applying multimedia features as part of teaching. The advantages are:

- Multimedia contents are portrayed in various ways, this allows students to read text to learn abstract principles and through an animation practical application can be identified [76].
- It can be individualised: users are enabled to navigate through the information depending on their own interests and create their own unique structures according to their exploration [72].
- Various learning styles and preferences are addressed; which means that multimedia can provide opportunities to teach individuals and combine together their preferred learning method [76].

- Learners have the ability to connect their own ideas from various media success, for example associating the sound of a certain musical instrument with the illustration that links to the sound [72].
- A more active learning environment can be provided: this enables lecturers to transfer real-world elements by incorporating different media features such as animation, sound, images, text and videos [76].
- With the use of multimedia, students can produce artefacts that can express their understanding of concepts with the use of multimedia features, as well as the lecturers can customise their lesson plans which can be individualised [75].

Alongside the advantages, there are also some identified disadvantages such as:

- The hardware and software needed for developing the multimedia can be identified to be a strain to organisations that are limited in their skills to install and maintain the system created [76].
- Some multimedia features can be non-interactive: the programs may present information one-way, which do not provide opportunities for users to interact or practice with feedback. Additionally, people can perceive something that is intended to be an interaction may turn out to be feedback due to poor design [72].
- The start-up cost for the resources needed in order to support the multimedia development can be excessive [76].
- There may be complexity and lack of standardisation: currently multimedia is still is proprietary, and it is regularly complicated to configure different components to make them work together [76], [72].
- It can be time-consuming: some programs may require more time for learners to achieve their pre-specified objectives, this could be because they can be more complex

Kassim et al [77], concludes in their study that multimedia learning materials can potentially improve students' creative performance, but advises that learning materials should be designed and developed suitably in order to effectively manage cognitive loads.

2.4 USABILITY TESTING:

Usability testing procedures will be carried out on the implemented website application for this project; this will help in giving feedback and evaluation on the implemented website. The main goal of usability testing is to identify the changes that needs to made to improve the produced project and to meet the user's goals or to find out if the product will work in different kinds of environments [78].

“Usability testing gives you this access to your users using your product to perform tasks that they would want to do, which are matched to goals that are realistic for them.” Barnum [79].

Usability testing includes the observation of human and computer interaction within a controlled setting when websites need to be evaluated, along with the main objective of determining whether the website's purpose is made clear for the user and the ease of navigation [80], [81]. Carrying out usability tests can give users the chance to give feedback on the tasks given to them, to observe their body language, and to determine how well they are supported in achieving their goals [79].

According to *Huff et al* [82] Usability is essential when carrying out tests because when the interface's usability is of great standard then users will be able to complete the given task faster and will not have difficulties. Usability that is poor quality can result in users in having difficulties in interpreting how the tasks or tests are carried out and this can result in unnecessary errors in the assessment process. On the other hand *Clemmensen & Qingxin* [83] argues that the majority of the sections of the usability tests are not linked to the interactive application that is being tested, but is more linked to the various user characteristics, test preparation, methods and location. *Emond and Steins* [84], view that usability testing is very helpful for iterative designs, they suggest that if users should iterate if he/she has the time to conduct only one or two usability test; this will enable users to validate the fixes carried out for the previous design flaws identified [84].

Lokman et al [78] states that there are four main usability testing process identified:

- Exploratory: this is when preliminary concepts are tested and is evaluated to determine if the aim has been followed.
- Assessment: the features during the implementation are tested.
- Comparison: the designs are assessed between or against each other.

- Validation: the features are certified to check that certain standards are met and near the end of the development process benchmarking is carried out.

Usability testing is generally used as an evaluation technique for industrial artefacts and computer software and hardware; there are different methods to conduct usability tests and these methods include heuristic techniques: expert reviews or cognitive walkthrough and formal testing: lab testing, human factor experiments or prototype testing; and usability testing methods are also be used to evaluate web usability [86].

2.4.1 USABILITY TESTING EXAMPLES:

There are different ways to conduct usability testing, one of the best usability test is to observe users interacting or using the website directly, by observing the users the tester will be able to record the actions that the users make in the website given to them. Another usability technique is by giving users a specific task to carry out and asking for an explanation of the steps that they make and asking the users to complete a questionnaire or survey which are mostly open-ended questions to gain thorough information on the website being tested [85].

A cognitive walkthrough method normally focuses on identifying the needs of the users in order to make learning easier; this method is carried out in a way where the evaluator will attempts to go through the website from a user's viewpoint and carries out tasks that users may usually complete [87]. *Dumas & Redish* [88] states that the cognitive walkthrough method aims to evaluate the usability of the user interface. This method is perceived to be useful for prototypes that are identified to be not so achievable and its main goal is to identify the strengths and weaknesses of the user interface without the need to produce the prototype or design straight away.

There are advantages of conducting the cognitive walkthrough, a fine-grained analysis of the series of steps needed for the end user to complete the task successfully when using a system is provided, which can be used to improve user interactions and comparing systems with regards to carrying out a similar task [89]. Another advantage of using this method is that it can make the identify the users' aims and objectives precisely because the walkthrough can point out the problems that users may face when carrying out a certain task on the prototype [88], [90]. A drawback of this approach would be that it usually focuses on low-level details of an interaction and a high level or holistic view of user interaction is not provided [89].

Another type of usability testing is the interactive prototype testing. This approach test and determines a website's ease of navigation and flow. Structured observations of users in a usability environment are conducted or a test relating to the specified general goals is conducted, the participants are given a task to carry out; the structured observations test allows the evaluator to identify and record the potential problems, frustrations, difficulties and bottlenecks that the participants experience [86].

Lane [91], states that the benefits of carrying out interactive prototype testing is that they can present the most effective prototype, but this approach also has its limitations such as there is limited interactive functionality presented and would need more time in creating the prototype. This is also backed up by *Hori et al* [92], they state that during the early development stage users may not be able to distinguish whether the flaws they encounter are intrinsic problems of the artefact or from an inadequate operational performance of the prototype.

Lastly, there is also the use of questionnaires to conduct usability tests. Questionnaires allow evaluators to measure users' subjective evaluations of software programs or products [90]. When producing a questionnaire for usability testing evaluators should make the questions open-ended and a section to allow users to address any additional comments on the system or program being tested, this will enable the evaluator to obtain valuable information [93]. Conducting a post-test questionnaire can be used to obtain information and evaluate the ease of a website's interface, clarity of language, or the opinions that participants give about a certain task carried out [94].

The benefits of conducting a questionnaire-based usability test is that it is inexpensive and easy to administer and furthermore, it is easy to evaluate. However, there are also some identified limitations for this approach similarly like other empirical evaluations, is that the actual performance of the program/system is not observed or measured, instead user experience and opinions are explored [95].

2.4.2 Web Usability

More attention on the context of the websites is needed when designing usable websites, when regarding to web usability, than when designing usable Graphical User Interfaces (GUI). When thinking of making a website usable it is beneficial to make sure that interaction is simple and also ensuring that users feel comfortable in the physical, mental, and emotional environment of the interaction with the web [86]. When the right animation element is used, it can help in conveying how the used elements on the page can link to other elements within the page and to the actions that the user has completed [96].

According to *W3C* [97], the concepts of usability is to design products that will be effective, efficient, and satisfying for the user; the key element of usability for web developers is to ensure that a user-centred design process is followed to promote a positive user experience. There are some web usability problems that users/developers can face with regards to adding animated contents on to a web page. Some of these web usability problems and solutions are:

- There are too many animations within the web page that is running continuously, some users may find that they would want to stop the animation so that he/she can focus on the task that he/she would like to do because they may find that the animation is distracting. The solution for this problem could be to include only one functioning animation for each page and use the animation in order to get the viewer to look at the main area of the page [7].
- Some network access speed may be slow or the browser version that the user is using can affect the performance degradation of the web page that contain graphical and animated content [98]. A solution for this problem could be that the animated contents placed within the web pages are minimal and that they should not run all at the same time in order for each animation to work as normal.
- Animations may degrade the performance of identifying the key information or keywords needed when web pages are associated with animated graphics that relate to task difficulties, the animation features, content and instructions [99], [100]. A suggestion for this problem could be that when applying animations to the website the contents should be made relevant to the subject and make sure that it will help in illustrating the subject topic for the user to understand.
- Some animation can be distracting or annoying for the user and may be a hindrance rather than being helpful, developers should be more aware of what animations should

be included or if it is actually needed for the web page [100]. A solution for this could be that only use animated contents when needed and possibly to provide users the ability to top or start an animation in order to focus on another section.

- Some animations maybe running too fast for the user to see, which results in users being unable to understand the animation well, for example text or images that rotate to show messages are set too quickly. A solution for this would be to make the animations slower, this can improve the usability of a website and also allow the users to take their time in gathering information [101].

Overall, the use of the mentioned techniques of each usability examples will be applied when conducting the usability test for the produced website. More in particular the use of questionnaires to obtain data on the user's experience of the proposed website will be used to get feedback. The study group to be asked to carry out a certain task within the website. The website created will contain animated contents and information needed for the learner/user to read and carry out the tasks. The aim is to ask the group for a feedback if they have learnt something from the produced website and if the website meets the usability conditions.

CHAPTER 3: RESEARCH METHODOLOGY.

In general, research can be viewed as a process that expand the boundaries of the unknown, people carry out research in order to give statements on questions that are unanswered or creating answers for a certain topic that currently does not exist [102].

A research methodology has various aspects and research methods form a part of the research methodology. Not only would the research methods be discussed in when discussing about research methodologies, the logic behind these methods are used in context of a research study and explanations of why a particular method or technique is used [103]. There are various types of research methods such as: Descriptive vs Analytical, Applied vs Fundamental, Quantitative vs Qualitative, Conceptual vs Empirical or Experimental vs Non-Experimental Research [103]. According to *Gast and Ledford* [104], the most common approach in research methodology that is used in behavioural sciences is the group research; they are normally suitable for large-scale efficacy studies or clinical trials, where the researcher's subject of interest is described [104].

3.1 RESEARCH PROCESS:

The aim is to have a group which consists of ten to fifteen people to carry out the given tasks. Each individual will be given a link to the website and will be asked to view the produced website which will contain animated illustration and activities within the page. After the group has finished the task, a questionnaire will also be created for users to answer to give suggestions and feedback of the website; through this it will aid in analysing whether having animation within an e-learning website is worth to be added as part of teaching to students or if there are no differences between having static graphics or animation within the website. Considering that the proposed project is aimed on the analysis of the application of animation in e-learning, the chosen age group that will be included to carry out the questionnaire are between the ages of eighteen to twenty-five; these age groups are generally groups that have experienced or are currently in higher education. The questions created will consist of fifteen to twenty open and closed-ended questions.

"Questionnaires can be short or long, simple or complex, straightforward or branched/ they can be rigidly structured or be a loosely organized list of topics to discuss." McNabb [105].

The questionnaire method is similar to other methods of data collection, they also aim to measure sociological variables and questionnaires generally collect information about an individual or group, and various data such as a person's characteristics, perception and feedback of a particular topic [102]. Questionnaires are a set of statements or questions that is designed to collect the opinions, beliefs, or preferences of the users; when evaluating a website's usability, questionnaires can be used to create personas or user profiles, website usage evaluation and the users' subjective opinions such as their point of view of the website can be measured. Additionally, they can also be used to combine with other usability evaluations to collect quantitative data [87].

There are various advantages of conducting questionnaires as part of the research process such as, questionnaires are considerably flexible, this is because they can be designed specifically in the way that the research wants in order to meet the objectives that the researcher has set [105]. Questionnaires also provide a highly structured quantitative data which can be easily comparable and the data obtained can be converted to tables and charts easily and be analysed statistically [106]. Additionally, questionnaires often enable user to record user feedback quicker and easier and they can choose to provide a section for users to have the ability to write a response [105].

On the other hand, there are also some disadvantages of conducting questionnaires that can be identified such as, questionnaires do not provide the user with a greater understanding of the questions raised by the researcher because some questions that the user may find difficult to answer and the researcher would not be able to elaborate the question to the users clearly,

similarly when the interviewee wants to elaborate on their answers more clearly [107].

Furthermore, if the questionnaires are self-administered, the users that are carrying out the questionnaire may choose to write short answers or decide not to provide an answer for a question, this can result in having a less detailed information of the research outcomes and the researcher may find it hard to document the responses well [108].

When users carry out the questionnaires, they should be able to give feedback on the implemented website that is provided for them to carry out a different task; this will help in obtaining research data to give a conclusion on whether the proposed research is backed up.

CHAPTER 3.1: DEVELOPMENT METHODOLOGY.

“Software development methodologies provide framework for planning, executing, and managing the process of developing software systems. There are many software development methodologies including waterfall, prototyping, iterative, rapid, structured, object, and agile approaches” Vijayasarathy & Butler [109].

Focusing on the requirements analysis stage as part of the development methodology of the project, it will be looking into the creation of use case documents and also adapting a feature/tool of the agile development methodology of creating user stories.

User stories is regularly defined as a process that the user wants for a system, the stories are similar to a traditional usability scenario in a way that it can include some sort of user persona. On the other hand, there is also the creation of use case documents, which normally consists of information about what the software is doing when a user is carrying out a certain task, it is normally viewed from a software’s perspective by showing how the system would react internally to a user interaction [110].

Requirements Analysis:

User Stories:

User stories consists of one or a couple of sentences in the everyday or business language of the end-user of a software system which obtains the process of work that a user does or needs to carry out on a system; it documents the functional requirements quicker and less formally compared to a traditional requirements model and this is achieved by focusing on the *who*, *what* and *why* of each function [111]. The stories are normally about what the product owner plans on the features that should be part of the product [112].

According to *Cohn* [113], user stories consists of three aspects:

- A written description of the story that is used for preparation and as a reminder.
- Discussions about the story that will deliver the details of the story.
- Tests which will disclose and document details and to be used to determine when a story is complete.

A benefit of user stories is that they allow the project community to define the capabilities and features that the system needs to support promptly without the need to examining a big effort in exhaustive requirement analysis [114]. Additionally, they can promote deferring

detail and participatory design, can be suitable for iterative development and is easily understood by the majority [115]. An identified disadvantage of this approach is that they are viewed to be incomplete because of the way that it is structured and constructed [116].

Use cases are part of the requirements analysis and modelling tools that generally describes the *what*, not the *how* of a system to user communication process [117]. Use cases analyse the functional requirements and is created through the specification of use case extensions which define the alternate scenarios that may or may not lead to the completion of the use case goal; the structure normally consists of the user turns into an actor, with a specified role which will interpret how he/she will interact with the system [118].

According to *Kulak & Guiney* [119], the benefits of applying use cases for the requirements analysis is that they not only gather requirements but also the whole software development cycle, a computer system's aspects are directly displayed, additionally it has the ability to drive the entire methodology through the process of helping to solve problems such as requirements traceability.

Another, advantage is that use cases can put together user stories which can provide a framework for the simplistic way that user stories identify as part of a requirement; in general, the scope of the use case is the quantity that the user story estimates. Additionally, there are also some disadvantages when using use cases one example would be that use cases can be time consuming when writing up use case documents, and should be changed whenever a section of code for the system changes [120].

These methods have been chosen in order to help in planning the outcomes for the development of the website application. Applying the user stories method can be advantageous for the project because it can help in analysing and highlighting the expected user outcomes, actions to take and its values for the implemented website. To back up the created statements on the user stories, use case documents will also be created to help in identifying the requirements that are needed to be achieved; the use case documents will help in demonstrating the expected process of a user's task when the implemented website is visited.

When implementing these methods there may be some disadvantages that may be identified such as: User stories created may not be enough to illustrate a detailed user process, so it may be difficult to explain in more detail how the implemented website will be used. In, order to

tackle this problem, use case documents will be created to help to further explain the processes that the user stories have not covered.

Use case documents would need to be altered every time that a section in the website needs to be changed, the process that was first written may be completely different from the changed feature of the website therefore the process in the document would need to be changed and this can result in the use case document to take a while to finalise. In order to work around this problem, use case documents will be created which will contain different expected task outcomes and will choose the document that is more relevant to the expected task when accessing the final website

For the implementation of the website the chosen software to be used to create the website is Microsoft Visual Studio, the software will be used to create HTML, CSS and JavaScript files that are necessary for producing the website. And a cross-browser CSS library has been applied to help in the creation of animation contents within the web pages. This software is essential for the project because it will help me in creating the website needed for the project. And in order to create the illustrations of the use case diagrams for the requirements analysis Microsoft Visio will be used, this software will be used because it has the required features that is needed to create the use case diagrams. To create the user stories Microsoft will be used, this will be use because it has all the required features needed. The use stories and use case documents are relevant for the project because this will illustrate the process.

CHAPTER 4: DESIGN & IMPLEMENTATION

This section will be discussing the design and implementation of the proposed website application that will be created to give support on the initial aims of the project's topic.

4.1 REQUIREMENTS ANALYSIS:

For the projects requirements the creation of user stories and use case documents have been made in order to illustrate the expected requirements for the website project. These project requirements models that will be used were discovered during the process of researching for the different types of development methodology methods of the project.

4.1.1 User Stories:

- 1) As a developer I want to create a website that will portray an online e-learning website that will aid learners to study a subject topic with the use of animations, so that I can identify whether the application of animated graphics would be a better as part of e-learning features rather than the use of static graphics.
Given that the tools and software needed is available when the website needs to be implemented then the website will be created as planned without any setbacks and the software and tools can be accessed when needed.
- 2) As a developer I want the websites design to contain a menu where users can navigate to different pages around the website, contain a section/button where users can view a page to carry out a quiz, have contents and information that are relevant to the subject topic and must contain some form of animations within a certain page, a contact page in order to allow users contact the developer and an about and homepage. So that I can carry out a usability test after the website is created to determine the effectiveness of an e-learning website. Given that there are no complications when creating the website features stated, then the website can be made public to everyone and be able to obtain user feedback of the implemented website.
- 3) As a user I want to be able to access and navigate through the website with no difficulties, so that I can analyse and review the contents of the website. Given that there were no problems encountered when accessing the website, then the website will be viewed and navigate around as normal.
- 4) As a user I want to be able to view the contents of the web page and be able to learn something and to examine whether the information and illustrations placed on the

website are relevant with each other, so that I can give user feedback on the given questions by the developer. Given that the information, animation contents and function features are working properly when analysing the website to view the illustrations and information then a questionnaire given out by the developer will be answered to give feedback on the implemented website.

4.1.2 Use Case Document:

To support the user story stated two use case documents have been created which gives a description of the tasks that the user and developer may take.

<i>Use Case Description</i>	
<i>Summary</i>	The developer creates a website using developer tools and software available and following the design plan for the website.
<i>Actors</i>	Developer
<i>Pre-Conditions</i>	The developer aims to design and implement a website application.
<i>Post-Conditions</i>	A website is created by following the design plan and including the necessary features needed.

<i>Scenario</i>
1) The developer opens up the software. <i>The code files and folders such as CSS, HTML and JavaScript will be created here.</i>
2) The developer creates the HTML code <i>The HTML code will create the structure for the website; it will include sections such as the navigation menu bar, what will be placed in the web page content section e.g. pop-up window, images, etc. and within this the JavaScript and CSS need to be declared.</i>
3) The developer chooses what the first task will be.

The developer has the choice of creating CSS or JavaScript code.

A) The developer creates the CSS Code

The CSS code will create the website's design, placed here are the features of each content and the layout design of the whole website, for example how the navigation would look like and how each menu option is spaced from each other.

B) The developer creates the JavaScript Code

The JavaScript code will contain the events and functions needed for the website that CSS features cannot do; for example, the creating a button event to start or stop an animation.

4) The developer finalises the website design and features

Deployment

Microsoft Visual Studio will be used to contain the code files and the CSS, HTML JavaScript tools will be used to generate the code.

Use Case Description

<i>Summary</i>	The user accesses the website and browses through the web pages to read and analyse the information contents of the website.
<i>Actors</i>	User
<i>Pre-Conditions</i>	The user accesses the website and navigates through to one of the web pages.
<i>Post-Conditions</i>	Interactive features placed on the website are tried out and analysed. User can choose to navigate to another page.

Scenario

1) The user accesses the website.

The user will initially be navigated to the home page. The user enters the button and will be brought to the website pages.

2) The user chooses which web page he/she will navigate to first.

The user has the choice of navigating through different pages of the website.

A) The user visits the Cells Page

This page features the illustration of a cell; the user can hover through sections of the cell and a tooltip window will show to give a brief information and function of the area, the user can also access a quiz within this page by clicking on the quiz button and a pop-up window will show. The user will also be able to navigate through the other page using the menu bar.

B) The user visits the Heart Page

This page features the illustration of a heart; the user will can click on certain areas of the heart and a pop-up window will show to give a brief information and function of the area, the user can also access a quiz within this page by clicking on the quiz button and a pop-up window will show. The user will also be able to navigate through the other page using the menu bar.

C) The user visits the Respiratory page

Just like the heart page, this page features the illustration of a lungs; the user will can click on certain areas of the lungs and a pop-up window will show to give a brief information and function of the area, the user can also access a quiz within this page by clicking on the quiz button and a pop-up window will show. The user will also be able to navigate through the other page using the menu bar.

D) The user visits the Contact page

This page will allow the user to contact the developer/person that owns the website by filling out the contact for enquiries, once the contact form is filled the user will be redirected to page to confirm that the enquiries are sent. The user will also be able to navigate through other pages using the menu bar.

3) The user chooses another page once the user is done navigating through the first web page

Similarly, like the first task the user has the choice of navigating through different pages of the website.

A) The user visits the Cells Page

This page features the illustration of a cell; the user can hover through sections of the cell and a tooltip window will show to give a brief information and function of the area, the user can also access a quiz within this page by clicking on the quiz button and a pop-up window will show. The user will also be able to navigate through the other page using the menu bar.

B) The user visits the Heart Page

This page features the illustration of a heart; the user will can click on certain areas of the heart and a pop-up window will show to give a brief information and function of the area, the user can also access a quiz within this page by clicking on the quiz button and a pop-up window will show. The user will also be able to navigate through the other page using the menu bar.

C) The user visits the Respiratory page

Just like the heart page, this page features the illustration of a lungs; the user will can click on certain areas of the lungs and a pop-up window will show to give a brief information and function of the area, the user can also access a quiz within this page by clicking on the quiz button and a pop-up window will show. The user will also be able to navigate through the other page using the menu bar.

D) The user visits the Contact page

This page will allow the user to contact the developer/person that owns the website by filling out the contact for enquiries, once the contact form is filled the user will be redirected to page to confirm that the enquiries are sent. The user will also be able to navigate through other pages using the menu bar.

4) The user chooses to leave the website and may carry on with another task.

Deployment

Website accessed by finding: <http://anievera.website/> .

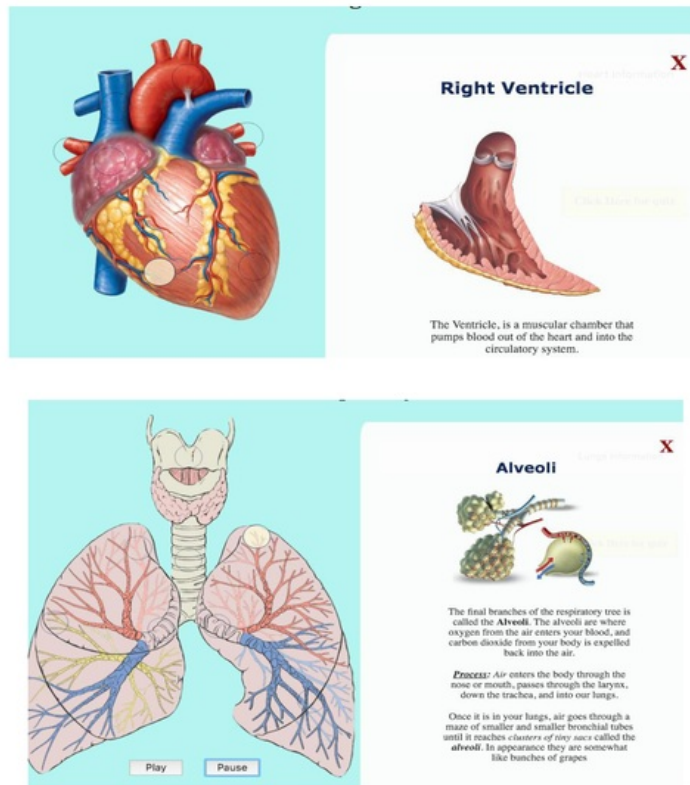
4.2 DESIGN:

When planning the project, the use of Adobe's edge animate was going to be used because the first objective was to create a website using edge animate and another website where it is coded using CSS, HTML and JavaScript to analyse which of the approach is better. This plan was changed and have decided to build one website with just coding because a conclusion was made that creating two similar websites was not necessary and the adobe edge animate software was not always accessible for use.

There were some ideas that was supposed to be included in the website but was not included such as:

On the "Heart" page of the website: a section of the heart was supposed to change image when the section that corresponds to it has been clicked. When all areas of the heart are clicked an illustration of the inside of the heart is supposed to show. This has been taken out of the final design of the prototype because when a solution was tried out the images that was supposed to show after did not appear or both of the images did not appear at all. An alternate solution has been administered to illustrate the contents similarly to the initial plan.

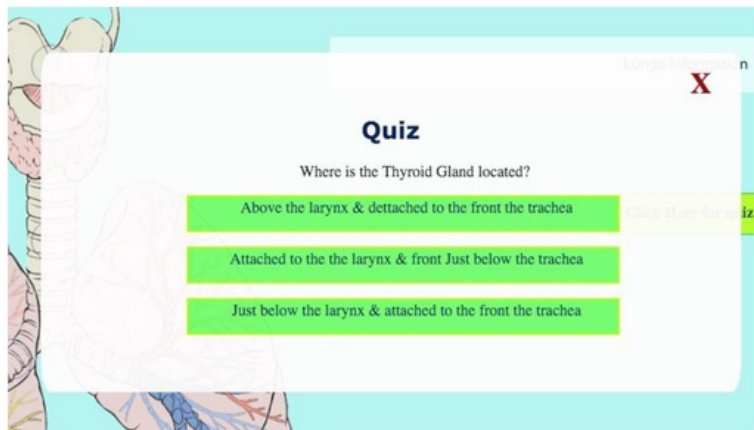
Similarly, within the "Respiratory" page: the initial idea is to enable the users to hover on sections of the lungs and a zoomed in image of the section will portray what happens inside the certain image hovered, also with the use of animation for illustration. This was chosen to not be included in the final design because there were some difficulties faced when trying to implement this feature such as: trying out different ways for the images to show when hovering on a section straight away did not work. A different solution and approach was conducted to make the effects similarly to the original plan.



The process used to implement the alternate solution for both of the statements above is by deciding on whether adding the new feature can make a big difference to the website. Different solutions were tried out to determine on what can be done and changed within the contents. A final decision was made that a feature where users can click on certain sections of the animated illustration to show a pop up with a brief information of the clicked area along with a small animated image illustration.

A separate quiz page is supposed to be added on the menu bar, but instead a button to show a pop up of the quiz has been created. This was done because the creation of another web page was not necessarily needed if the quiz can be included in the web page which corresponds to the web page that the user visits. The process used to implement the alternate solution by placing the quiz within the specific web page which contains the animated illustrations and information instead of creating a separate web page just for the quiz. This is done by creating a button that users can click on to show a pop-up window that will generate the questions and answer options of the quiz. This solution was thought to be better because it will save the user

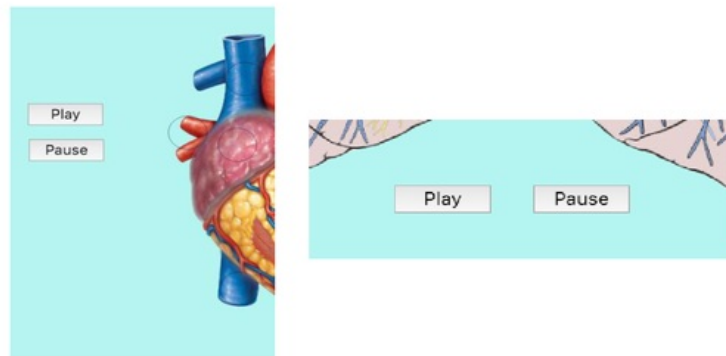
from going back and forth web pages because the user will still be within the web page and the pop-up window can be closed easily.



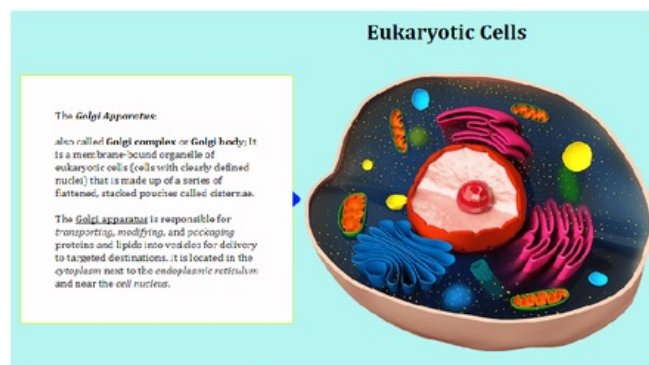
JSON was used to create the hold the question and answers data for the quiz section, instead of using SQL to create the database for the questions and answers. To come up with the conclusion of what is the best solution on how a database can be created to store the data for the quiz, a suggestion from the quiz code tutorial [121] that was followed had suggested to use JSON to hold the data questions and answer. This solution can be better because it can be identified that the process time to code the data can be quicker than making an SQL database and linking it within the websites code implementation.

```
{ "quizlist": [
  {
    "question": "Where is the Mitochondria found?",
    "option1": "In the Cytoplasm",
    "option2": "In the Eukaryotic Cell",
    "option3": "In the Golgi"
  },
  {
    "question": "Nucleus _____ & _____ the activities of cells & carries the _____ ?",
    "option1": "Controls, Regulates, Genes",
    "option2": "Controls, Regulates, Jeans",
    "option3": "Retract, Moves, Genes"
  },
  {
    "question": "There are two types of Cells: _____ & _____?",
    "option1": "Prokaryotic & Eukaryotic",
    "option2": "Probiotic & Eubiotic",
    "option3": "Probiotic & Eukaryotic"
  }
]
}
```

The use of the play and pause button has been placed to enable users to pause and play the animations that illustrate the heart and the lungs. The original plan was that users only needed to click on the image and the animation would pause similarly it will also play. This was changed because some users may not realise that the image can be clicked on to play or pause the animation, buttons can draw the user's attention to give them the idea that they can click the buttons to operate the animation.



The use of tooltips on the “Cells” page was not originally planned, instead a feature similarly like the respiratory page where users hover on certain sections of the cell would show an animated section of the area that the user hovered on. This was changed because it was thought that image animations alone cannot give enough information to the users so a different approach was done.



The process used to implement the alternate solution is by placing the tooltip features on certain area of the cell illustration by hovering over the area, a small window that contains a

brief information of the area e.g. the nucleus, will show and the tooltip will disappear or change information when the user moves onto a different area. This approach was thought to be better approach because placing some text information within a tooltip can enable the users to obtain more information about the illustration that they are trying to view and learn from.

Website Theme:

The main aim for the theme of the website is to make the website look eye-catching and contain interactive animated contents. Adobe Kuler [122] has helped with choosing colours that is more relevant to the website with regards to the choice of colour for the website, the colours chosen for the objects such as the menu, background, pop-up windows etc. of the website was not made too vibrant. Furthermore, the choice of font style and font size have been tried out when creating the website, in order to come up with a decision what the most appropriate style and size of the fonts would when users view the website.

4.3 IMPLEMENTATION:

The website will be implemented to obtain user information and feedback of the website, to help in coming up with a conclusion on whether the aims and objectives that are disclosed on the introduction of the project have been met.

During the production of the website there were some difficulties encountered when coding the website. Stated below are the sections that had problems during the implementation, along with explanations on how the problems are fixed or if it has been fixed:

Making the tooltips was not corresponding directly to the area that the mouse is hovered on. The concepts of from the tutorials [123] and [124] was used to give a better understanding on how tooltips can be included on certain elements. Illustrated below are code snippets of how CSS and HTML is used to apply the tooltip features on the website. Instead of making the tooltips hover a specific area of the image, depending on the side of a specific area of the cell, the tooltip will show on the area's side: the tooltip will show either on the left or the right side of the image (as shown below on the CSS code, named: tooltipL and tooltipR to specify right and left).

```
a.tooltipL span {
  z-index: 10;
  display: none;
  padding: 5px;
  width: 300px;
}

a.tooltipL: hover span {
  display: inline;
  position: absolute;
  color: #000000;
  border: 1px solid #000000;
  background: #FFFFFF;
  top: 25%;
  left: 10%;
}

a.tooltipR span: after {
  content: "";
  position: absolute;
  top: 50%;
  right: 100%;
  margin-top: -12px;
  border-width: 12px;
  border-style: solid;
  border-color: transparent #0000FF transpa
}

a.tooltipR span {
  z-index: 10;
  display: none;
  padding: 5px;
  width: 300px;
}

a.tooltipR: hover span {
  display: inline;
  position: absolute;
  color: #000000;
```

```
<a href="#" id="tooltip" class="tooltip">
  <div id="endoret"></div>
  <span>
    The <b><i>Endoplasmic Reticulum</i></b>:
    <br /><br />
    It is a continuous membrane system that forms a series of flattened sacs
    within the <i>cytoplasm</i> of <b>eukaryotic cells</b>.
    <br /><br />
    and serves multiple functions,
    being important particularly in the
    <i>synthesis</i>, <i>folding</i>, <i>modification</i>, and <i>transport of proteins</i>.
  </span>
</a>
```

Making the movement of each questions on the quiz when changing to another question more fluidly, because of the code concept used for this feature was created for a full web page, the movement did not work fluidly and was moving further than it should have as it was placed within a popup window. This problem was resolved by making the movement smaller that will make it move inside the window, but the problem could not be fully fixed as the fluidity of the movement could not be altered well. This change was edited through the CSS alterations within the code in JavaScript as illustrated below.

```
$(stage2).animate({ "right": "+=60px" },
    "slow", function () {
        $(stage2).css('right', '0px');
        $(stage2).empty();
    });

$(stage).animate({ "right": "+=0px" },
    "slow", function () {
        questionLock = false;
    });
```

On the other hand, there are also areas when creating the website was a success. Illustrated below are code examples and explanations on how they were achieved:

A quiz was created as part of the interactivity of the website. A code concept implemented by [121], has been followed and altered to design the quiz in the way that it is planned. The quiz was placed within a pop-up window; the users can access the quiz by being on one of the web pages that contain the animated illustrations and clicking on the button. A JavaScript file was created in order to hold the event that generates when the quiz is started and when users answers a question, and the use of JSON is used to contain the question and answer data which would then be linked inside the JavaScript file. As shown below:

<pre>#popupBtn:hover{ background: #72fe6c; opacity: 0.7; } .pBtn1 { left: 854px; top: 195px; } .overlay1 { position: fixed; top: 20%; left: 42%; background: #FFFDDE; transition: opacity 500ms; visibility: hidden; opacity: 0; }</pre>	<pre>.qPopup .close:hover { color: lightcoral; } .qPopup { max-height: 100%; } #quiz1 { margin: auto; width: 500px; position: absolute; } .textQuestion { font-size: 1em; color: darkred; }</pre>	<pre>.option:hover { border: #b6ff00 solid 2px; color: #001648; background-color: #faf3bb; } .spacer { height: 30px; } .feedback1{ width: 150px; padding: 5px; font-size: 1em; color: #FFFFCC; background-color: #009900; font-family: Verdana, Geneva,</pre>
--	--	---

```

$(document).ready(function () {
    var questionNumber = 0;
    var questionBank = new Array();
    var stage = "#quiz1";
    var stage2 = new Object;
    var questionLock = false;
    var numberOfQuestions;
    var score = 0;

    $.getJSON('Quest.json', function (data) {
        for (i = 0; i < data.quizlist.length; i++) {
            questionBank[i] = new Array;
            questionBank[i][0] = data.quizlist[i].question;
            questionBank[i][1] = data.quizlist[i].option1;
            questionBank[i][2] = data.quizlist[i].option2;
            questionBank[i][3] = data.quizlist[i].option3;
            questionBank[i][4] = data.quizlist[i].option4;
        }
        numberOfQuestions = questionBank.length;
        displayQuestion();
    })

    function displayQuestion() {
        {"quizlist": [
            {
                "question": "The Atrium is split into two sections, they are t",
                "option1": "Left & Right Atrium",
                "option2": "Top & Bottom Atrium",
                "option3": "Left & Right Ventricle"
            },
            {
                "question": "What is a Ventricle?",
                "option1": "Muscular chamber that pumps blood out of the heart",
                "option2": "Receives from the lungs blood high in oxygen",
                "option3": "Heart Valves pumps around the body"
            }
        ]}
    }
}

```

When the user clicks on a circled area in the heart and lungs illustration, a pop-up window which displays a small animation of the inside of the heart or lungs area clicked on, along with a brief information and function and the user can close the pop-up window by clicking the "X" placed on the corner of the window or by clicking on another area. The circle areas were tagged as a button attribute and a *div* was placed to place the contents in and to allow the pop-up window elements to be edited through the CSS style sheet.

```

<a id="button" class="button" href="#popup1"></a>

<div id="popup1" class="overlay">
    <div class="popup">
        <h2>Thyroid</h2>
        X</a>
        <div class="content">
            <ol>
                <li id="alv1" class="animated fadeIn"
                The <b>Thyroid Gland</b> secret
                normal growth and development f
                and for maintenance of normal m
                </li>
                <li id="alv2" class="animated fadeIn"
                The gland is located just below
                The major functional and struct
                The characteristic of thyroid f
                to utilize dietary iodide.
                </li>
            </ol>
        </div>
    </div>
</div>

#button: hover {
    background: lightyellow;
    opacity: 0.7;
}

.overlay {
    position: absolute;
    top: 15%;
    left: 50%;
    background: #FFFDFE;
    transition: opacity 500ms;
    visibility: hidden;
    opacity: 0;
    border-radius: 10px/30px;
    text-align: center;
    width: 500px;
}

.overlay:target {
    visibility: initial;
    opacity: 0.94;
    z-index: 1;
}

.popup {
    margin: 50px auto;
    padding: 15px;
    background: #FFFDFE;
}

```

A dropdown panel is included to reveal further text information of the specific illustration on the web page, this feature was added in because it can allow the users to focus on one area at a time, showing a text content straight away on the page may move the user attention from the main objective of the page. In order for the dropdown to work a button attribute is placed along with a panel features placed in the CSS style sheet, the text content will show when the user clicks on the button.

```
$(function){
  $(".play-animation").click(function(){
    $(".animated").css("animation-play-state","running");
  });
  $(".pause-animation").click(function(){
    $(".animated").css("animation-play-state","paused");
  });
});

$(function () {
  $(".play-animation1").click(function () {
    $(".animated").css("animation-play-state", "running");
  });
  $(".pause-animation1").click(function () {
    $(".animated").css("animation-play-state", "paused");
  });
});
<button class="pause-animation1">Pause</button>
<button class="play-animation1">Play</button>
```

A pause and play button is placed in order to allow the user to pause and play the animations if they think that the animation is becoming a nuisance to them or distracting them from focusing on other contents. These features are created with the use of HTML and JavaScript codes; the JavaScript code will contain the event that is needed to stop or play the animation.

```
<div id="txt1">
  <button class="accnBtn" id="btnText">Heart Information</button>
  <div class="panel">
    <p class="animated flipInX">
      The heart itself is made up of 4 chambers, 2 atria and 2
      De-oxygenated blood returns to the right side of the heart
      It is pumped into the right ventricle and then to the left
      The oxygenated blood then travels back to the left side of
      then into the left ventricle from where it is pumped into
    </p>
  </div>
</div>

div.panel {
  padding: 0 18px;
  background-color: #ecfffa;
  max-height: 0;
  overflow: hidden;
  transition: 0.6s ease-in-out;
  opacity: 0;
  position: relative;
  width: 715px;
  left: 572px;
  top: 54px;
}

div.panel.show {
  opacity: 1;
  max-height: 500px;
}
```

The animation elements for the heart and lungs are altered e.g. the duration & speed of the animation, which sections need to move first. This was done with the use of CSS animations features derived from: [125] by specifying the particular feature needed and to keep the code running continuously a section of the code in the HTML was changed.

```

#ht2 {
  animation-delay: 1.3s;
}

#ht3 {
  animation-delay: 2.3s;
}

#al {
  animation-duration: 6s;
}

/*Lungs*/
#L2 , #L3, #al{
  animation-duration: 6s;
}

```

```

<h1>Heart Diagram</h1>


<div id="heartDial">
    
    
    
    
  </div>


```

Different development tools have been explored in order to make a decision that this is the right tool to be used for creating the website. As there is more knowledge of using CSS to alter the styles of elements and contents of the website, it has been researched on how CSS can be used for the creation of animation for the proposed website without the use of JavaScript to animate. To create the animations on the website CSS animation and transition features have been used because they have the ability to make an element or an object within the website to move different ways that the developer wants. CSS had the features needed in order to create the animation for the contents of the website. A CSS library called animate.css and also to further help in understanding CSS more W3Schools were used to give support on how to make image elements placed on the web pages animate.

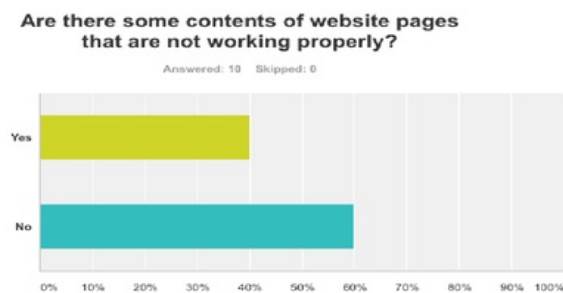
Additionally, the use of JavaScript, jQuery and JSON has also been used to help in some areas of the website such as: the use of JavaScript to create the event for the play and pause button provided in the website, and an event for the quiz section and alongside the use of JSON to create the database.

4.3.1 Usability Testing:

As stated above on the research development, the potential users of the website are the people that are in the higher education who may difficulties in understanding a particular subject.

The procedure used to carry out the usability test for the website is by asking the users that are included on the group that were involved in testing out the website to carry out a questionnaire that contains some questions regarding the analysis of the design layout of the website.

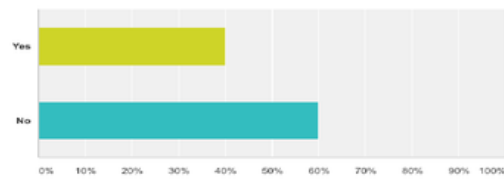
Users were asked whether more information should be added within the web pages as seen on the table below it shows that more people had said that there was no need to add more contents within the page, some have commented that the web pages contain enough information already and that adding more text information within the web page can overpower the other contents and may discourage users from carrying on in viewing the page. While other users have given their opinion that more content would be needed such as text and information and videos.



The users gave their feedback on whether there are some contents within the website pages that are not working properly; most of the users have said that there were no problems with the website. But a few have pointed out some issues such as: the web page that contained the cells illustration and contents were not working properly and that the circles that were placed on areas of the heart and lungs illustration were not so visible so the user did not realise that it was interactive to show another content and have suggested that the circles should be made more visible. Additionally, another user has suggested that some information or description can be put within the homepage to give the users an idea of the websites concept.

Do you think that more information or content should be added within the web pages?

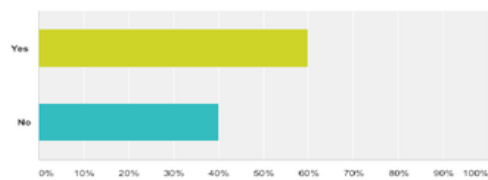
Answered: 10 Skipped: 0



When users were asked if they had an initial idea of the website when it was first viewed just over half of the users have stated that they had an idea of the website. Some users have stated suggestions such as: an educational website, the website could be something about the human body, topic that is specifically looking at the heart, lungs and cells and animated contents. And the rest of the users stated that they did not have a clue and found that the homepage was slightly confusing and did not relate as much to the rest of the web page.

Do you have an idea of the website when you first viewed the website?

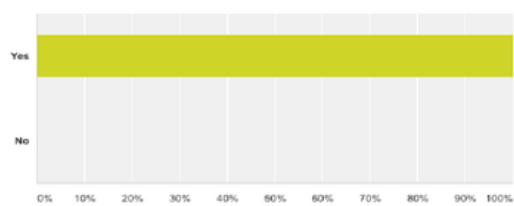
Answered: 10 Skipped: 0



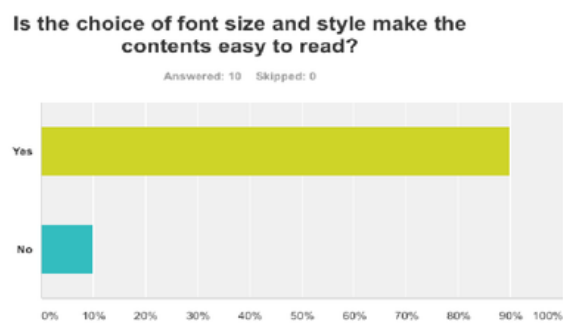
According to the result shown below users have stated that there was no problem with navigating through the website and have found it easy to navigate around.

Did you find it easy to navigate through the website?

Answered: 10 Skipped: 0



Lastly, users were asked regarding the choice of font style and size make the contents easier to read. The majority of the users had agreed that the font style and size used was just right and there was only one user that said that it was not and have specified that some text contents were quite difficult to read as they were a bit too small such as on the text shown on the pop-up windows and tooltips.



In summary, it can be identified that the illustration and contents placed for the implemented website was able to demonstrate to the users what the concept of the website is and that the choice of style and design for the website was relevant. Although there were some suggestions that some sections of the website could be improved overall it can be seen that the objective for the implementation of the website has been achieved.

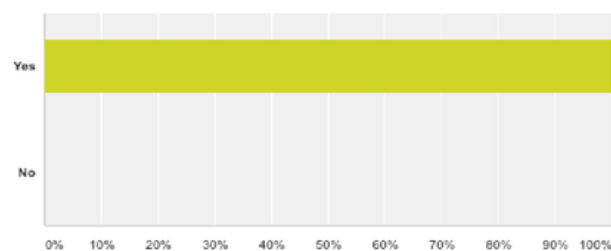
CHAPTER 5: EVALUATION.

Ten people were given the task to browse through the website by doing different types of task in each web page and was asked to fill up a questionnaire after to give a feedback on the implemented website.

From the results of the user feedback obtained from the questionnaire that was given to the users, it can be analysed that the users have learnt something from the information and animated illustrations that is placed on the website.

Have you learnt anything when viewing the contents of the website?

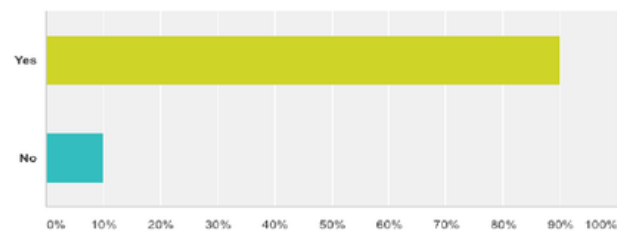
Answered: 10 Skipped: 0



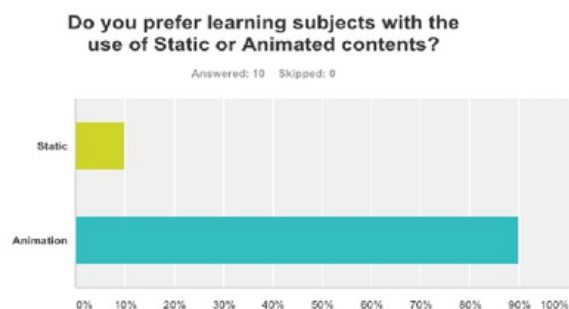
However, when asked about whether animations can enhance peoples learning the majority of the group have agreed that animation does enhance learning, but there is one user that has stated that animation does not help enhance learning.

Do you think the use of animations enhance learning?

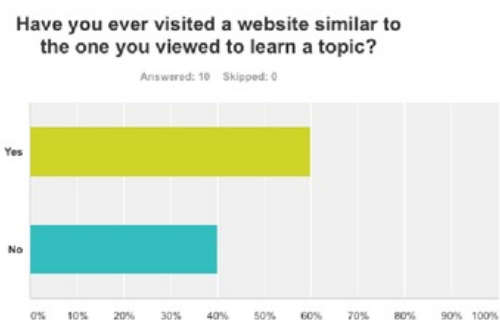
Answered: 10 Skipped: 0



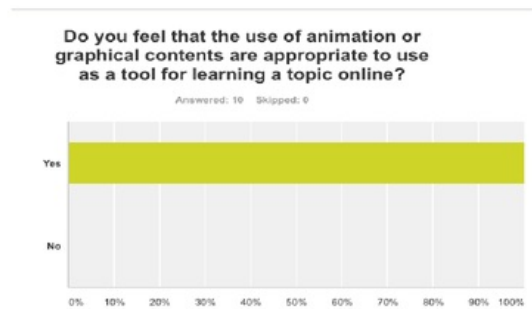
On the next question they were asked on whether they prefer learning with the use of static or graphic illustrations and the majority has chosen animation over static images except for one user. When asked about their opinion they say that they prefer animation because they find it more interesting and like to learn visually using moving contents and the user that preferred static graphics stated that they find animation more of a distraction instead of being helpful.



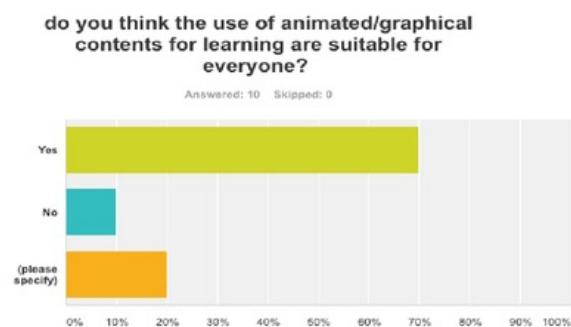
The next question asked if they have accessed similar websites from the one created six people have stated that they have, with some responses stating that they have accessed something similar to the subject topic of the website to learn the body functions and four people have stated that they have not.



The following question asks the users if they feel that using animations or graphical contents are appropriate to use as a learning tool online, they have all agreed that it does and have responded that using animations and graphical contents can help people to learn and visualise better, remember a topic more and can engage the users, but have also stated that animations are not necessary unless they are interactive.



Finally, users were asked if using animated/graphical contents for learning is suitable for everyone, most of them have agreed with the questions and the rest have disagreed and stated that animations are not for everyone because it can take away interesting effects and users can find them a hindrance. One person has stated that it can depend on the learner, if someone is a visual learner then they may find it more helpful to learn with animated/graphical contents.



From analysing the data obtained from the user feedback it can be identified that similar outcomes of the data have been gathered that agree with most of the research that have been investigated in the literature review. It can be seen from the statements above that the results show that users have found animation can help in learning, but also concludes that the use of animations is not suitable for everyone because of their own perception; either they like learning through the help of animated illustrations or static illustrations.

By analysing through the whole project it can be concluded that the specified project objectives have been met.

- The application of animation in e-learning and the effectiveness of animations in interactive environments have been researched and can conclude that animations can be effective as part of a learning tool, but due to different perspectives and perceptions on animations the results can vary.
- Different tools and technologies have been explored and was used to help in the creating some interactive contents on the website. The software used to create the files and code was Visual Studio and for the tools used for the code are, CSS, HTML, JavaScript and JSON.
- A usability test was conduct through the use of questionnaires to gain feedback from the users on the implemented website and has helped in giving an answer for the stated objective: whether static or animation illustrations are better.

The project aim stated on this project can be identified that it has been met, with the research carried out on the topic stated, it can be identified that animations does have its advantages and usability when applying through an interactive website. However, there were some obstacles faced when creating the website because there were some areas and design ideas that was found to be difficult to achieve, therefore, there was not enough interactivity placed on the website contents.

Overall, when the research was carried out the expected outcomes were not so similar to the outcomes that were initially thought of. Initially, the expected outcome was that most of the researched articles and information on animations would be that the use of animations would be more preferred by the majority of people to be used as a learning tool for teaching.

If the project was to be done again there would be some processes that will be done differently, such as:

- further researching on ways that animations can be created for the website and on how the animations can be more interactive.
- Try out other software that can be used to create the website without the use of coding the website e.g. adobe edge animate.
- Conduct a more detailed usability tests to gain more information and better conclusion and feedback for the project.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS.

In conclusion, the aims and objectives stated on the introduction of the project has been met. Thorough research has been implemented in order to back up the statements given. This project was able to disclose various research and implementation outcomes that are required to support the aim and objectives written, such as:

- Carrying out the literature review has helped in giving a final conclusion and better understanding on the advantages and disadvantages of the use of animation for e-learning and the various ways that animation and graphical content can be used as part of an online teaching tool.
- Producing the website design and implementation has helped in obtaining user feedback and information to back up the research statements that are discovered in the literature review. Through this, it can be concluded that the research statements discovered have similarities with the feedback outcomes from the usability test questionnaire the users conducted.

Furthermore, more research that is more related to e-learning and animation could be made, as there were some difficulties in finding more relevant research papers and information on this topic and better planning of the website's design should be made in order to make the website look more presentable.

CHAPTER 7: REFLECTION.

During the production of this project I have learnt the different ways on how animation can be created with the use of CSS alone without the use of other tools such as JavaScript, this has helped me to further develop my knowledge on the use of other CSS features, additionally, I have also gained more knowledge on the how I can code events and create data with the use of jQuery, JavaScript and JSON. And with the research conducted it has helped me in gaining more insight on the benefits of animation for interactive online learning and how researches are carried out and structured by analysing through the journal articles that have been read.

In addition, the experience of producing this project has enabled me to become more aware of how research projects need to follow a very thorough process and an extensive thought should be given. And has helped me in being able to prioritise my workload: such as knowing which sections are more of priority to finish first.

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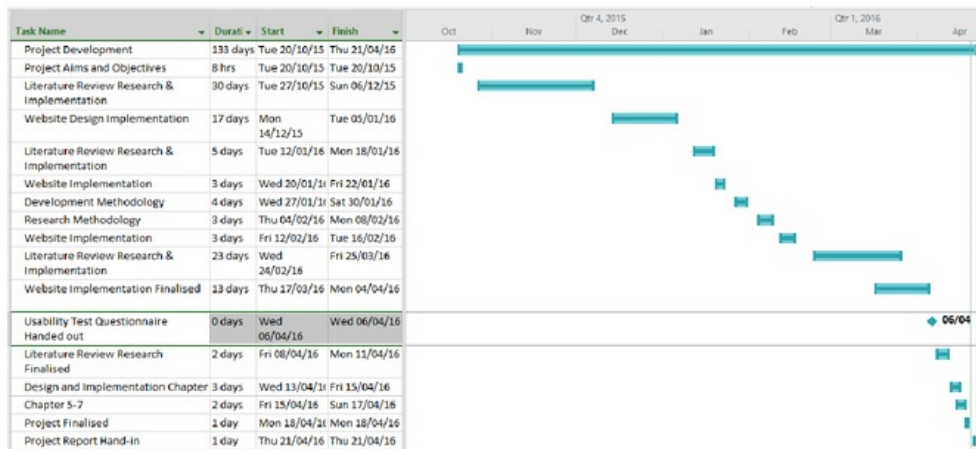
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CHAPTER 9: BIBLIOGRAPHY.

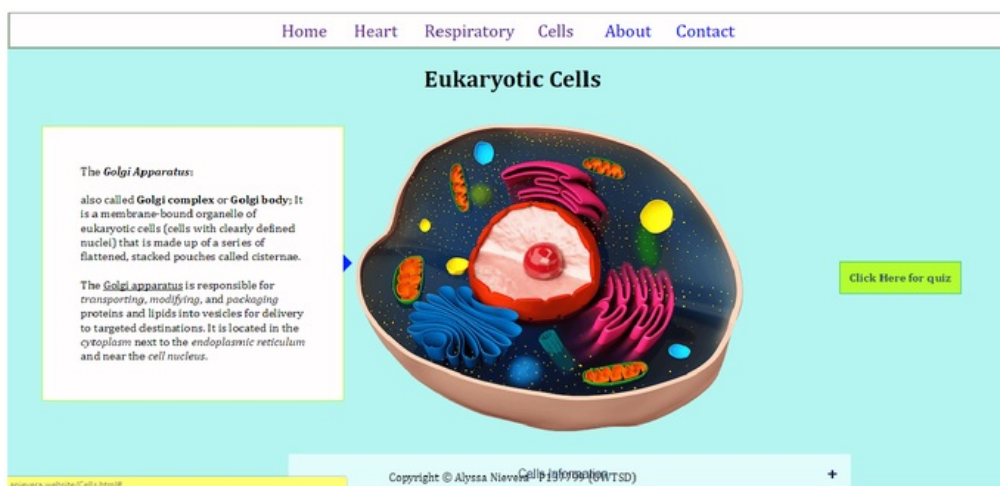
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APPENDICES.

[1] Gantt Chart Illustration of the process followed for the implementation of the project.



[2] Website Screenshots:





Cells Information

Click Here for quiz

Like a prokaryotic cell, a eukaryotic cell has a plasma membrane, cytoplasm, and ribosomes. However, unlike prokaryotic cells, eukaryotic cells have:

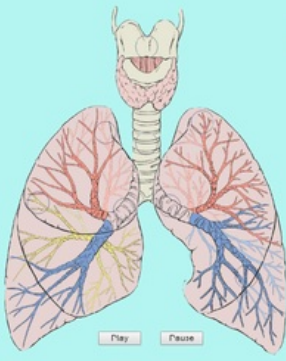
1. a membrane-bound nucleus
2. numerous membrane-bound organelles (including the endoplasmic reticulum, Golgi apparatus, chloroplasts, and mitochondria)
3. several rod-shaped chromosomes

Because a eukaryotic cell's nucleus is surrounded by a membrane, it is often said to have a "true nucleus." Organelles (meaning "little organ") have specialized cellular roles, just as the organs of your body have specialized roles. They allow different functions to be compartmentalized in different areas of the cell.

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Home Heart Respiratory Cells About Contact

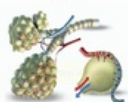
Respiratory



Play

Pause

Alveoli



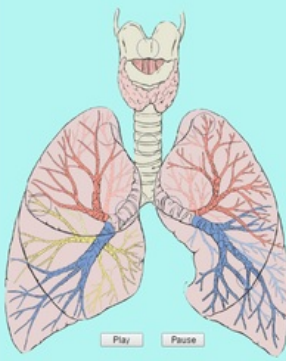
The final branches of the respiratory tree is called the **Alveoli**. The alveoli are where oxygen from the air enters your blood, and carbon dioxide from your body is expelled back into the air.

Process: Air enters the body through the nose or mouth, passes through the larynx, down the trachea, and into our lungs.

Once it is in your lungs, air goes through a maze of smaller and smaller bronchial tubes until it reaches clusters of tiny sacs called the alveoli. In appearance they are somewhat like bunches of grapes.

Home Heart Respiratory Cells About Contact

Respiratory



Play

Pause

Lungs Information

The Lung is an air-breathing vertebrates, either of the two large organs of respiration located in the chest cavity and responsible for adding oxygen to and removing carbon dioxide from the blood.

In humans each lung is enclosed in a thin membranous sac called the pleura, and each is connected with the trachea (windpipe) by its main bronchus (large air passageway) and with the heart by the pulmonary arteries.

The lungs are soft, light, spongy elastic organs that normally, after birth, always contain some air. If healthy, they will float in water and crackle when squeezed; diseased lungs sink.

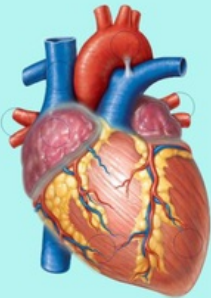
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Heart Diagram

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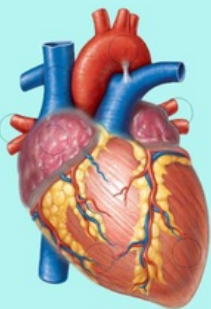
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Right atrium

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The **Atrium** , in vertebrates and the higher invertebrates, heart chamber that receives blood into the heart and drives it into a ventricle, or chamber, for pumping blood away from the heart.

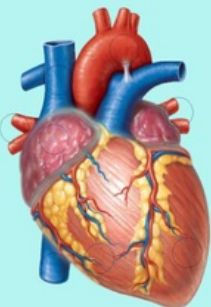
In humans the **atria** are the two upper chambers of the heart. Each is roughly cube-shaped.

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Quiz

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The Atrium is split into two sections, they are the _____ & _____

Top & Bottom Atrium

Left & Right Ventricle

Left & Right Atrium

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About

This Website is created to give students/learners an experience on how an e-learning website that contains animations would be like.



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