IMPACTS OF MODES OF GAMIFICATION ON SENIOR SECONDARY SCHOOL STUDENTS' LEARNING OUTCOMES IN PHYSICS IN ONDO CITY, NIGERIA

BY

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CERTIFICATION

This is to certify that this research work was carried out by Olaide Gbemisola KOMOLAFE under my supervision in the Department of Science and Technology Education, Faculty of Education, University of Ibadan, Ibadan, Nigeria.

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DEDICATION

This work is dedicated to God Almighty, the giver of life, and my late mother: Mrs. Christianah Tomike Fasan

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ABSTRACT

Physics is an important science subject that should be given a solid foundation at secondary school level. However, reports have shown that students, especially in Ondo city, Nigeria, considered it as a difficult subject due to its abstract nature. Previous studies focused largely on predisposing students' factors with less attention paid to interventions, such as Storytelling Points and Levels Strategy (SPLS) and Storytelling Leaderboards and Badges Strategy (SLBS), which are interactive, capable of making learning fun, and providing opportunity for students to see real- world application in physics. This study, therefore, was carried out to determine the impact of modes of gamification of SPLS and SLBS on senior secondary school (SSS) students' learning outcomes (motivation, interest and achievement) in physics in Ondo, Nigeria. The moderating effects of gender and computer self-efficacy were also examined.

The Social Determination and Flow theories provided the framework, while the pretest-posttest control group quasi experimental design using a 3x2x2 factorial matrix was adopted. Six public SSS with functional computers and standby generators were purposively selected. The participants in the schools were randomly assigned to SPLS (84), SBLS (56) and control (81) groups. The instruments used were Instructional guides, Physics Achievement Test (r=0.75), Student Motivation in Physics (r=0.94), Students' Interest in Physics (r=0.70), Computer Self Efficacy (r=0.73) scales. The treatment lasted 12 weeks. Data were analysed using Analysis of covariance and Bonferroni post-hoc test at 0.05 level of significance.

The participants' age was 17.50±2.30 years and they were mostly males (62.9%) with a high level of computer self-efficacy (65.5%). There were significant main effects of treatment on students' Motivation (F (2, 206) =14.44; partial $\eta 2$=0.12), Interest (F (2, 206) = 14.17; partial $\eta 2$=0.12) and Achievement (F (2, 206) = 16.19; partial $\eta 2$=0.14) in physics. The students exposed to SPLS had the highest adjusted post-motivation mean (78.63), followed by SLBS (75.34) and control (69.71) groups. The students in SPLS had the highest adjusted post-interest mean score in physics (34.10), followed by SBLS (32.62) and control (30.61) groups. The students exposed to SPLS group also had the highest adjusted post achievement mean score in physics (23.13), followed by SBLS (22.98) and control (18.03) groups. There were no significant main effect of gender and computer self-efficacy on students' learning outcomes in physics. There were no significant two-way and three-way interaction effects on learning outcomes in physics.

Storytelling points and levels and storytelling badges and leaderboards strategies improved secondary school students' motivation, interest and achievement in physics in Ondo, Nigeria. Teachers should adopt these strategies for improved learning outcomes in physics.

Keywords: Storytelling points and levels strategy, Storytelling badges and leaderboards strategy, Computer self-efficacy, Achievement in physics.

Word count: 420

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Physics is one of the vital subject that is needed for economic improvement of any nation as it helps in the development of information on the natural world (Erinosho, 2013). Consequently, Physics instruction and enquiry plays a key role in the search of a country's development. On a more extensive scale, the degree of improvement of any country is relies on the degree of its obtaining and use of mechanical developments, which in turn cannot be accomplished without working knowledge of Physic (Mbamara and Eya, 2015).

In Nigerian colleges and tertiary institutions, Physics subject is one of the compulsory/basic subjects for the investigation of engineering, innovation-related controls, medicine, and other applied science courses. Accordingly, the teaching and learning of Physics ought to be given due consideration across all degrees of education (Ojediran, 2016). The necessity of the subject for secondary school science students is such that no candidate can be admitted into any institution of higher learning to study engineering, medicine, pure and applied sciences, environmental science and technical education without at least a credit pass in physics .This is the reason Agommuoh and Ifeanacho (2013) affirmed that Physics is a core science subject that ought to be given a strong background from secondary school level of education to guarantee that students are equipped with applicable information, abilities and capabilities to seek after other science-related courses that are vital to the development and advancement of nations across the globe.

Regardless of the essential impact of this subject (Physics) in general advancement of any country, the degree to which expected secondary school students opt for the subject at various degrees of schooling has been on the decrease (Adeyemo, 2010).

Despite the strategic roles of physics in the overall development of any nation, the level of enrolment for the subject at different levels of education has been on the decrease, and this has become a worrisome issue for scholars and other stakeholders in education. Also, the performance of secondary students in physics has remained slightly average over the years. The result from the West Africa Examination Council (WAEC) had shown that the failure rate is as high as 60% in the year 2015 and there is inconsistency in the performances over the years. It should be noted that physics is a practical-oriented subject that equips students with the requisite skills to solve personal and societal challenges. Thus, this level of enrolment and poor performance would not allow Nigeria to produce citizens who would be equipped with relevant skills and competencies to function effectively in this digital age. In this wise, there is a need to address the issues that are related to the low level of enrolment and poor performance in physics at the secondary school level to ensure that students can pursue their degrees in other science-related disciplines in higher institutions.

In contrast with other science subjects like Biology and Chemistry, fewer students decide to consider Physics at secondary school level laying claim to the instructional difficulties of the subject. This misconception about Physics has been extended to a higher level of education. It has been seen that in Nigerian Colleges of Education, the Physics Department have observed scarcity of students which has brought about the shortage of Physics educators in secondary schools in Nigeria (Erinosho, 2013; Adeyemo, 2010).

Table 1.1 Performance of Physics Students in West African Senior School Certificate Examination 2010-2019

Year	No of candidates	Credit (1-6)%	Pass (7-8)%	Fail (9)%	Total failure (7-9)%
2010	463775	51.27	26.40	18.27	44.67
2011	563161	63.94	24.30	11.76	36.06
2012	624658	68.74	22.06	9.20	31.26
2013	638857	46.62	27.62	22.92	50.54
2014	644391	60.21	24.83	12.58	37.41
2015	605248	40.02	25.36	34.62	59.98
2016	666901	76.27	16.05	5.52	21.57
2017	709481	53.10	27.43	17.40	44.83
2018	727733	78.40	13.95	4.85	18.80
2019	742394	76.95	14.69	5.73	20.42

Source: Research and Statistics Unit, West African Examination Council, Yaba, Lagos, Nigeria

Table 1.1 shows inconsistency in the performance of students within the years under review. The WASSCE results over a ten-year period (2010-2019) indicate poor and average performance of students in Physics. The failure rate is as high as 60% in the year 2015. This has affected the number of students qualified to study Physics at a higher level of education in the country. Students need to perform well above average to show that they possess solid foundation in Physics before proceeding to higher institutions to pursue Physics-related courses that would help in the development of the society and the world at large.

Scholars have identified reasons for the low enrolment and poor performance which has been attributed to the methods of instructional delivery in Physics classrooms, especially at the secondary school level. Furthermore, Ogunleye and Babajide (2011) indicated in their study that students' poor attitude towards Physics is as a result of perceived abstract and difficult nature of Physics instructional strategy that results in lack of motivation on the part of the learner and poor methodology by the teachers. This implies that the challenges of poor performance and low level of enrolment in Physics are encompassing and are deeply rooted in teachers and student-related factors. In a study, Ogunleye and Babajide (2011) affirmed that the major causes of poor performance and low level of enrolment in Physics are students' misconception about the subject; inadequate exposure and motivation; students' negative interest towards Physics; insufficient Physics teachers; teaching methods and ill- equipped Physics laboratories for practical tasks.

Motivation refers to psychological processes that are responsible for initiating and continuing goal-directed behaviours, (Robinson and Bellotti, 2013). Motivation is a crucial issue that is considered as influencing students' learning in school. It tends to be characterized as any cycle that starts and keeps up learning conduct. Motivation is significant for learning since students cannot learn except they are persuaded (Ali, Ismail, and Sedef, 2010). In this way, understanding motivation is vital for planning an instructional cycle that can draw in students towards the topic at various degrees of education (Saleh, 2104). If the content of the subject matter has motivating components, students would be interested in the classroom activities and they would no longer consider Physics as a difficult subject. In other words, when students are well motivated to be part of instructional activities, their performance in Physics could improve significantly and this could result in increase in the level of enrolment and better performance at the secondary school level. Thus, motivation is an important variable that should be properly examined when considering students' performance in Physics at different levels of education. It is imperative to note that motivation propels students' interest to become active participants in instructional activities. Students develop the interest to learn instructional content when they are motivated to be active participants in the instructional process. Therefore, motivation and interest are different concepts that are inextricably linked to facilitate the teaching-learning process.

The dwindling capability of learners to perform as expected in Physics could be attributed also to teacher and student-related factors, poor motivation to learn the instructional content, and lack of interest in the subject matter can largely be associated with the teaching approach employed by teachers in the instructional delivery process. These methods of instruction of teacher centered method take students far away from the Physics concepts and a significant number of them would not be able to apply the knowledge to solve personal and societal challenges in the future. Using the lecture method, as it were, makes Physics concepts to be abstract and unconnected to a real-life situation. In this wise, students would not be motivated to learn the instructional content and this could result in loss of interest in the subject matter. These challenges can easily be overcome with the appropriate use of technological tools or technology-based strategies that could motivate learners and stimulate their interest in physics. The application of ICT in physics instructions could help expand learning opportunities, access to educational resources, and facilitate the education process (Millerand Robertson, 2010). Different technology-based strategies like simulation, online instruction, and other interactive packages had been used to facilitate instructional delivery in Physics classrooms. Many of these strategies are focused on the need to improve students' academic performance in Physics, especially at the secondary school level of education

However, effective teaching and learning of Physics and Physics-related concepts transcend the issue of students having credit passes in internal and external examinations. The instructional content needs to be loaded with motivating components to stimulate students' interest and engage them with the content of the subject. This would lay a solid foundation to pursue this important subject at a higher level of education and perform better in internal and external examinations. It would also strengthen students' capabilities to effectively apply the knowledge and competence gained in the classroom to solve personal and societal challenges. With this steps in place, Physics instruction becomes less abstract and more realistic because concepts are connected to a real-life situation. Along these lines, spurring students to gain proficiency with the instructional substance could prompt improved students' interest in Physics. Hence, there is a requirement for an instructional-methodology that improves students' degree of motivation and supports their advantage in the instructional substance. One of such requirement that can be integrated in improving learners' ability is gamification.

Gamification allows the use of game elements in instructional delivery. The game elements are the regular design of patterns that are used to design games. Some of these elements, sometimes described as components, as seen in most of the games nowadays, including points, badges, leaderboards, storytelling, progress bars/progression charts, performance graphs, quests, levels, avatars, social elements, and rewards. The points indicate the numeric accumulation based on certain activities, badges are the visual representation of achievements, and leaderboards show how the players are ranked based on success while progression shows the status of a player. In the same vein, storytelling provides context for the application of tasks, levels are section of the game; social elements show the relationships with other users through the game while reward indicates a system to motivate players that accomplish a quest. All these elements have different purposes and can be adapted to any work, business, or education-related environment.

Within the context of this study, the instructional content was gamified with five-game elements to motivate learners, arouse their interest, and also improve their performance in Physics at the secondary school level of education. These elements are storytelling, points, badges, levels, and leaderboards. In this research, storytelling, points, and levels are game elements that will be combined to form one instructional strategy for the study. Another instructional strategy will combine storytelling, badges, and leaderboards. This is done to determine the capabilities of these combined elements to motivate learners, arouse their interest, and improve their performance in Physics instruction.

While considering gamifying physics concepts, some variables or factors that may interfere with the instructional process that needs to be moderated are gender, age, attitude, technology self-efficacy, and computer self-efficacy. However, gender and computer self-efficacy would be adopted as moderator variables in the study, based on their strategic importance in influencing game-related activities and learning of physics. Gender is a variable whose influence on students' learning outcomes has been vigorously examined by researchers. Kessels, Rau, and Hannover (2006) found that female students lack interest in physics compared to male students. Female students claimed that physics is difficult for them because the subject aligns more to the masculine nature. The issue of gender is very important in this study even though the effect of gender seems to be controversial.

Many studies have revealed that the combination of gender and computer self-efficacy (CSE) could determine students' participation in computer-related activities in the classroom and learning of Physics in particular (Olatundun, 2008; Okoye, 2010). Results from these studies, however, have been inconsistent and research findings are inconclusive with regards to the effect of gender and computer self-efficacy on computer use. Tella and Mutula (2008) found in their study that there is marked significant difference in application and use of the computer by male and female. Durndell, Hagg, and Laithwaite (2000) found that in general, male students had higher computer self-efficacy than females and this was more so with advanced as opposed to beginning skills.

Hence, gender could be a potential factor that determines achievement, motivation, or interest in a computer-dependent learning environment. Pearson, Sheng, and Crosby (2003) suggested that students with higher CSE are likely to be more enthusiastic to use technology in their classrooms than those with lower self-efficacy. This study, therefore, would examine the impact of gamifying physics concepts on students' motivation, interest, and achievement of students in physics in Ondo city Nigeria

1.2 Statement of the problem

Physics remains a strategic science subject that could engender the technological development of different countries across the world. However, the observed inconsistency in the performance of Physics students and declining enrolment at the secondary school level has been a cause for concern. Scholars have consistently advocated the need to employ modern technology-based instructional strategies that ensure the active engagement of students in classroom activities and motivate them to give attention to the details of the instructional content. Studies have revealed that learning physics should create joys of discovery. However, this has been hampered by the fear of failure, lack of motivation, and interest.

Past studies have concentrated largely on the use of technologies like simulation, interactive videos, mobile instruction, online instruction, among others, to improve academic achievement in physics, especially at the senior secondary school level. However, there is more to the teaching and learning of physics than students scoring high marks. The instructional content needs to be incorporated with elements that could motivate students and arouse their interest in physics. The instructional substance should be fused with components that could inspire students and stir their interest in Physics. These are instructional difficulties that could be overcome with the appropriate integration of gamification into classroom exercises. This could have ripple effects on the students' performance and rate of enrolment as well as promoting the application of physics concepts in solving personal and societal problems. Physics instructors could, therefore, leverage the capabilities of game elements in gamification to solve the fundamental challenges in the teaching and learning of physics in secondary schools. This research was therefore carried out to determine the impact of gamification on students' motivation, interest, and achievement in Physics in senior secondary schools.

1.3 Objectives of the study

The main purpose of this research is to determine the impact of gamification on senior secondary school students' motivation, interest and achievement in Physics. The specific objectives of this study are to:

1. determine the difference(s) in the posttest performance of students exposed to gamified instructional packages and their counterparts using the conventional method.

2. determine the difference(s) in the posttest performance of students exposed to storytelling points and levels instructional packages and their counterpart using the conventional method.
3. determine the difference(s) in the posttest performance of students exposed to storytelling badges and leaderboards instructional packages and their counterpart using the conventional method.
4. determine the motivation of students towards the use of gamified instructional packages.
5. determine the interest of students towards the use of gamified instructional packages.

1.4 Hypotheses

The following seven null hypotheses were tested at 0.05 level of significance.

Ho 1: There is no significant main effect of treatment on students' motivation, interest and achievement in Physics

Ho 2: There is no significant main effect of gender on students' motivation, interest and achievement in Physics

Ho 3: There is no significant main effect of computer self-efficacy on students' motivation, interest and achievement in Physics

Ho 4: There is no significant interaction effect of intervention and gender on students' motivation, interest and achievement in Physics

Ho 5: There is no significant interaction effect of treatment and computer self-efficacy on students' motivation, interest and achievement in Physics

Ho 6: There is no significant interaction effect of gender and computer self-efficacy on students' motivation, interest and achievement in Physics

Ho 7: There is no significant interaction effect of treatment, gender and computer self-efficacy on students' motivation, interest and achievement in Physics

1.5 Scope of the study

This study examined the development of gamification and its impact on students' motivation, interest, and achievement in Physics in Ondo city. Six state-owned senior secondary schools were selected to participate in the study. Three fundamental topics that were strategic to all the seven topics identified from the baseline study were selected to develop a gamified package for Physics classroom instruction. ‘Waves’ as a topic is central to the study of concepts like propagation of sound waves and reflection of light waves which were part of the identified seven perceived difficult topics identified from the baseline study made by the researcher. Therefore, the three central topics used for the gamified package were:

i. Waves
ii. Equilibrium of forces
iii. Heat energy- the measurement of heat

Senior secondary school II Physics students in six schools were used for the study. Gender and computer self-efficacy were used as moderator variables to examine their moderating effects on the learning outcomes. Also, motivation towards learning Physics, interest in Physics and achievement in Physics were the learning outcomes in the study

1.6 Significance of the Study

This investigation gives a mediation that could demystify teaching and learning of difficult Physics concepts to motivate and interest students and thus promote students’ improved learning outcomes at the senior secondary school level. Improved motivation and interest could bring about better scholarly achievement in Physics at this level of education. It is also expected that this study provides a suitable platform for the educational policymakers to integrate appropriate technological tools into the Physics curriculum that could arouse learners’ interest, motivation and improve the performance of Physics in secondary schools. Thus**,** the discoveries from this investigation are required to give experimental information on the utilization of game components in instructions and the impact of mediator factors like computer self-efficacy and gender on gamified content. This could give a policy direction to educate stakeholders on how to overcome the challenges of abstractness, inadequate motivation, interest faced by students, and achievement in the learning of Physics in secondary schools.

1.7 Operational definition of terms

The following terms are operationally defined as used in the study:

Gamification strategy: is the use of game elements such as storytelling, points, levels, badges, and leaderboards to engage senior secondary school Physics students in instructional content.

Student Motivation in Physics- the willingness of SS II students to actively participate in Physics instructional activities, as measured by the Questionnaire of students' motivation in Physics (QSMP).

Student Interest in Physics: the desire of students to engage in intellectual curiosity about different concepts in Physics as measured by the Questionnaire of students' interest in Physics (QSIP).

Student Physics Achievement: is the performance of students in Physics as measured by Physics concepts achievement test (PCAT)

Points: are rewards given to Physics students while using the gamified package.

Badges: a recognition of Physics students' efforts reaching new levels or completing challenges.

Levels: are a system, or ramp, by which Physics students are rewarded by increasing value for accumulating points.

Leader boards is a board used to track and display Physics students' desired actions, using competition to drive valuable behaviour.

Storytelling: This is the process of using computers to create stories around different concepts in Physics, which could be used by students in Nigerian secondary schools.

Computer self-efficacy: is a belief of Physics students' capability to use the computer to play gamified concepts in the subject as measured by Physics students' computer self-efficacy scale (CSES).

CHAPTER TWO

LITERATURE REVIEW

This part manages the theoretical framework, conceptual review, empirical review and an appraisal of the literature.

The review of writing covered the following areas which are:

2.1 Theoretical framework

2.2 Conceptual review

2.3 Empirical review

2.4 Appraisal of the literature

2.1 Theoretical framework

2.1 The Theoretical Framework

2.1.1 Self-determination theory

The Self-determination theory (SDT) was developed over the last 50 years by Ryan and Deci (2000). It has its roots in humanistic psychology and it follows the hierarchy of human needs by Maslow (1943). The fulfillment of basic human needs described in the Self-Determination Theory (henceforth, SDT) is a resource of personal growth and psychological well-being. According to Ryan and Deci (2000), every human being tries to gain as much autonomy over its actions and decisions as possible. Likewise, humans strive for competence in their actions and surroundings. These two needs are essential but as activities such as learning often happen in a social context (for instance, classroom) a third factor is proposed: relatedness. Studies have shown that a context of security, warmth, and autonomy support created by a parent or a teacher fosters intrinsic motivation and exploratory behavior (Anderson, Manoogian, & Reznick, 1976; Bowlby, 1976). The fulfillment of the three basic needs, competence, autonomy, and relatedness does not rely on objective judgment but personal perception.

However, these needs cannot be fulfilled completely except if every agent sets out to act as the source of intrinsic motivation. In self-determination the SDT, three basic psychological and intrinsic needs are postulated: the need for competence, the need for autonomy, and the need for social relatedness (Deci and Ryan, 1985; Ryan, 1995; Ryan and Deci, 2002). The need for competence refers to feelings of efficiency and success while interacting with the environment (White, 1959; Rigby and Ryan, 2011; Vansteenkiste and Ryan, 2013). It is assumed that every human strives to feel competent when deliberately influencing the environment they interact with. The need for competence can be addressed by points, badges, or leaderboards (Sailer et al., 2013; Hense *et al*., 2014). Points provide the player with granular feedback, which can be directly connected to the actions of the player. Badges and leaderboards assess a series of player actions and in doing so provide cumulative feedback (Rigby and Ryan, 2011). Thus, essentially, it is the feedback function of these game design elements that can evoke feelings of competence, as this directly communicates the success of a player's actions.

The need for autonomy refers to psychological freedom and volition to fulfill a certain task (van den Broeck, Vansteenkiste, Witte, Soenens and Lens, 2010; Vansteenkiste, Niemiec and Soenens, 2010; Vansteenkiste, Williams and Resnicow, 2012). While psychological freedom refers to the feeling of making decisions based on one's own values and interests (Ryan and Deci, 2002; Deci and Ryan, 2012), volition refers to the feeling of acting without external pressure or enforcement (Vansteenkiste *et al*., 2010). The need for autonomy includes two aspects: experiences of decision freedom, and experiences of task meaningfulness. In the first aspect (autonomy concerning freedom of decision), avatars are relevant, as they offer the players freedom of choice (Annetta, 2010; Peng, Lin, Pfeiffer and Winn, 2012). In the second aspect (autonomy concerning task meaningfulness), stories play an important role. Stories can help players experience their actions as meaningful and volitionally engaging, regardless of whether choices are available (Rigby &Ryan, 2011).

The need for social relatedness refers to one's feelings of belonging, attachment, and care about a group of significant others. It represents the basic desire of the individual for coherent integration with the social environment (Deci and Ryan, 1985, 2000; Baumeister and Leary, 1995; Deci and Vansteenkiste, 2004). The need for social relatedness can also be affected by a story if it offers a narrative frame in which the player is given a meaningful role. Together with teammates, who can be real co-players or non-player characters, a sense of relevance can be evoked by emphasizing the importance of the players'(Ryan and Deci, 2002; Deci and Ryan, 2012;), volition refers to the feeling of acting without external pressure or enforcement (Vansteenkiste *et al*., 2010)

Gamification as a whole is supported by the self-determination perspective, which advocates that controlling and mastering a situation fulfills the key psychological needs for competence, autonomy, and relatedness, because any type of gamer seeks to control and master the game or gamified platform at hand.

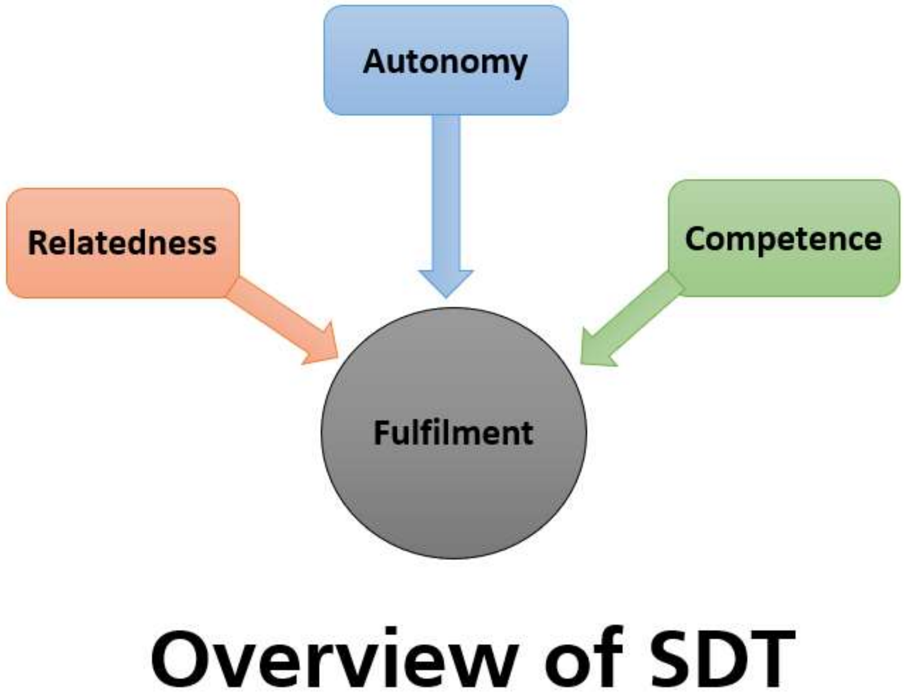

Figure 2.1: Overview of Self-Determination Theory

Instructional content must be packaged such that these three needs are progressively developed and monitored in the educational setting. Gamification develops these strategic areas of human activities by engaging students in instructional content. This implies that gamification could find its root in self-determination theory.

2.1.2 Flow theory

Csikszentmihalyi's theory of flow (1990) theory, which has its root in positive psychology, has been used to describe the best possible design in many studies and can already be called a classic in human-computer interaction research. Despite flow being more of a process and SDT being a theory of motivation that is including factors like personality, development and social context, they do have overlaps (Kowal and Fortier, 1999). Flow is considered as the optimal experience, a state of mind and body with absorption and enjoyment. When everything comes together and we feel focused and involved in the task at hand, we experience flow (Jackson, 2012). Csikszentmihalyi also called flow the autotelic experience, which means doing something for its own sake – a concept related to intrinsic motivation. The complexity of the task which one is carrying out does not influence flow; it can occur during most complex surgical procedures or a simple game of tag. Indeed, Kowal and Fortier (1999) have shown that flow can occur in a myriad of life domains, such as school, work, leisure and sports. Csikszentmihalyi (1990) has postulated nine dimensions that should together represent the optimal psychological state of flow. These conceptual elements are 1) challenge-skill balance; 2) action-awareness merging; 3) clear goals; 4) unambiguous feedback; 5) concentration on task; 6) sense of control; 7) loss of self-consciousness; 8) time transformation; and 9) autotelic experience. The first three elements, challenge-skill balance, action-awareness merging, and clear goals are pre-conditions of flow (Csikszentmihalyi, 1990).

The dynamic challenge-skill balance is probably the core element of the flow concept. To experience flow, both the challenge of the situation and the skill to meet the challenge needs to be at an individually high level (Jackson, 2012). This balance is called the flow channel. As Figure 2.2 depicts, if one is above the flow channel (that is the skill cannot meet the challenge) anxiety is likely to occur. In the opposite case, the result is boredom. What matters is only the perception of the challenge and skill level, not the objective analysis.

The action awareness merging dimension describes the feeling of oneness with the activity (Jackson, 2012). People being in the state of flow often report as perceiving the activity as spontaneous or automatic with a sense of effortlessness (Csikszentmihalyi, 1990). In the clear goals and unambiguous feedback, people experiencing flow report a sense of knowing what they are supposed to do (Jackson, 2012). Clear goals together with unambiguous feedback allow people to check their progress in a task anytime. Feedback can be both internal, such as body tension, and external. This aspect is related to competence in SDT.

In the concentration on the task at hand, one tends to forget about all the unpleasant aspects of life and the thoughts do not wander but rather are focused on the task to accomplish. It is also described as a pure mental order without any irrelevant information (Csikszentmihalyi, 1990).

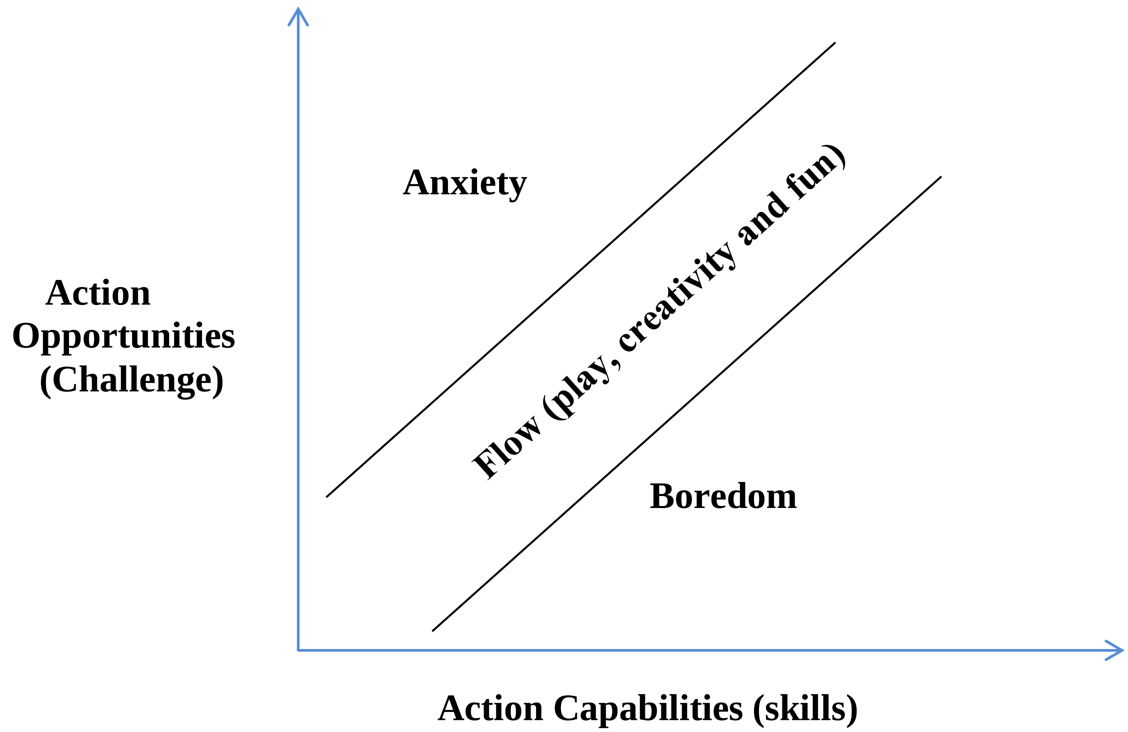

Figure 2.2 Flow Channel

Source: Nakamura and Csikszentmihalyi (2002)

The sense of control also includes a feeling of the liberation of the fear of failure and a feeling of empowerment. The task or activity is approached positively. It is necessary to expect one to be in control because the sense of control keeps the flow alive as long as it is not too strong and reduces the feeling of challenge (Jackson, 2012). Due to flow, total absorption in the activity leaves no room to worry about self-evaluation or evaluations of others in the loss of self-consciousness dimension. Hence, flow can be considered liberating (Jackson, 2012).Another frequently mentioned flow by-product is the transformation of the perception of time. For some, time seems to slow or stop and others perceive time to pass quicker than usual (Jackson, 2012). An autotelic experience is an experience so enjoyable and rewarding that one is motivated to repeat it (Jackson, 2012). This is considered the result of the other eight factors that enable flow (Csikszentmihalyi, 1990). It is striking how this experience resembles the concept of intrinsic motivation within SDT. This and other similarities will be reviewed in the discussion. The existence of a challenging situation is necessary to induce a state of flow. The balance between challenge and skills during flow must be maintained very carefully.

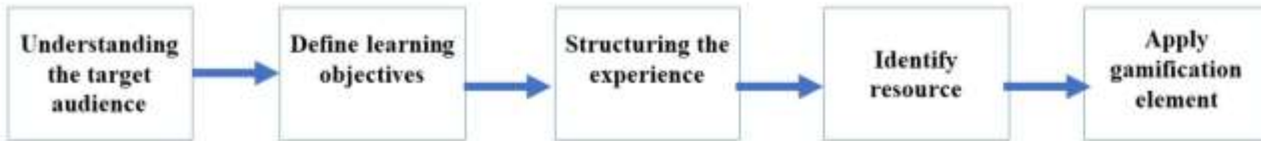

Figure 2.3. Educational Gamification Five-Step Model
Source: Huang and Soman (2013) and Figueroa (2015).

2.1.3 Gamification model

Step one relates to understanding the target audience and the context; the instructor needs to know who his or her students are. A combination of the target audience is necessary along with analysing the context to understand several key factors like group size, environment skills sequence, and length. This step is where the pain points are exposed. Pain points are real problems, which make an entrepreneur look for solutions. In education, there are some common pain points like focus, motivation, skills, pride, learning environment and nature of the course, and physical, mental, and emotional factors. By understanding these points, the educator will be ready to determine the gamification elements to implement. In this study, perceived difficulty Physics topics are the pain points that need to be gamified. Step two involves defining the learning objectives, which necessary for a successful teaching and learning experience. The objectives need to have general instructional goals, specific learning goals, and behavioural goals. To have a successful learning experience through gamification, the instructor needs to have the ability to combine and implementing the learning objectives and in this gamified package, instructional objectives are stated at the beginning of each topic.

Step three is structuring the experience; and it emphasizes the need to break down the program and identify the main points. In this stage, the instructor prepares the sequence and quantifies what the student needs to learn and achieve by the end of each stage. If students are lagging, the instructor needs to re-think and provide a push for motivation (gamification elements) for the student to complete the stage. The educator needs to move his educational program from simple to complex by starting with easier milestones so that the student stays engaged and motivated. The push for motivation in the package is the game elements used in this package- the audio animated stories of the animal kingdom in teaching the physics concepts, the collection of points and levels, leaderboards colour changes and badges received as the students' progress in the use of the gamified package.

Step four is identifying resources, where the instructor may have complete assurance of which stage can or cannot be gamified. The instructor needs to reflect on several aspects that need to be considered. These are: tracking mechanisms, points, levels, rules, and feedback. All these were put in place in the gamified package. The baseline study generated the required topics to be gamified.

Step five involves applying gamification elements. In this step, the educator or teacher decides which gamification elements should be applied. For this research, two instructional strategies will be used which are Storytelling, Points, levels, and Storytelling, Badges and Leaderboards will be used as gamification strategies. Storytelling is used in the two strategies to concretize the abstractness of the perceived difficult topics.

The diagrammatic structure in the figure underneath expressly clarifies the gamify teaching methodology;

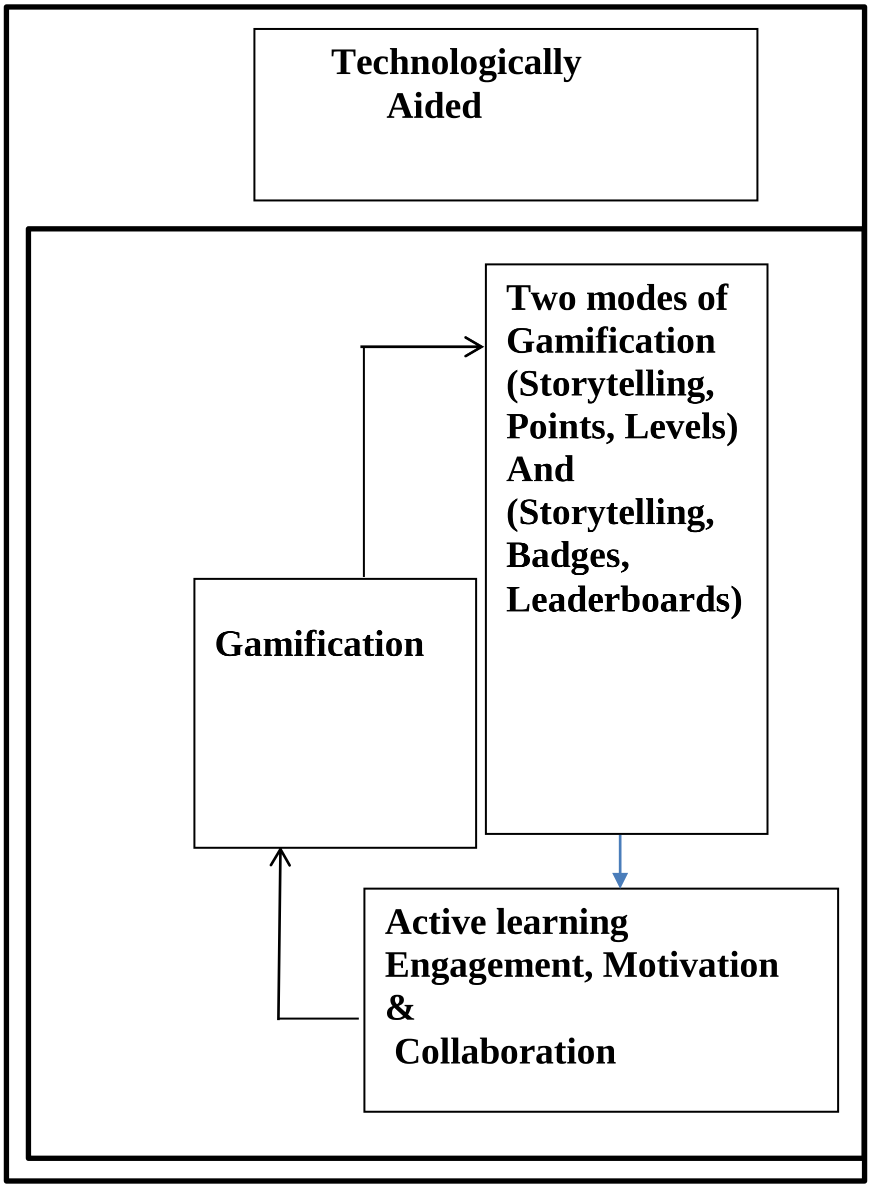

Figure.2.4 Visual Representation of Gamification

2.2 Conceptual review

2.2.1 Physics as a Science Subject

Physics is viewed as the most problematic area within the domain of science, and which traditionally attracts fewer students compared to other sciences like chemistry and biology (Ryan, 2013). Most of the students perceived physics as a difficult subject at the secondary school level and this becomes more problematic when they are in polytechnics/colleges, and even more challenging at the university level of education. Oladejo, Olosunde, Ojebisi, and Isola (2011) affirmed that Physics is one of the science subjects that is difficult to understand by secondary school students. . Many physics students have the wrong conception of the subject prior to the beginning of its learning, and it is considered boring and unappealing (Hirschfeld, 2012). Numerous students mistakenly believed that Physics only deals with computations (critical thinking) using mathematical equation and unique calculations. . Based on this, students believe that physics is difficult, abstract, uninteresting, and theoretical with a resultant effect on the level of enrolment for the subject at different levels of education and poor performance in the course (Adeyemo, 2010, Dough 2010).

Physics is a part of science that manages energy and matter and their communications. It is in some cases alluded to as the study of estimation and its information has contributed significantly to the creation of instruments and gadgets that give colossal advantages to humankind. In Nigeria, Physics is one of the science subjects at the senior school level and its branches incorporate mechanics, optics, heat, electricity nuclear Physics, and Physics of sub-nuclear particles. The significance of Physics cannot be over-underlined as it shapes the reason for the innovative progression of any country. Its investigation is integral to activities in a few logical fields and professions, for example, engineering, assembling, mining, and construction ventures. Additionally, information on Physics assumes a huge part in the financial advancement of any country. As a result of the enormous relevance of this subject, it has been introduced in Nigerian secondary schools at the senior level to achieve the following objectives:

(i) to provide a basic literacy in Physics for functional living in the society;

(ii) to acquire basic concepts and principles of Physics as a preparation for further studies;

(iii) to acquire essential scientific skills and attitudes as a preparation for the technological

application of Physics, and

(iv) to stimulate and enhance creativity (Federal Ministry of Education, 2008 pg.28).

Physics challenges our creative mind with ideas like relativity and string theory which prompts extraordinary revelations and innovations that transform us. Its significance cannot yet over-underscored, consequently the requirement for all residents to consider the subject with most extreme understanding. The ideas and standards of Physics are applied in different every day exercises, for example, innovation, transportation, correspondence, power generation, and space revelation, and investigation. Physics has contributed such a great amount towards the turn of events and prosperity of man particularly in this period of science and innovation. (Educational program Advancement Centre, 2002).

2.2.2 Problems and Challenges of Teaching Physics in Senior Secondary Schools

The educating and learning of Physics is being gone up against with hordes of difficulties, particularly at the senior secondary school level of training. These instructional difficulties going from insufficient showing approach by a Physics instructor, unfit educators, wrong instructional materials, and the absence of inspiration to get familiar with the instructional substance to the absence of interest in Physics ideas. These difficulties have brought about a low degree of enrolment and generally terrible showing in the subject. Physics is considered as the trickiest region inside the domain of science, and it customarily draws in less learners than different sciences like Chemistry and Biology (Ryan, 2013). The greater part of the learners apparent Physics as a troublesome subject at the secondary school stage and this turns out to be more risky when they are in polytechnics/colleges and significantly all the more testing at the college level of instruction. For some students, who join up with science courses, the inspiration is not such an extensive amount characteristic interest as the need to satisfy different necessities, for example, the passage to school or admission to clinical school.

Silverman (2015) asserts that students who will study science must see it as a gift and a pleasure that is worth studying. Oladejo, Olosunde, Ojebisi, and Isola (2011) assert that physics is one of the science subjects found that is difficult for secondary school students. Many physics students have the wrong conception of the subject prior to the beginning of its learning, and it is considered boring and unappealing (Hirschfeld, 2012). Many students erroneously believed that physics only deals with calculations (problem-solving) using equations and special algorithms. They do not understand that there are concepts in physics that require no mathematical solution but only need mental ability to learn it. Based on this, students believe that physics is difficult, abstract, uninteresting, and theoretical with a resultant effect on the level of enrolment for the subject at different levels of education and poor performance in the course (House of Lords, 2006; Adeyemo, 2010, Dough 2010).

In comparison to other science subjects, only a few students choose to study physics at the ordinary level owning to its abstractness. This is generating concerns among science educators, and researchers are increasingly exploring why students avoid the subject. This misconception about physics has been extended to a higher level of education. This has resulted in the scarcity of physicists and teachers of physics in industries and secondary schools respectively. As a matter of fact, in most Nigerian secondary schools, physics is usually taught by those whose areas of specialisation are in other aspects of the sciences and not professionals who studied physics (Ogunleye 2009; Ogunleye and Babajide 2011; Erinosho 2013). Mbamara and Eya (2015) discovered that the major causes of low physics enrolment in schools are students' misconception about the subject; inadequate exposure and motivation; students' negative affective attitude towards mathematics and physics; insufficient physics teachers; insufficient teaching materials; and ill-equipped physics laboratories for practical tasks. Nnachi and Ekpe (2013) note that students' negative attitudes towards physics could be attributed to poor teaching methods, unqualified and inexperienced teachers, poor learning environment, the arrangement pattern of learning spaces, and inadequate instructional materials, (Omosewo 1999; Erinosho 2013).

This implies that teachers and students face unprecedented challenges in the teaching and learning of physics, especially at the secondary school level of education. These challenges need to be properly addressed by educational stakeholders, to ensure that learners acquire requisite skills and competencies to contribute to the growth and development of the society and the world at large. This would engender effective realization of the objectives of teaching physics in secondary schools.

2.2.3 Students' Motivation to Learn Physics

The strategic importance of physics in the nation's development has necessitated the need to ensure that instructional content is configured in such a way that learners are motivated to give attention to the details of the subject at all levels of education. Physics students are not motivated to learn the content as many of them consider the subject as abstract and difficult to understand. Thus, physics content needs to be incorporated with technology and technology-based strategies to motivate and engage learners in classroom activities (Renata, 2015). Motivation refers to psychological processes that are responsible for initiating and continuing goal-directed behaviours, Robinson and Bellotti, (2013). Motivation is a crucial factor affecting students' learning in school. It can be defined as any process that initiates and maintains learning behaviour. Motivation is important for learning because students cannot learn unless they are motivated (Palmer, 2010). Students who have high or strong motivation have been found to possess a more positive attitude towards physics and are willing to learn the subject more effectively and can contribute better in classes and the school's overall development (Ali, Ismail and Sedef, 2010).

Motivation is a complex, multidimensional construct that interacts with cognition to influence learning (Taasoobshirazi & Sinatra, 2011). Students who are motivated to learn will show interest in the subject matter and pay close attention to the details of the instructional content. This shows a close relationship between motivation and interest of students in the content of instruction (Chan and Norlizah, 2017). According to Cavas (2011), student motivation plays a crucial role in science learning, which targeting in promoting student's construction of his/her conceptual understanding of science. Students' motivation towards science learning has contributed a considerable impact on students' science achievement (Janelle, 2011). Students who have high or strong motivation have been found to possess a more positive attitude towards Physics are willing to learn the subject more effectively (Ali, Ismail and Sedef, 2010). The motivation of students is one of the paramount factors that affect the learning process (Korur and Eryilmaz 2018).

Therefore, if teachers give suitable feedback to the students on their level, initiate students' interest through engaging instructional content, make them understand the importance of the content, and have students share their ideas in classroom discussions, then the students' motivation increases as well as their achievement (Smith and Schmidt, 2012).

The content of instruction should be motivated to engage learners in classroom activities. It should be noted that when students are engaged in the subject matter, it propels them to give attention to the details of instructional content and thereby improve their performance in the long run. The implication is that students' level of motivation has direct nexus with their participation in classroom activities and this could influence their performance in the subject. Thus, physics content needs to be motivating, to engage students in the instructional content. This could result in improved performance in the subject and increase the rate of enrolment.

2.2.5 Students' Interest in Physics

Evidence abounds in the literature that interest is strategic to the performance of students in any subject at different levels of education. Interests are considered to be the most important motivational factors in learning and development. The studies carried out around the globe indicated the fact that students acknowledge the importance of natural sciences for life and career but have also pointed out a significant drop in their interest in the study of these subjects (Ciomos, 2010). Students' attitudes are considered to be a key component in the students' appropriating their competences within Natural Sciences and Math and they include the students' motivation, interest and sense of self-effectiveness. The students who value scientific research are confident in their abilities to engage in the scientific-educational process, can solve scientific tasks efficiently, can overcome difficulties in solving scientific problems, use different perspectives and scientific and rational arguments, etc. In other words, they exhibit strong scientific abilities Prokop, Tuncer and Chuda (2011).

Students interested in science manifest a curiosity towards scientific problems and they manifest a desire to enrich their scientific knowledge and abilities. Thus they use a variety of resources and methods and exhibit a desire to search for information, showing interest in a potential career in the scientific area (Organisation for Economic Cooperation and Development, OEDC 2011). Student's interest in Physics at secondary school level can be influenced by some factors including gender, teacher's characteristics, teaching method, school location and level of motivation (Onah and Ugwu, 2010).

Students' interest towards physics is on the decline across the phases of the study. The most pronounced decline in the interest towards Physics, especially for female students, is associated with negative feelings towards the subject in schools (Zara, 2010). Generally, physics education has been characterised by such didactic approaches as lecture methods, discussion and so-called guided inquiry methods which have been carried out haphazardly by relying entirely on textbook as well as rote memorisation (Adeyemo, 2011). This could be due to the abstract nature of some concepts in the subject. Prokop, Tuncer & Chuda (2007) show that students' attitude towards sciences differs from one subject to another and modifies with age. According to this source, the students' attitude towards physics becomes more negative with age while their attitude towards biology becomes more positive with age. Thus, students' interest is a crucial factor that needs to be given due consideration, while planning for teaching and learning of physics at different levels of education.

2.2.6 Students' Achievement in Physics

The strategic importance of physics in the growth and development of any nation cannot be over-emphasised as the subject equips students with a solid foundation to acquire requisite skills and competencies to function effectively in 21st Century society. Thus, stakeholders in science education need to ensure that students are provided with appropriate resources to acquire these important skills to become useful members of the community. Despite the importance and usefulness of physics, secondary school students' achievement in the subjects has not been encouraging and consistent over the years. Investigations reveal that secondary school students' achievement in physics in both internal and external examinations have not been encouraging over the years (Adeyemo, 2011). Many factors could contribute to the students' poor achievement in physics in the senior secondary school certificate examination. Adeyemo, (2010) had identified such factors as students' poor academic background, insufficient qualified teachers, lack of motivation on the part of the teachers and their students and inappropriate teaching methods. Poor academic achievement in physics could be attributed to many factors among which are the teachers' teaching strategies.

This means that physics concepts cannot be well understood if students are not taught with effective teaching strategies. Many researchers have blamed this poor achievement in physics on the use of inappropriate teaching strategies which might lead to a lack of interest and retention of physics concepts among students in the classroom (Ifeanacho, 2012). The inconsistent achievement of students in Physics could be attributed to many factors among which the teacher's strategy itself was considered an important factor. This implies that the mastery of physics concepts might not be fully achieved without the use of appropriate strategies and tools to engage learners in the instructional process. The teaching of Physics without the use of instructional strategies that could engage learners in classroom activities may certainly result in poor academic achievement Oladejo, Olosunde, Ojebisi and Isola (2011). The implication is that teachers need to be creative and efficient in the discharge of their responsibilities by leveraging the capabilities of technology to demystify instructional content and engage learners in teaching-learning activities at all levels of education. Physics teachers could, therefore, explore the capabilities of gamification to improve students' performance in physics, especially at the secondary school level of education.

2.2.6 The Concept of Gamification

The broad use of the term 'gamification' started in 2010. In general, this term is widely accepted and used to refer to the use of game-based elements, such as game mechanics and game dynamics, in non-game contexts to improve people's experience, engagement, motivation, and to create a sense of playfulness (Burke, 2014; Reiners and Wood, 2014; Schönbohm and Urban, 2014). Gamification is the combination of two worlds: work and play; it allows for the enjoyment of playful interactions while at the same time working to produce quality results. Gamification is defined as the application of game elements and theories to "non-game contexts" to modify behaviours, increase fidelity or motivating and engaging users (Deterding *et al.,* 2011, Paharia, 2013). It is a powerful tool that draws from the notion of the changes currently happening in our society regarding the increasing use of technology and the popularity of games. It allows us to understand what is "pleasurable to people" (Xu, Itonululu and Hi, 2011). Gamification takes the "potentially magical power of games and applies this power to a given problem. The term "gamification" captures the idea that certain elements of games can be infused into instructional situations to provide a positive learning outcome without having to create a full-blown learning game. Gamification has been defined as the "process of using game thinking and mechanics to engage audiences and solve problems" (Zichermann, 2010), "using game techniques to make activities more engaging and fun" (Kim, 2011), and "the use of game design elements in non-game contexts" (Deterding *et al*., 2011: 1).

Game mechanics have some distinctive tools which play a key role in gamification. The points-scoring system, competition with others, award of rewards or badges for levels of achievement and display of leaderboards are the specific elements used in the gamification application. In the literature, research on gamification has indicated that it is effective in terms of engaging and motivating people to drive behaviours and effect desired outcomes (Caton and Greenhill, 2014; Cheong, Filippou, and Cheong, 2014; Brigham, 2015; Leaning, 2015). Businesses are the most common users of gamification. In business, gamification "walks the line between an entertaining game and a professional creative solution to a problem". Gamification has been seen to be used for: "changing behaviours, developing skills or innovation".

It is a "non-monetary incentive" strategy that delivers superior results in terms of quality but with low operating costs, Liu, Alexandrova and Nakajima (2011). A company may use gamification for marketing by altering customer behaviour to engage them into purchasing or visiting their website. Internally, Gamification is a creative tactic to motivate employees to increase productivity, develop new skills, or increase their loyalty and involvement in the company Liyakasa (2013). Lastly, they may also use gamification for innovation by engaging users and/or employees to submit creative ideas or solutions. While some people may argue that gamification involves playing at work that will consequently lead to distraction and unproductively, experts would argue otherwise. As Stuart Brown stated in 2009, play is not the opposite of work. Hennessy, Major and

Habler (2012) also argue that "Gamification is a powerful tool for fusing play with work to help organizations teach, persuade, motivate, and develop meaningful brand relationships with partners." The potentials of gamification make it appropriate to engender interaction and engagement in different sectors of the economy, including the education system.

There is a growing interest in the use of gamification in education; many educators have attempted to apply its concept to learning activities. Moreover, several studies have been conducted to show the potential of gamification in teaching and learning. Nevertheless, there is still a need for more studies that report the implications of applying gamification in learning environments (Borges, Durelli, Reis and Isotani, 2014). Gamification of education is the use of game-based elements in a learning environment. It is a new approach and has become a popular technique to enhance instructional outcomes in education. Most studies have demonstrated the usefulness of gamification in education, particularly in increasing students' motivation and engagement. Examples of such studies are Domínguez *et al*., 2013; Kim, 2013; O'Donovan, Gain and Marais, 2013; Ibanez and Manes, 2014; Kuo & Chuang, 2016). Moreover, game elements used in gamification can make learning more fun and interesting for students (Barata, Gama, Jorge and Gonçalves, 2013; Werbach & Hunter, 2012). Thus, it can be used as a potential learning strategy to enhance students' motivation and engagement, to improve the quality of education in general.

2.2.7 Gamification in Education

With the advancement of technology in the 21st century, new pedagogical strategies and tools have continued to evolve. These strategies are developed based on the needs, the environment, and competences of the 21st-century learners, who are digital natives. According to Prensky (2001), digital natives are described as living lives immersed in technology, surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age (Prensky, 2001). The digital natives belong to the Net generation and in many cases, are labeled as 'millennials' (Howe and Strauss, 2000; 2003). According to Mongan-Rallis (2009), the digital native wants to be engaged by the instructor and expected to create and interact with teachers and peers. One of these emerging pedagogical strategies which could be employed by teachers to engage 21st-century learners is Gamification. It is new to education and has adjusted rapidly to the profile of the 21st-century learner or digital native. According to Kingsley and Grabner-Hagen (2015), gamification in education allows the instructor to gamify an activity or a certain literacy skill to engage learners in classroom activities. It integrates game elements and rewards mechanisms as part of the lecture, while motivating and engaging the student, and promoting healthy competition. The students learn a concept and practice skills as if they were playing in a game. This makes the educational experience challenging and fun (Vassileva, 2008) and at the same time motivates the learner to move forward. The objective of integrating gamification in education is to unchain a more attractive and effective learning experience for the student (Figueroa, 2015). Nowadays, more educators are using gamification as part of their teaching strategies. This is due in part to the realisation that appropriate game elements stimulate productivity and creativity. Also, gamification has been successful in non-traditional educational settings such as E-learning.

Traditional schooling is perceived as ineffective and boring by many students. Although teachers continuously seek novel instructional approaches, it is largely agreed that today's schools face major problems around student motivation and engagement (Lee and Hammer, 2011). The use of educational games as learning tools is a promising approach due to the games' abilities to teach and reinforce not only knowledge but also important skills such as problem-solving, collaboration, and communication. Games have remarkable motivational power; they allow for utilisation of several mechanisms to encourage people to engage with them, often without any reward, just for the joy of playing and the possibility to win. Creating a highly engaging, full-blown instructional game however is difficult, time-consuming, and costly (Kapp, 2012), while typically targeting only a single set of learning objectives as chosen by the game designer. Besides, their effective classroom adoption requires certain technical infrastructure and appropriate pedagogical integration. As opposed to using elaborate games that require a large amount of design and development efforts, the gamification approach encourages the use of game thinking and game design elements to improve learners' engagement and motivation. Gamification is a fairly new and rapidly growing field. The concept of gamification is different from that of an educational or serious game. While the latter describes the design of full-fledged games for non-entertainment purposes, “gamified” applications merely employ elements of games. The term “gamification” is quite recent: According to Deterding *et al*. (2011), its first documented use is in 2008 but it did not see widespread adoption before the second half of 2010.

Gamification entered popular culture at the beginning of 2010 and has since penetrated a plethora of domains including business, marketing and education. Whether supported or opposed, what it does is bring together a selection of popular student engagement mechanics under the one umbrella term making them more accessible to educators. Early-adopter academics are inherently intrigued and eager to adopt new technologies with the specific potential for education application, which provides opportunities to further engagement, motivation and loyalty in their students. As such, gamification has been experimentally applied in a variety of classroom situations.

Inspired by Sheldon’s work, de Byl (2013) developed a gamified curriculum in which XP was awarded instead of grades, the ability to level-up by completing extra-curricula work and weekly team-based content revision quizzes. From a study of students’ engagement in the curriculum, de Byl (2013) identified five orthogonal dimensions that influenced students in her gamified curriculum; playfulness, alternative pedagogies, instrumentalism, status and performance. The playfulness dimension considers playful students and those who are not. Its revelation is not unexpected given that play is the foundation on which gamification rests. Playfulness as a dimension of gamification suggests this reward system may provide students with acceptable mechanics keyed at deep and independent motivated learning as the play itself is considered an experience with intrinsic motives (Henricks, 1999). The second dimension, alternative pedagogies, at its extremes includes students who prefer traditional teaching methods (such as lectures and tutorials) and those open to more novel pedagogies (such as action-learning and games-based learning).

Instrumentalism is the third dimension that encompasses both students who are single-minded and require the shortest path to success and those who are happy to explore and take instruction daily. Instrumentalist students respond well to a clear plan of the course and knowing exactly what to do and when to achieve the best grade possible. By breaking down tasks into equal-weighted activities, gamification can provide students with a clear plan for students to follow, which according to Skinner and Belmont (1993) offers instrumental support.

The fourth dimension, status, ranges from students who prefer to know where they sit concerning grades in the overall class, to those less concerned. Finally, performance, the fifth dimension, relates to a student's ability to perform at their best. Gamified systems make performance data available giving options to players to gain more points and to reach higher levels. The data collected for the original five-dimensional model of a gamified curriculum was based on a student engagement survey. This experiment clearly shows how gamification could be used to develop different aspects of learning in an instructional setting. The gamification process requires the presence of game elements to engage learners in instructional activities.

Game elements are the components of an educational game that determine the level of interaction and engagement in an instructional setting. These are the game elements. These are the basic components of an educational game, which scaffold students' learning within and outside the school settings. Game design elements are the basic building blocks of gamification applications. They are largely equivalent to game design patterns (Bjork and Holopainen, 2004; Kelle, Klemke and Specht, 2013). In the context of games and gamification, several authors have proposed compilations of recurring game design elements (Zichermann and Linder, 2010; Kapp, Zichermann and Cunningham, 2011; 2012; Werbach and Hunter, 2012, 2015; Robinson and Bellotti, 2013;). Reeves and Read (2009), for example, propose "Ten Ingredients of Great Games", which include representation of oneself through avatars, narrative context, feedback, competition and teams. Werbach and Hunter (2012) identify 15 important components, among them avatars, badges, leaderboards, points and teams. In particular, they highlight the so-called "PBL triad" and the interplay of points, badges and leaderboards, which they consider characteristic of gamified applications (Werbach and Hunter, 2012).

Literature has shown that the elements of gamification commonly implemented include points, leaderboards, badges, storytelling and levels. O'Donnell *et al*. (2013) posit that badges, progress bars, leaderboards and storytelling with accompanying visual hold the most potential for effective engagement within an educational setting.

Gamified applications rely on game elements such as points, levels, badges and leaderboards as the core of the experience stated by Werbach (2012). Many studies did not examine the effectiveness of narrative storytelling in motivating students. Lawley as cited in Stott and Neustaedter (2013) caution against reducing the "complexity of well-designed games to their surface elements (that is, badges and experience points) as the game could fall short of engaging students. This is not suggesting those game elements should not be incorporated into gamified learning environments, however good game design also includes instant feedback, freedom to fail, progression, and narrative stories (Stott and Neustaedter, 2013).

Leaderboards allow users to compare themselves with others, as points and badges are used as external rewards for completing certain actions. The points and levels systems, in which points are generally awarded for the completion of tasks and then accumulated, were used in the gamified learning activities of the treatment group with a positive result. As suggested in the game and gamification design literature, points and levels are indicators of self-performance (Cheong *et al*., 2014), so they are important tools for students tracking their achievement. In this study, digital achievement badges are used as symbols or indicators of the accomplishment of various achievements in the learning task. Gamification studies (such as Hakulinen, Auvinen and korhonen, 2015; Hamari, 2015) found that achievement badges can be used to influence students' behaviour and as a promising method to increase user engagement

Moreover, in the gamification context, points (Attali and Arieli-Attali, 2015) and badges (Abramovich, Schunn and Higashi, 2013) are considered as types of formative feedback to students in two ways. The first way is that they provide students with their competency level. The second way is that they allow students to reflect on how much effort, motivation, or engagement they should invest in their learning. From a theoretical perspective, feedback will have a positive effect on learning when it is related to the process of learning and it can be done through both cognitive processes and affective processes (Hattie and Timperley, 2007; Sadler, 1989, as cited in Attali and Arieli-Attali, 2015). Thus, the effect of providing instant feedback is likely to be a key mediator between the use of game mechanics (points and levels systems, and digital achievement badges) and increased student engagement.

However, relying solely on these external motivators without considering important human factors like the need to feel competence, autonomy and relatedness will not only fail to engage users but will also overcrowd any existing interest and internal motivation to perform a particular behaviour (Rigby and Ryan 2011). Gamification should be used to boost the user's internal motivation. Gamification's impact on student motivation and performance is an important topic, as there has been increased interest in gamification (Hanus and Fox, 2015) at the college level. Fanshawe College in London, Ontario, is using gamification elements (for example, goals, rules, and feedback systems) to engage children and adults in improving their literacy skills. Ensuring students are engaged in their learning in post-secondary environments is critical as student engagement is positively related to academic outcomes as represented by first-year student grades and by persistence between the first and second year of college (Kuh, Cruce, Shoup and Kinzie, 2008). Jigsaw for example is a gamified application that helps users learn photoshop, through a jigsaw puzzle that challenges players to match a target image. Although no empirical evaluation was presented, users reported being able to explore the tool and discover new techniques (Dong et al 2012). GamiCAD by Liz and Grossman (2012) is a gamified tutorial system for AutoCAD. By performing line and trimming tasks, users help NASA build a spacecraft to participate in an Apollo mission. Tasks are designed to be challenging and users are encouraged to repeat them until they achieve the required score. When compared to a non-gamified version, results show that users completed tasks faster in GamiCAD and found the experience to be more engaging. Sheldon (2011) describes how a conventional learning experience can be designed as a game, without using technology, to engage students and make classes more fun and interesting. Students start with an F and go all the way up to an A+, by completing quests and challenges, which will reward them with experience points. Khan Academy, on the other hand, is a free online service that allows users to learn about several topics, such as algebra, economics, or history, by watching videos and then completing exercises. Progress is rewarded with energy points and badges. Similarly, Code academy teaches online students to code in numerous programming languages, also using points and badges to track their progress. Gamified examples like these suggest a string nexus between gamification and education.

Points

Points are basic elements of a multitude of games and gamified applications (Zichermann and Cunningham, 2011). They are typically rewards for the successful accomplishment of specified activities within the gamified environment and they serve to numerically represent a player's progress (Werbach and Hunter, 2012; 2015). One of the most important purposes of points is to provide feedback to students on their learning progress. Points allow the players' in-game behaviour to be measured, and they serve as continuous and immediate feedback and also as a reward (Sailer, Hense, Mandl and Klevers, 2013).

Research reviewed in this area examined studies that focused solely on the inclusion of points to motivate and engage students, as well as on studies that examined the effectiveness of points in combination with other elements of gamification. The majority of studies found that points provided instant feedback that students found motivating. Many researchers also identified the fact that points must be used in combination with other elements of gamification to be effective in motivating students. Points can be awarded for a wide variety of tasks such as completing quizzes, attending lectures, taking part in-class exercises, solving puzzles, creativity in assignments (Charles *et al*., 2011; O'Donnell *et al*., 2013), completing practice questions, or correct answers (Mekler *et al*., 2013a). Mekler *et al*. (2013a) discovered that awarding points was effective in increasing intrinsic motivation.

Gåsland (2011) also determined that students found a points-based gamification system to be somewhat motivating and quite engaging. Not all research reported a positive relationship between points and student motivation and performance. Meyer (2008) examined the impact of points on the quality of postings in an online discussion forum by graduate students and found that nine of 13 students reported that points did not affect the quality of their postings. Abramovich *et al*. (2013) found that the prior experiences of students impacted the effectiveness of gamification; therefore, in the case of the research by Meyer (2008), one reason for his results maybe that graduate students are already motivated and, therefore, less motivated by points. In any case, the point remains a strategic element in the gamification process to engage learners in classroom activities.

Levels

Levels are one of the key elements in the gamification process, which motivate learners in the content of classroom instruction. One of the features that make gamification successful is that this strategy ensures appropriate scaffolding, progression and sequencing through content and activities, in a manner which does not leave the learner frustrated, but instead ensures an appropriate level of challenge (Stott and Neustaedter, 2013). These features could be entrenched in classroom activities through the use of levels in the gamified package. Levels allow a game to be divided into small, separate, attainable pieces and moving up to the next level is often a strong motivator of continued effort (Gåsland, 2011). The use of levels was reported in eight of 19 gamification studies across different subject areas (Mayer & Johnson, 2010; Barata *et al*., 2013; Berkling and Thomas, 2013; Goehle, 2013; Li *et al*., 2013; Mekler *et al*., 2013b; Turner *et al*., 2013; Watson *et al*., 2013). To implement levels, users must gain points. After gaining a certain pre-determined number of points, users move up a level. Generally, "leveling up" confers some sort of in-game benefit (Goehle, 2013). Levels positively impact on students' motivation and engagement. Goehle (2013) reports that 93% of students kept track of their levels and achievements while 89% actively worked to obtain achievements. As a result of this, course designers may want to ensure that there are clear criteria available for students to review how to earn higher levels. If points are used to determine "leveling up", course designers could indicate the number of points needed before attaining the subsequent level.

Badges / Achievements

Badges are defined as visual representations of achievements and can be earned and collected within the gamification environment, (Werbach and Hunter, 2012). They confirm the players' achievements, symbolise their merits (Anderson, Huttenlocher, Kleinberg and Leskovec, 2013), and visibly show their accomplishment of levels or goals (Antin and Churchill, 2011). Earning a badge can be dependent on a specific amount of points or particular activities within the game (Werbach and Hunter, 2012). Badges have many functions, serving as goals, if the prerequisites for winning them are known to the player, or as virtual status symbols (Zichermann and Cunningham, 2011; Werbach and Hunter, 2012). In the same way as points, badges also provide feedback, in that they indicate how the players have performed (Rigby and Ryan, 2011). In general, badges usually have no narrative meaning, and collecting them is not compulsory. However, badges can influence players' behaviour, leading them to select certain routes and challenges to earn the badges that are associated with them (Wang and Sun, 2011). Additionally, as badges symbolise one's membership in a group of those who own this badge, they also can exert social influences on players and co-players particularly if they are rare or hard to earn (Antin and Churchill, 2011; Hamari, 2013).Mixed results were found concerning the impact of badges and achievements on student motivation and performance at the post-secondary level. Some research found badges and achievements supported student engagement, while other research found there was no impact or a negative impact on student engagement and motivation.

Badges or achievements are symbolic awards given to students for completing "any type of skill, knowledge or achievement" (Abramovich, Schunn and Higashi, 2013) that can be displayed by learners to "let others know of their mastery or knowledge" (Abramovich *et al*., 2013) and typically have specifically stated criteria (Dominguez et al., 2013; Ahn, Pellicone and Butler, 2014; Hanus and Fox, 2015). Badges are a common element of gamification introduced into courses, reported in 11 of 19 studies (Abramovich *et al*., 2013; Barata *et al*., 2013; Charles *et al*., 2011). Badges introduce a social element to courses by allowing students to identify with other learners who are working towards the same goals (O'Donnell *et al*., 2013; Turner *et al*., 2013). If social sharing is built into courseware, then learners can share their badges on social media gaining additional recognition for their achievements from family and friends, (Turner *et al*., 2013).

Users typically have access to review the badges they have earned and to review the requirements to obtain new badges (Hanus and Fox, 2015). Haaranen *et al*. (2014) stated that approximately one-third of college students were motivated by the badges, one-third were indifferent towards the badges, and the remaining one-third did not find the badges motivating. Contrary to this, Hanus and Fox (2015) found that students in the gamified version of a university course, which incorporated badges and leaderboards, were less motivated and had lower final exam scores than students enrolled in the non-gamified version of the course. Ahn *et al*. (2014) assert that “not all learners are motivated by the same types of badges” in a gamified environment. Abramovich *et al*. (2013) maintain that there is a difference in badge acquisition patterns for learners with different levels of prior knowledge; low-performing students are motivated by badges awarded for participation, while high performing students are motivated by badges awarded for skill acquisition.

Leaderboards

Leaderboard is another important element in gamification as it helps to sustain learners’ interest in classroom activities. Competition caused by leaderboards can create social pressure to increase the player's level of engagement and can consequently have a constructive effect on participation and learning (Burguillo, 2010). It should be noted, however, that these positive effects of competition are more likely if the respective competitors are approximately at the same performance level (Slavin, 1980; Landers and Landers, 2014).

Leaderboards are a commonly used gamification element, and there are mixed results with respect to the impact of leaderboards on motivation of students at the post-secondary level. For some students, leaderboards provide motivation, while other students dislike the element of competition that leaderboards introduce into the learning environment. For competitive students, leaderboards provide instant feedback and allow learners to continuously strive to improve their place in the rankings. Leaderboards create competition and a sense of belonging to a similar minded group in the classroom (O’Donnell *et al*., 2013). They allow learners to compare performance to that of other students (Charles *et al*., 2011; O’Donnell *et al*., 2013). Leaderboards can be based on a points system, on how many achievements learners have obtained, or a learner’s percentage progress towards a final end goal (Dominguez *et al*., 2013).

Leaderboards are similar to the sticker charts used for years by teachers in classrooms, but have the distinct advantage of allowing students to access the leaderboard outside of the classroom (Hanus and Fox, 2015). This allows students to

spend as much time as desired to compare their performance to others without anyone else knowing, they are engaged in such deep social comparison (Hanus & Fox, 2015). The impact of leaderboards on motivation varies among learners. Some studies had shown that leaderboards are a "source of motivation because students can see their work publicly and are instantly recognized" (Dominguez *et al*., 2013). Also, leaderboards have been shown to inspire "participants to maintain their performance for longer, compared to points and control groups" (Mekler *et al*., 2013b: 70). Other researches have shown that for students who do not enjoy competition, leaderboards can negatively impact student motivation (Dominguez *et al*, 2013;
Hanus and Fox, 2015). Charles *et al*. (2011) reported that the minority of students "expressed discontent with the competitive nature of the feedback.

Storytelling

Storytelling naturally arouses students' interest and technology has become part of the life of these digital natives. Meaningful stories are game design elements that relate to the player's performance and engagement in classroom activities. The narrative context in which a gamified application can be embedded contextualizes activities and characters in the game and gives them meaning beyond the mere quest for points and achievements (Kapp, 2012). A story can be communicated by a game's title or by complex storytelling typical of contemporary role-playing video games (Kapp, 2012). Narrative contexts can be oriented towards real, non-game contexts or act as analogies of real-world settings. The latter can enrich boring, barely stimulating contexts, and, consequently, inspire and motivate players particularly if the story is in line with their interests (Nicholson, 2015). As such, stories are also an important part of gamification applications, as they can alter the meaning of real-world activities by adding a narrative 'overlay'.

2.2.8 Benefits of gamification to classroom instruction

Gamification has been promoted as a practical procedure that could be utilized to animate students' advantage and improve their presentation in instructional substance. Thus, instructors across various subjects could use the capacities gave by the game components in the gamified bundle to improve study hall association and connect with students in instructional exercises. The advantages of gamification to the instructing and learning of Physics are summed up beneath. Boosts excitement toward Physics: For some growing students, Physics can end up being a dry subject. Instructors have battled to keep students occupied with Physics. Studies demonstrated that the gamification study class helps give students a more uplifting disposition (attitude) towards Physics as a rule. It lessens problematic conduct: Gamification in the homeroom is particularly useful to troublesome students. Studies have demonstrated that games designed for assisting students with controlling their breathing and pulse, and furthermore affected improving their conduct in the homeroom. It increases psychological development: Students show huge intellectual development when they are entrusted with establishing their computer game climate. It powers students to utilize rationale to build up a computer game story.

Mature pretend supports development and advancement: When students are entrusted with utilizing their creative mind to make expound situations maturely and strongly, they are permitted to create inside the homeroom. All things considered, study hall instructors should join play-based figuring out how to empower an elevated level of development and development inside the learning climate. Play-based learning permits students to fill in a maintainable and significant manner. Game-driven learning improves capacity to focus: Game- driven learning improves and supports students' consideration spans of battling students in the study hall: Past investigations have demonstrated that taking an interest instructors found that gamification helps an educator's trust in a kid's capacity to partake what's more, adapt autonomously. Moreover, educators revealed a more grounded relationship with their classmates (Martin 2014).

2.3 Empirical review

2.3.1 Gamification and motivation of students to learn Physics

Gamification's effect on learner's motivation and execution has stood out lately, particularly at the school level (Hanus and Fox, 2015). Lambton School in Sarnia, Ontario has, as of late, declared expectations to join gamification into its educational program to more readily arrive at portable, clever students and increment learners commitment. The school is ready to plan educational programs that incorporate symbols and scoreboards (Kloet, 2014). This establishes that gamification is an authentic technique that could be utilised to persuade students and improve their advantage in the topic (Rughiniș, 2013). Obviously, interest is considered by specialists as a stack with feeling and mental variable and advances in substance unequivocal and coordinated effort with the climate (Hidi, Renninger and Kapp, 2004). At last, feeling can be influenced by instructional structures as it is portrayed by scientists as a lively game plan of heading, which works with moving parts (Astleitner, 2004).

Motivation impacts students' learning and foresees a fundamental occupation in masterminding conduct towards a particular target, expanding the effort and energy towards a level headed, building up the action and enthusiasm of a new development, and improves solitary execution, (Ormrod, 2000). It is famous that understudies motivation is impacted by both inward and outside segments that can begin, keep up, strengthen or cripple practices (Reeve, 1996). Interior segments join the individual attributes or mindsets that an learners brings towards his learning improvement, for example, premium, commitment regarding learning, exertion, characteristics and saw limit (Ainley, 2004). Then again, outer segments solidify outside prizes that come from an external perspective of the individual, for example, cash, acknowledgments and grades.

Teachers concur that students are spurred to learn instructional substance that is fascinating and associated with genuine circumstances (Gebbels, Evans and Murphy, 2010). This demonstrates that a significant explanation supporting students' investment in a learning task is their premium in the subject. Proof proliferates that students who locate a subject intriguing will in general, pick it for additional investigation in their educational interest (Erinosho, 2013). Students' advantage keenness is relevant to the decision of the subject of study and it should not be ignored in the instructional cycle at all degrees of education. Tella (2007) contended that, if a kid is keen on the topic, he will have the option to concentrate on the subtleties (details) of instructional substance and perform better towards the end of it. Exploration study has indicated that students will perform better in Physics and select Physics-related courses in higher institutions of learning in the event that they are keen on the instructional substance as introduced by the instructor (Osborne, Simon and Collins, 2003; Bennett, 2003).

2.3.2 Gamification and interest of student in physics

There is general consensus among educators that every society must construct its science curriculum to fit its own particular needs and schooling purposes. Science education can provide some useful insight into the process of curriculum selection and construction. However, educators also agree that teaching should build on the interests and experiences of students. Experiences and interests among learners vary, and there is similar variation in what can be considered relevant and useful knowledge for students from different life situations. Haussler and Hoffmann (2002) cite results from an international survey showing that students' interest in physics declined worldwide during senior secondary level one. This lack of interest in science often manifests itself when students are at an age when they are permitted to make their own curricular choices (Sjøberg 2002). The above findings raise serious questions about the implementation of changes made in science curricula regarding the development of students' interest in science.

Cronk (2012) implemented a reward-based system to improve college students' interest and engagement in the form of a virtual tree that would grow in response to points assigned in class. This study reported an increase in students' interest after the experiment. In an attempt to integrate game mechanics into an engineering curriculum, researchers at St. Cloud State University and the University of Wyoming implemented a points-based system that allowed students to progress through three levels. Through the use of rapid feedback mechanisms, the researchers found students showed positive interest to engage in the given tasks (Thamvichai & Supanakorndavila, 2012). One of the most thorough applications of gamification in the classroom is that of Sheldon (2011). His classroom takes the form of a massively multiplayer game in which students are divided into guilds and compete in quests to gain experience points (XP). In the end, XP translate into traditional letter grades. Although there is no formal research presented for Sheldon's structure, the students do respond favourably to the class activities in the end of semester class evaluations. In other words, gamification sustains students' interest to pay attention to the details of the instructional content at different levels of education. The game elements used in gamification process encourage students to learn the content and therefore, improve their interest in that particular subject.

2.3.3 Gamification and student Achievement in physics

The low level of enrolment and inconsistency in the performance of students in physics at the secondary school level could be associated with the low rate of motivation and negative interest of students to the subject. However, studies have indicated that use of gamification boost learners motivation to study physics and thereby improved learners achievement. The use of gamified approach on learners achievement in the school environment is a process for the students to initiate and execute the class activity, which could also result to improved interest in instructional content such as physics and enhance the performance of different categories of students in the classroom (Lee and Reeve, 2012; Dariese, 2012; Eraikhuemen and Ogumogu, 2014). This shows that Gamification is closely related in improving learners' achievement in physics concepts. Similarly, this could influence student engagement in instructional content at different levels of education (Charles, 2011; Barata, 2013; Li, 2013). Thus, students who are motivated to learn will show interest in the subject matter and pay close attention to the details of the instructional content. This shows a close relationship between gamify approach and achievement in physics (Chan and Norlizah, 2017).

Even though students still pass Physics at credit level, evidence abounds in the literature that a significant number of them consider Physics as a difficult subject to understand due to its nature of abstraction. This indicates that Physics students are not motivated to learn the instructional content but just read to pass the examination. Study have indicated that Physics students are not motivated to learn the content as many of them still consider the subject as abstract and difficult to understand. Thus, Physics content need to be incorporated into technology and technology-based strategies to motivate and engage learners in classroom activities (Renata, 2015)

Thus, for those students who see Physics as being difficult to learn and comprehend very well and being a normal exercise, there is more uncertainty that the information learnt will be advantageously used. Such discernment may deter students from learning it at higher levels of study. This has genuine consequences for building a pool of physicists that are needed for moulding innovative (technical) development and Physics instructors that would assist in building the establishment for the subject in schools. It has been seen that the theoretical idea of Physics ordinarily lessens students' advantage to partake in the subject. For example, researchers have demonstrated that most students can not reason abstractly at certain development age, in this way discovering learning materials that are conceptual or demand formal thinking in other to demystify a troublesome concept (Achor, 2004).

Consequently, the use of gamified elements has being discover to be a helpful approach to learners by help them to be a content creator, with the use of game in teaching and learning this allow secondary school learners to have potential of providing or revealed immediate as well as useful feedback that capable of develop their achievement in various subject (Adachi and Willoughby, 2013). Learners were able to discovered themselves also their ability and therefore the approach (gamification) help them to work upon their weakness (Virvou, Katsionis and Manos,2005) Nevertheless, gamification elements are essential to the development of students achievement in physics subject because it affect them positively as well as influence them positively by improving their academic progress also contribute in develop their behavioral way of learning most especially in science related subjects.

2.3.4 Gender and Motivation of Students in Physics

Motivation, according to Gardner (2006), is a very complex phenomenon with many facets. This is because the term motivation has been viewed differently by different schools of thought. Brown (2000) identified motivation as the anticipation of reward; he also asserts that motivation of learners often refers to a distinction between two types of motivation namely, instrumental versus integrative motivation. With a lack of attitudes and motivation in the physics course, most of the engineering graduates have a poor background in physics, yet, taking prerequisite subjects made them difficult to understand more in succeeding topics. Students' motivation can be external or intrinsic. External motivation generally consists of recognition and praise for good work. In a college student, this might be in the form of sustainability of the scholarships, or good impression in the class and at home. Students' grade is one of the most prominent factors of their extrinsic goal orientation, while intrinsic motivation generally consists of an internal desire to learn about a specific topic.

Learners' motivation has been widely accepted as a key factor that influences the rate and success of learning. Eryilmaz, Yildiz and Akin (2011) investigated the relationships between attitudes towards physics laboratories and motivation for the class engagement. The result showed that the most significant problem that teachers confront in physics lessons is that abstract or concrete concepts cannot be understood by students correctly or efficiently. If the students do not have the motivation to participate in the lesson, classroom activities become boring as they cannot focus their attention on the subject, and cannot establish any connection between the physics related concepts and real-life situations. This challenge of abstractness could reduce students' motivation to learn physics and other physics-related concepts (Pintrich and Maehr, 2004). Therefore, the onus lies on the teachers and other educational stakeholders to package instructional content with interactive elements that could sustain students' motivation to actively participate in classroom activities. Students' motivation to participate in instructional activities could be influenced by several factors like self-efficacy, learning style, gender among others. Over time, gender had been found to have a significant influence on learners' motivation to participate in classroom tasks or using technology to carry out instructional activities. Gender has been found to play an important moderating role in video game contexts. Although gender differences seem to diminish among younger generations (ESA, 2015) boys usually have positive motivation to participate in video gaming than girls (Bonanno and Kommers, 2008). Gender differences have also been observed during gameplay in an educational context (Bressler and Bodzin, 2013). In terms of the instructional content, male students, in general, are found to be more motivated in the aspects of physical sciences, while female students are motivated to learn biological and environmental aspects of science (Murphy and Whitelegg, 2006).

2.3.5 Gender and Interest of Students in Physics

Students' interest had been touted as a strategic factor that could stimulate attitude and achievement in any subject across different levels of education. Leper and Henderlong (2000) stated that without interest, there will be no learning. Arousal of interest and intrinsic motivation is not possible if the learner does not have a minimal level of competence. This explains why studying Physics has been motivating for gifted pupils who enjoy learning about natural phenomena, solving problems and experimenting. It is therefore important to know how Physics teaching and learning activities, learning materials and learning environment could be designed to arrest the interest of the learners in the classroom, (Krapp 2002; Krapp 2003; Lavoner, Meisalo, Byman, Uiito and Juiit 2005). Lavoner *et al* (2005) stated that there are two types of interest. These are situational interest, which is said to be spontaneous, fleeting and shared among individuals; this type of interest has a short term effect. While the second type of interest is the personal interest which develops slowly and has a long-lasting effect. However, situational interest if sustained over some time translates to personal interest. It is now a widely accepted idea that computer simulations and other modes of computer-assisted instructions have the potentials to capture the interest of the learner, accomplish higher learning outcomes such as bridging the gap between concrete and abstract reasoning in a way not previously possible in the science classroom (Sierra–Fernandez and Perales-Palacios 2003; Keller, Finkelstein, Perkins, and Pollock 2005; Fong, Lee and Chee 2010).

Studies have revealed that students' interest in instructional content could be moderated by gender. Gender could determine, to an extent, the level of students' interest to participate in classroom activities. Kessels, Rau and Hannover (2006) found that female students lack interest in physics compared to their male counterparts. Female students have a higher negative attitude towards physics compared to male students. Female students claimed that physics is difficult for them because the subject tends to favour the masculine nature. According to Marsh and Tapis (2002), the difference in students' attitudes in terms of gender will result in differences in achievement, interest and readiness to achieve learning targets. Based on the study carried out by Ryan (2013), physics and mathematics are said to be in contrast to the female natural being that is known to have feminine characteristics. Male students showed more positive interest in subjects that are considered as masculine compared to female students who are more interested in subjects that are more feminine such as Biology. Male students, generally, show a higher positive attitude towards Physics compared to female students. They also incline to choose a Science and Technical related career (Krogh and Thomsen, 2005). A study by Sgoutas, Nagel and Scott (2005) conducted on 148 science students in San

Diego found that female students have a higher negative attitude compared to male students. The majority of female students opined that science classes are boring and they only need to memorise facts to secure good grades whereas careers related to science are perceived as having to do a lot of work.

Fatoba and Aladejana (2014) in their study examined the influence of gender on students' attitudes in Physics in senior secondary schools in Oyo State, Nigeria. It was found that there was a slight difference in attitude among the students in favour of females in Physics. Shaw (2003) in his study identifies the relationship between students' attitudes towards Physics with their achievements in Physics. The finding showed that there is a relationship between attitude and achievement for female students but not for male students. The result showed that there is no difference in attitude between male and female students towards Physics. A study by Lena (2005) showed that male and female students who achieved high grades in Mathematics do not differ in terms of their attitudes towards Mathematics. For Physics, female students who showed positive attitude obtained better results compared to male students.

A study by Visser (2007) found that students' attitudes towards science, especially female students, decreased when they entered secondary schools. The female students' attitude towards Physics was found to be low and they commented that learning Biology was more enjoyable. A study by Nur Asyiqin (2004) showed that there is a difference in terms of attitude dimension between male and female students. Pell and Manganye (2007) reveal that there is no difference between interest and gender among African students. However, Pell and Jarvis (2001) aver that male students recorded a much higher positive attitude compared to female students. Male students, consistently, have a more positive interest in science-related subjects compared to their female counterparts. This inconclusiveness in research findings necessitates the need to examine the moderating effect of gender on students' interest in physics in a gamified learning environment.

In a study by Walper et al. (2013) conducted, they suggested that male students have a higher personal interest in physics than female students. In this respect it could be said that the low level of interest towards physics may lead to females being unsuccessful in physics, having prejudice for physics and making less professional choices regarding the field of physics. There are many findings in the literature stating that, with regards to the field of physics, females are highly underrepresented in science fields more than male students (Sainz, 2011; Beede, et al., 2011).

2.3.6 Gender and Achievement of Students in Physics

Abiona (2010) presumes that sex contrasts exist in learner's achievement in Physics and some other subjects. Studies have demonstrated a huge distinction for young men (Aremu
2005, Ojo 2009); now and again for young ladies (Ogunleye 2002, Olatundun 2008) and now and then have indicated no huge contrast among young men and young ladies with their accomplishment and mentality in various science subjects (Oduwaiye 2009, Okoye 2010). These irregularities make sex a significant factor to be utilised to direct the effect of gamification on learning Physics at various degrees of education.

Gender distinction is one of the elements influencing learning and numerous scientists have zeroed in consideration on investigations identifying with its impact on understudies' achievement in Physics. Notwithstanding, as of late, the perspective on the significance of gender has been addressed. In light of the fact that for example, in their survey, Krapp and Pritzel (2011) propose that at any rate in the lower optional school, young men and young ladies don not contrast many assumptions as a result of science and technology concepts. Similarly, gender relationship is another factor that needs to be checked. It has been found that learners gender relationship with their tutor does affect their achievement most especially in Physics concept, male learners’ find it easy to relate with their instructors irrespective of the gender than female counterparts. Good relationship with instructors will help learners to perform very well because the teacher will give adequate support and the learner would be free to interact with their instructors unlike their counterparts that are lacking in such behaviour would defiantly have an issue in academic progress such as in Physics.

2.3.7 Computer Self- Efficacy and Motivation of Students in Physics

Motivation has been recognised as an important construct in the field of science education (Koballa and Glynn, 2007). Studies have shown that motivation remains an important factor in science learning at all levels of education. Students’ motivation to

participate in science-related activities makes science learning effective in the classroom, (Sarıbıyık, Altunçekiç and Yaman,
2004). According to Cavas (2011), students' motivation plays a crucial role in science learning, which focuses on promoting student's construction of a conceptual understanding of science- related concepts. Some factors will influence students' motivation towards science learning.

According to Tuan, Chin and Shieh (2005), students' motivation towards science learning may be influenced by six factors, namely: self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation. Nevertheless, efficacy in terms of PC (computer) usage for learning is one of the important thing that need to take with all seriousness. Both teachers and learners were supposed to be knowlegeble in using ICT for teaching-learning system. More so, it has been discovered that instructors' self-efficacy has to do with learners' motivation to learn Physics. Similarly, learners must posess ability to learn or develop skills to assimilate through the use of ICT. This would somehow affect their interest in learning system as well as developed secondary school learners' motivation towards learning science- related subjects most especially ones that really have do with practicals. Thus, learners' capability in using technology has been found to be influencing learners' behaviour as well as motivate them to practise and develop new ideas. This would give a way for them to translate classroom learning to practical way of life.

2.3.8 Computer Self-Efficacy (CSE) and Interest of Students in Physics

According to Compeau and Higgins (1995) CSE is the ability of a person confidents and ability to use computer effectively. More so, teachers as well as learners are expected to have confident in using technology for teaching-learning process. This will give them ability to be creative and discover new ideas, similarly help learners to search form resource and discover more learning skills. The study correspondingly emphasize that when learners have confidents in doing learning task, this will have improvement on interest of learning towards particular subject however, as well as learners achievement.

This connotes that there is link between efficacy and learners' interest most especially in physics concepts. The interest of learners will be determined by the level of learners confidence as well as ability to use available media resource. (Holcomb, Brown, Kulikowich and Zheng, 2003). However, students with low efficacy likely not to have a very good interest in study most especially physics concepts that look so abstract in nature. Therefore, learners' efficacy will determine the level of their interest towards learning.

Wood (1999) postulated that efficacy is a vital thing to master when it comes to the use of technology for both instruction and learning process. When users of technology had an adequate skill or have a good knowledge of ICT, this will help them to good attitude as well as better interest towards learning science-related subjects. This would also affect students' academic progress most especially in Physics concepts. However, lack of computer self-efficacy will definitely affect students' interest in learning behavior when it comes to the use of ICT.

Similarly, when a user does not have effective way of ICT usage, anxiety and discouragement may set in, which will eventually affect their academic advancement. Technology self-efficacy may vary at times; therefore, it is expected that high level of efficacy should be maintained by the user of ICT because average level may decline to low level in the absence of non-support and close monitoring. Hence, it is clear that valuable knowledge of PC self-efficacy is a prerequisite factor in improving learner's interest and achievement in Physics subject.

2.3.9 Computer Self-Efficacy and Achievement of Students in Physics

Numerous studies (Pintrich and DeGroot, 1990; Pajares, 1996; Miller *et al*., 1996; Bandura, 1997; Andrew, 1998; Chemers, Hu, and Garcia, 2001) linked achievement of learners with their efficacy in computer usage or technology related device for instructional purpose. Similarly, when learners derived high seif-efficacy in using computer for learning purposes, the learners academic progress found to be improved positively. However, learners' self-efficacy could also be as a result of previous experience of the users. Also, been science-oriented subject could also be the reasons of improving their potential in using technology for teaching and learning. (Multon, Brown, and Lent, 1991). Self- efficacy also positively related to achievement (Silver, Smith, and Greene, 2001).

It is believed that self-efficacy in science may affect learning, choice of science by the secondary school learners, amount of effort exerted, and persistence in science (Kennedy, 1996). Many studies (Pintrich and DeGroot, 1990; Smist, 1993; Andrew 1998; DeBacker and Nelson, 1999, 2000; Wainwright and Gallahan, 1999) has found a connection between self-efficacy and science achievement. Compeau, Higgins, and Huff (1999) pointed that learners with higher level of computer efficacy always out performed their counterparts that has lower efficacy in ICT usage in terms of academic achievement most especially in science oriented subjects. Similarly, as the learners efficacy increasing in both intellectual and skillful manner, so their efficacy go higher in general activities as well.

2.4 Appraisal of Literature

Physics has consistently been seen as an extreme, exhausting and theoretical subject contrasted with its other two unadulterated science subjects - Biology and Chemistry. Physics is not simply hard to be handled yet students likewise consider finding the answers to take care of any issues identified with Physics as convoluted. There is a developing attention (interest) in utilizing gamification to simplify difficult aspects of the subject. Numerous instructors have endeavoured to apply its idea to learning exercises. Series of studies on gamification has shown its significance regarding its viability in connecting with and inspiring students to drive practices and impact wanted academic outcomes. Also, a couple of researches have indicated the capacity of gamification in teaching and learning.

Gamification incorporates intertwining segments of computer games, for instance, centers, levels, leaderboards, and distinguishing pieces of proof into non-game settings to abuse the inspiration given by a game environment. Disclosures from various assessments prompted sort out what degree gamification maintains learner achievement and inspiration among learners uncovered that centres, recognizable pieces of proof as well as academic progress, leaderboards and levels are the most ordinarily completed kind of gamification segments. However, researches have made known that gamification has high potential to boost level of secondary school learners' assimilation most expecially in learning conditions on inspiration, interest and academic development of learners. Additionally, educators have consistently remarked that discouragement of learners in Physics accomplishment by certain students is because of their negative mentality and absence of interest towards the subject. Interest influences intrinsic motivation which thus influences the scholarly accomplishment and students' support in schools. Notwithstanding, the arising patterns in innovation helped learning, the assessed sources set up that less has been done on the utilization of innovation in persuading students and concretising Physics ideas to decrease the degree of relevance related with the educating and learning of the subject.

Learners’ motivation should be organized in choosing proper components for study room guidance. In the event that students are not spurred, at that point they will not get familiar with the substance. By applying gamification to the homeroom, students could be propelled to learn recently or appreciate in any case dull assignments. This exploration tries to see whether gamifying Physics could rouse the learners to effectively get familiar with the instructional substance. Likewise, there is absence of hypothetical underpinnings and observational exploration with respect to the motivational impact of Physics ideas utilizing gamification.

Interest describes an individual’s inclination towards and liking of a particular object and includes cognitive as well as affective processes. Interest is positively associated with students’ content-related learning and achievement and also has a central role when it comes to lifelong learning and career-related choices. In general, students regard science as moderately interesting, yet compared to other school subjects the science subjects are perceived as less interesting (Jenkins and Nelson,2005; Sjoberg and Schreiner,2006).

Gender has been found to assume a significant directing part in the instructional cycle. Gender just as the PC (Computer) fitness of students have been distinguished by scientists as basic factors that could impact the utilization of PC based learning for instructional conveyance. PC (computer) self-efficacy alludes to a judgment of one's ability to utilize a computer. PC (computer) self-efficacy significantly affects a person's assumptions towards utilizing PCs and people who did not consider themselves to be skilled PC clients tend not to make use of it.

However, influence of gender could be view from different perspective, based on how it affects personality. People are different in social behavious. This could affect their characters in terms of learning, for instance female were subjected to be of more collaborative and interactive than their male conterpet whose they found to be competitive in nature. Similarly, the study emphasized that female gender found to do more of task that does not require much energy compared to their counterparts whom they found to be more useful in science oriented studies. This disagreement of how gender has impact on the intervention such as CSE on ICT usage for learning remains inconclusive and more studies need to be conducted on the influence of these moderator variables on students' learning in a gamified environment. Therefore, this study would determine the impact of gamified concepts on students' motivation, interest and achievement in Physics in senior secondary schools.

CHAPTER THREE

METHODOLOGY

This chapter presents the research design adopted for the study, variables of the study, research instruments, selection of participants, the procedure for carrying out the study, methods of data collection and analysis.

3.1 Research Design

The study adopted the pretest-posttest control group quasi-experimental design. It examined the possible effects of gamification moderated at two levels. Storytelling, points, levels strategy and storytelling, badges, leaderboards instructional strategies on senior secondary school II students' motivation, interest and achievement in Physics in Ondo city, Nigeria. The experiment was carried out in two stages. Stage one had to do with the development of the gamification package, and stage two was the delivery stage when senior secondary school II Physics students are exposed to the gamification package and students in the control group are taught using conventional strategy.

The design for the implementation stage is symbolically represented as:

O_1 X_1 O_2

O_3 X_2 O_4

O_5 C O_6

X_1 represents storytelling, points, levels strategy (Experimental Group I)

X_2 represents storytelling, badges, leaderboards strategy (Experimental Group II)

C represents the conventional strategy (Control Group)

$O_{1,}$ O_3 and O_5 are pretest scores for experimental and control groups.

$O_{2,}$ O_4 and O_6 are posttest scores for experimental and control groups.

The study employed a 3x2x2 factorial matrix presented in Table3.1

Table 3.1 3x2x2 Factorial Matrix of the Study Variables

Interventions	Computer self-efficacy	Gender	
		Male	**Female**
Experimental I	Low		
	High		
Experimental II	Low		
	High		
Control Group	Low		
	High		

3.2 Variables in the Study

3.2.1. Independent Variable:

a. Gamification manipulated using storytelling, points and levels
b. Gamification manipulated using storytelling, badges and leaderboards
c. Conventional strategy

3.2.2. Moderator Variables

a. Gender (Male and Female)
b. Computer self-efficacy (low and high)

3.2.3 Dependent Variables

Three specific learning outcomes constituted the dependent variables in the study are:

a. Students' motivation in Physics
b. Students' interest in Physics
c. Students' achievement in Physics

3.3 Selection of Participants

Four senior secondary schools were purposively selected for the experimental groups, while two schools were randomly selected for the control group. This makes a total of six schools that was selected within Ondo city for the study. The criteria for the purposive selection of the schools in the experimental groups are as follows:

i. availability of functional computers to deliver the instructional content;
ii. availability of alternative power supply in case of a power outage;
iii. readiness and willingness of the school to participate in the study.
iv. the readiness of the students to participate in the study

Intact class of SS II Physics students was used in the selected schools. A total of 221 Senior secondary school II Physics students in six schools were assigned to storytelling, points and levels (84), storytelling, badges and leaderboards (56) and control (81) groups.

3.3.1 Criteria used for the selection of concepts for the study

The Physics concepts selected for this study were waves, the equilibrium of forces and measurement of heat. These are the topics that students find difficult based on the baseline study conducted by the researcher. The difficult topics were ranked, and the three most perceived difficult topics selected were found to be central to other difficult topics in the baseline study. Thus, the need to use a gamification based instructional strategy using two modes; storytelling, points, levels and storytelling, badges, leaderboards instructional strategy and followed by a face-to-face collaborative classroom session. The concept selected was taught within eight weeks**.**

3.4 Research instruments

The instruments used in the study were divided into two major parts which are: response and stimulus research tools for gathering information

Part A (Response)

i. Questionnaire on Student Motivation in Physics (QSMP)
ii. Questionnaire on Student Interest in Physics (QSIP)
iii. Computer Self-Efficacy Questionnaire (CSEQ)
iv. Physics Concepts Achievement Test (PAT)

Part B (Stimulus) are:

i. Teacher’s Guide for Storytelling, Points and Levels Instructional Package (SPLIP)
ii. Teacher’s Guide for Storytelling, Badges and Leaderboard Instructional Package (SBLIP)
iii. Teacher’s Guide for Conventional Lecture Instructional Guide (CLIG)
iv. Gamification instructional packages (Storytelling, Points and Levels and Storytelling, Badges and Leaderboard)

Assessment Checklist

i. Rubric for Evaluating SPLI Package
ii. Rubric for Evaluating SBLI Package

3.4.1. Questionnaire on Student's Motivation in Physics (QSMP)

This instrument was adapted from the instructional materials motivation survey (IMMS) by Keeler (2010). The instructional materials motivation survey (IMMS) instrument has been used to measure learners' motivation. It measures motivation from four dimensions: attention, relevance, confidence, and satisfaction (ARCS). It is divided into two sections. Section A deals with demographic information of the respondents such as name of school, class and gender. Section B aims at assessing the motivation of students in the use of instructional materials but it was adapted to learning of Physics with 25 items measured on a four-point likert type scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) from the former scale of 1 (poor) to 6 (excellent),. To ensure that the items in the instrument are consistently reliable, the questionnaire was administered to 30 students from a secondary school who were not part of the main study. Cronbach Alpha was used to analyse the data and a reliability coefficient of 0.94 was obtained which indicated that the instrument was consistently reliable.

3.4.2 Questionnaire on Student's Interest in Physics (QSIP)

This instrument was adapted from the Career Interest Questionnaire by Tandra, Gerald and Rhonda (2010). Each item was placed on a four-point likert type ordinal scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) on the career interest of students and it was adapted to interest in Physics. The Career interest Questionnaire is a likert-type (1 = strongly disagree to 5 = strongly agree) instrument composed of 12 items on three scales. The three scales measure the following constructs: perception of a supportive environment for pursuing a career in science, interest in pursuing educational opportunities that would lead to a career in science and perceived importance of a career in science but was adapted to the concept of Physics by the researcher. The questionnaire was created for career interest in science and the items selected were used as written, the research team envisioned that the instrument's original form, once confirmed to be useful for science, could be easily modified to address any science discipline. The QSIP was administered to 30 students from a secondary school different from the target audience. Cronbach alpha was used to analyse the data and a reliability coefficient of 0.70 was obtained which indicated that the instrument was consistently reliable.

3.4.3 Physics Concepts Achievement Test (PAT)

This is a multiple-choice test item developed by the researcher. It comprises two sections. Section A was designed to collect demographic data about the students. Section B contains 40 multiple choice questions with options A-D from which students would be expected to pick the correct options. The questions were drawn from difficult topics identified in the baseline study. A test blueprint was formulated to reflect the different levels of bloom's taxonomy of the cognitive domains on one axis and content areas on the other. The draft instrument was shown to four Physics teachers in different senior secondary schools to determine their suitability for the target population in terms of face and content validity. To ascertain the reliability of PCAT, it was administered to 30 SS2 students who were not part of the main study. Kuder-Richardson (KR 20) was used to test for the level of difficulty and the reliability coefficient index of 0.75 was obtained.

Table 3.2 Specifications table of participants achievement test

Content Area	Categories in Cognitive Domain			
Main Contents	**Remembering (Knowledge Recall)**	**Understanding (Comprehension and Application)**	**Thinking (Synthesis and Evaluation)**	**Total across Items Concepts**
Equilibrium of forces	1,2,4,5 (4)	23,33,40 (3)	17,20,21,22, 39, (5)	12
Heat energy: measurement of heat	6,8,9,16,32, (5)	10,29,31 (3)	7,18,30 (3)	11
Waves	11,12,13,14, 15,19,34 (7)	25,27,35,36,38,40(6)	24,26,28,37 (4)	17
Total/Percentage	40%	30%	30%	40

3.4.4. Computer Self Efficacy Questionnaire (CSEQ)

This instrument was adopted from Eachus and Cassidy (1997) on Computer self-efficacy assessment. Section A sought information on demographic data of the students while section B elicited information on their experience and proficiency in computer usage. It comprises thirty items on student's computer self-efficacy indicating the strength of their agreement/disagreement with the statements. A reliability coefficient of 0.73 was obtained which indicated that the instrument was consistently reliable.

3.4.5. Teacher's Guide for Storytelling, Points and Levels

This instructional guide was designed to regulate the activities of senior secondary school II students while dealing with the storytelling, points and levels group. The guide was validated by some Educational Technology lecturers and post-graduate students in Educational Technology Unit, Adeyemi college of Education, Ondo and University of Ibadan as well as the researcher's supervisor. Comments and corrections were effected and its inter-rater reliability was estimated using Scott's π. The inter-rater reliability index obtained was 0.80.

3.4.6. Teacher's Guide for Storytelling, Badges and Leaderboards

This instructional guide was designed to guide the activities of senior secondary school II students while delivering instruction in the storytelling, badges and leaderboards group. The guide was validated by some Educational Technology lecturers and post-graduate students in the Educational Technology Unit, Adeyemi college of Education, Ondo and University of Ibadan as well as the researcher's supervisor. Comments and corrections were effected and its inter-rater reliability was estimated using Scott's π. The inter-rater reliability index obtained was 0.78.

3.4.7 Teacher's Guide for Conventional Teaching Method

The conventional lecture guide was designed by the researcher, it is a stimulus instrument that was used to teach the senior secondary II students in the control group. It consisted of three lessons, each of which had five steps including introduction, presentation, evaluation and assignment. It was designed to direct the research assistants in creating learning experiences. The guide was validated by the secondary school teachers of Physics in different secondary schools and the supervisor of the researcher. Their possible observations, criticisms and suggestions were taken into consideration to improve the quality of the instrument. The inter-rater reliability was estimated using Scott's π and the reliability index obtained was 0.76 which showed that the instrument was reliable.

3.4.8 Gamification Package

The package incorporates storytelling, points, levels, badges and leaderboards as critical game elements to teach difficult concepts in Physics. The package began with instructional objectives before the content of the package. There were class activities within the package to engender active engagement and mastery of the contents during instructional delivery. The storytelling element uses traditional stories of the animal kingdom to demystify abstract Physics concepts, as the point increases; they will be motivated to complete the tasks. Levels element in this package is responsible for students' progression in terms of levels. There are ten levels altogether in the package which are divided into lower and higher levels (Lower levels: 1-5 and Higher levels: 6-10). Varieties of badges have been introduced in this system to keep students motivated and to highlight different achievements of the student. Different types of badges can be won by the student on different activities such as 'Keep trying' badge for completing first exercise, 'Be Focused' badge, 'Be Determined' badge, 'Excellent' badge, 'Skilful' badge, 'Proficient' badge as they interact with the exercises in the package**.** The leaderboard element shows the top students based on the results of various game elements used in this system and as the students proceed in the exercise given, the colour on their leaderboards changes accordingly.

3.4.9 Validation of the Gamification Package

The gamified instructional package was subjected to face and content validity, through expert reviews by lecturers in the Educational Technology Unit, Science and Technology department, University of Ibadan and Adeyemi College of Education, Ondo. An evaluation rubric was used to evaluate the instructional content of the package. The areas of the review were curriculum content, story content ease of use, quality of sound and images, gamification elements clarity of animation character, documentation and support, ability levels, engagement/ interactivity, technical quality, fun, adaptability, accessibility and speed. Their valuable comment and suggestions informed the final production of the package.

Development of Prototype of the Gamification Package 1

The prototype of the gamification package was developed after a thorough analysis of the learners and the medium of delivery have been considered. The content in first prototype was designed in frames using a modular and linear page structure. The method adopted for the user to interact with the package was to click on and follow the instruction given in each platform and proceed to go to the next stage. The prototype of the package was produced and presented to some selected educational technologists for feedback and comments on the technical quality and appropriateness of media used for the package.

Feedback from Educational Technologists

The experts raised the following comments:

i. That introducing gamification in Physics concepts is a welcome development.
ii. The gamified package would make the learning of Physics more interesting, effective and help students to master the difficult concepts in the subject.
iii. That platform should be gamification of Physics and not gamification in Physics
iv. There were needs to add forward and backward icon to emphasise important points in the package to avoid confusion for students
v. That correct answers should be marked as correct either in lower or upper case in the package
vi. That the package would help in the demystifying problem of abstraction of Physics and arouse students’ interest.

Rethinking the Problem

Based on these comments, necessary corrections were made to improve the quality of the package so that this intervention would have capabilities to solve the problems identified in the background of the study. After this, the proper editing of the text component was carried out to ensure error-free instructions and information. All these comments were properly examined, and appropriate corrections were made to produce the second prototype of the package.

Development of Prototype of the Gamification Package II

The second prototype was produced based on the comments and suggestions of experts on the technical quality and appropriateness of the media used in the package. The package was renamed as gamification of Physics and not in gamification in Physics. The forward and backward icon emphasised in the package was not corrected because it is a sort of assessment for the students, they get points and moves to levels as they proceed, and answer quizzes provided in the package. The leaderboard's icons also change to different colours and badges are won as they proceed, and answer quizzes provided in the package to ensure active engagement throughout the content. Correct answers are programmed in lower cases so all answers to questions were in small cases. At the end of the process, the second prototype was produced. Thereafter, the technical quality and the appropriateness of the package for classroom instruction was validated.

Feedback from the Educational Technologists

The respondents agreed this prototype was a significant improvement over the last sample. It was also recommended that there was a need for animation and video in the storytelling element aspect in the package to fully concretise the abstraction of Physics. Headphones/Earpiece should be provided to the target audience to streamline the underground noise as to allow proper concentration when listening to the story content of the package.

Feedback from the Teachers and Students

Their comments were summarised below:

i. They showed interest in using the package for classroom instruction.
ii. Some of the students even said they prefered the package especially the story content to conventional method of teaching.
iii. Both teachers and students believed that using gamification for learning would make Physics more interesting and less difficult

The researcher took note of all these comments and effected the necessary corrections to produce the third prototype.

Development of Prototype of the Gamification Package III

To produce the final copy of the package, necessary corrections were made, through the feedback from students, teachers, media design expert and discussions with other educational technologists. Corrections were made to the presentation of the content on the screen, the navigation, the overall interface and interactivity. The animation and video were put where necessary in the story content, head phones were also provided to each student. These adjustments were made to ensure the production of a complete instructional package that could be used to solve the problems associated with the teaching and learning of Physics**.**

Evaluation of the Package

The developed package was validated by the experts in instructional design. However, the zones of audit were educational program content, clearness of video, convenience, documentation and backing (caption), capacity levels, commitment, specialized quality, versatility, openness, and speed. Their important remarks and recommendations helped in the last creation regarding the video-based bundle. This package was then pilot tried on 30 secondary school II Physics students that were not part of the investigation.

Report from the Pilot Study of Gamification Package

To ensure smooth delivery at the implementation stage, a pilot study was carried in a secondary school that was not be part of the main study. The senior secondary school II students were divided into two groups to participate in the experimental groups.

Challenges from the Pilot Study

i. The challenges confronted were built into the main study to ensure minimum hitch at the implementation stage: The computers in the secondary school used, the volume of the system is not audible for the students to hear the storytelling aspect of the gamified package, the researcher needed to provide ear piece for each of the students to complement the existing facilities. This challenge was overcome in the main study by ensuring that all the participants make use of ear piece to hear the story.

ii. Power irregularity was also a challenge as the researcher needed to buy dissel to run the generator of the school for the pilot study and schools where there was no generator, the researcher provided a functional generator

3.4.10 Rubric for Evaluating Storytelling, Badges and Leaderboards Instructional Package (RESBLIP)

Evaluation rubric was developed by the researcher and completed by the experts in the field of Educational Technology Unit, University of Ibadan, the researcher's supervisor, and experts in Physics education from the Department of Physics, Adeyemi College of Education, Ondo, after they have interacted with the package. The areas of review were curriculum content, clarity of video, ease of use, documentation and support (sub title), ability levels, engagement/ interactivity, technical quality, adaptability, accessibility, and speed. Their valuable comments and suggestions informed the final production of the instruction. The instrument was administered to a sample of 30 senior secondary two students who were not part of the target group. They were rated and the reliability coefficient was 0.86, which indicated that the instructional package was reliable.

3.5 Research Procedures

The researcher visited the secondary schools selected for the study in order to get approval and cooperation of the Principals and Physics teachers who would participate in the study. The procedures for the study across the two stages were as follows:

Stage One: This stage has to do with the development of gamification package and a systematic procedure was followed in producing this instructional package to ensure that the required curriculum content was incorporated.

Time Plan for Stage Two of the Study (Implementation Stage)

Week 1: The researcher acquired a research permit from appropriate authority to officially have access to select secondary schools that would be used for the study. Furthermore, the selected schools were assigned into intervention and control groups.

Week 2: Training of research assistants on the rudiments of gamified instruction and coordination of classroom activities. Three research assistants used in the study were for experimental I, experimental II and for control group.

Week 3: Administration of pretests to the senior secondary school II students. Pretests on motivation to learn Physics, interest in Physics and Physics achievement test, were administered to the participants in both control and experimental groups before the intervention.

Week 4 – Week 11: Senior Secondary School II students were exposed to storytelling, points and levels based instructional learning (Experimental group I); storytelling, badges and leaderboards (experimental group II) and conventional instructional learning, using print media in the control group.

Week 12: Administration of posttests to the Senior Secondary School II students on motivation to learn Physics, interest in Physics and Physics achievement test were administered to the participants in both control and experimental groups after the intervention

3.5.1 Treatment Procedure

Experimental group I (Storytelling, Levels and Points based Instructional Guide)

This instructional guide was designed to serve as a template for seamless implementation of gamification package for Physics students in experimental group I. In this group, Physics teachers who served as research assistants were trained on how to use the package so that they will be able to direct the students following the instructional steps involved in the use of storytelling, levels and points gamified package in the classroom. Students in this group interact with the gamified Physics content already installed on the school computers. Steps that followed in achieving above stated are listed below.

Step 1: Preparatory Stage

The teacher copied the storytelling, levels and points gamified Physics content on the desktop of the school computer systems for easy access.

Step 2 Introduction

Teacher introduced the topic to the students on how they would learn through storytelling, levels and points gamified package.

Step 3: Gamified Instruction

Student located and clicked on the icon on the desktop.

Step 4: On the home page, student clicked on ‘have fun’ button.

Step 5: Student logged in with the user name and clicked on the 'go to menu' button to access the

gamified Physics content.

Step 6: Student clicked on a topic on the gamified Physics content and followed the given instructions.

Step 7: On each topic, there were 'gamified platform' and 'proceed to learn' buttons, student first

clicked on the story icon to hear the audio narrative story of the selected difficult topics.

Step 8: Student clicks on 'interpretation of the story' button after listening to the story

Step 9: Student clicks on 'proceed to learn' icon to interact with series of activities including the topics, exercises and assignments. As student proceeded and interacted with the package, levels are increased, and points are gained.

Step 10: To finish each topic content, 8 levels needs to be reached and 60 points gained. The teacher checked and recorded the level attained by the participants.

3.5.2 Experimental group II (Storytelling, Badges and Leaderboard based instructional Guide)

This instructional guide is designed to systematically expose students in experimental group II for gamified instructional package. In this group, Physics teachers were expected to follow the instructional steps involved in the use of storytelling, badges and leaderboard gamified package in the classroom. The participant in each cluster interacted with the package of Physics content that was installed on the system. Here are the steps that needs to follow:

Step 1: Preparatory Stage

The teacher copied the storytelling, badges and leaderboard gamified Physics content on the desktop of the school computer systems for easy location.

Step 2: Introduction

Teacher introduced the topic to the students on how they would learn through storytelling, badges and leaderboard gamified package.

Step 3: Gamified Instruction

Students located and clicked on the gamified package on the desktop. This allowed students to have access to the content of the package.

Step 4: On the home page, student clicked on ‘have fun’ button.

Step 5: Students’ logged in with the user name and clicked on the ‘go to menu’ button to access the gamified Physics content.

Step 6: Students’ clicked on a topic on the gamified Physics content and follow the given instructions.

Step 7: On each topic, there were ‘gamified platform’ and ‘proceed to learn’ buttons. Student

first clicked on the story icon to hear the audio narrative story of the selected topic.

Step 8: Students clicked on ‘interpretation of the story’ button after listening to the story.

Step 9: students clicked on ‘proceed to learn’ icon to interact with series of activities including the content, exercises and assignments. As students proceeded and interacted with the gamified package, leaderboards colour changes from purple, white to yellow, brown, blue, peach, white and lemon indicating their progress in relation to others. Also, badges were won, ranging from determined badge, excellent badge, and skilful badge to marketable badge.

Step 10: To finish each topic, 8 colours of leaderboards and 5 badges were won by the students.

The teacher checked and recorded the number of colours of leaderboards gained and badges won by each of the students on the gamified activities.

3.5.3 Control Group (Conventional strategy)

Step 1 The research assistant introduces the lesson to the participants by asking related questions from them especially based on their previous lesson. All questions were centered on students’ previous knowledge.

Step 2 The research assistant introduced the topic for the day.

Step 3 The research assistant introduced the topic, state formula and explain methods (steps) to solve problems under the topic of the day.

Step 4 The research assistant gave some examples and ensure that the students follow the sequential order of solving problems through teacher’s note.

Step 5 The participants wrote down the examples given by the research assistants in their notebook

Step 6 The research assistant gave some problems to solve by the participants as class work, to test how far they understood the topic being taught.

Step 7 The research assistant made necessary corrections based on the problem giving to the participants.

Step 8 The research assistant gave some problems to solve by the participants as home assignment.

3.6 Method of Data Analysis

Both quantitative and qualitative approaches were employed in analysing data that was collected. The descriptive statistics of frequency count, percentages, standard deviation and mean score were used to analyse the demographical information of the participants. Analysis of Covariance and Estimated Marginal Means were also used as inferential statistical tools. Bonferroni Post-hoc analysis was used to determine the source of the significant difference. The level of decision was 0.05 level of significance.

CHAPTER FOUR
ANALYSIS AND RESULTS

4.1 Testing of Null Hypotheses

Ho1a: There is no significant main effect of treatment (instructional strategy) on students' motivation towards Physics

Table 4.1: Analysis of Covariance (ANCOVA) of Post-Motivation by Treatment, Gender and Computer self-efficacy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	10682.453	12	890.204	29.808	0.000	.635
Intercept	2915.593	1	2915.593	97.628	0.000	.322
PreMotivation	9221.234	1	9221.234	308.771	0.000	.600
Treatment	862.304	2	431.152	14.437	0.000*	.123
Gender	97.009	1	97.009	3.248	0.073	.016
Computer self-efficacy	85.573	1	85.573	2.865	0.092	.014
Treatment x Gender	0.427	2	0.214	0.007	0.993	.000
Treatment x Computer self-efficacy	161.402	2	80.701	2.702	0.069	.026
Gender x Computer self-efficacy	39.265	1	39.265	1.315	0.253	.006
Treatment x Gender x Computer self-efficacy	84.850	2	42.425	1.421	0.244	.014
Error	6152.049	206	29.864			
Total	1206183.000	219				
Corrected Total	16834.502	218				

R Squared = 0.64 (Adjusted R Squared = 0.61)   * denotes significant p<0.05

Table 1 reveals that there is a significant main effect of (treatment) on students' motivation to learn Physics ($F_{(2, 206)} = 14.44$; $p<0.05$, partial $\eta^2 = 0.12$). The effect size is 12.3%. This shows that 12.3% of the 64.0% variation (Adjusted $R^2 = 0.64$) in students' motivation towards Physics in this model is due to the significant main effect of the treatment. Hence, hypothesis 1a was rejected. To explore the magnitude of the significant main effect across treatment groups, the estimated marginal means of the treatment groups were carried out and the result is presented in Table 4.2.

Table 4.2: Estimated Marginal Means for Post-Motivation by Treatment and Control group

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Storytelling, Points and Levels Strategy (SPLS)	78.63	1.03	76.60	80.66
Storytelling, Leaderboards and Badges Strategy (SLBS)	75.34	1.26	72.85	77.83
Conventional Strategy (CS)	69.71	1.29	67.16	72.26

Table 4.2 indicates that students exposed to Storytelling, Points and Levels Strategy (SPLS) treatment group 1 had the highest adjusted post-motivation mean score to learn Physics (78.63) than their counterparts in the Storytelling, Leaderboards and Badges Strategy (SLBS) treatment group 2 (75.34) and the Conventional Strategy (CS) control group (69.71). This order is represented as SPLS > SLBS > CS. In order to determine which of the groups caused the significant main effect, the Bonferroni post-hoc analysis was carried out across the treatment groups and the result was presented in Table 4.3.

Table 4.3: Bonferroni Post-hoc Analysis of Post-Motivation by Treatment and Control Group

Treatment	Mean	SPLS	SLBS	CS
Storytelling, Points and Levels Strategy (SPLS)	78.63			*
Storytelling, Leaderboards and Badges Strategy (SLBS)	75.34			*
Conventional Strategy (CS)	69.71	*	*	

Table 4.3 reveals that the post-motivation towards Physics mean score of students exposed to Storytelling, Points and Levels Strategy (SPLS) was significantly not different from their counterparts exposed to the Storytelling, Leaderboards and Badges Strategy (SLBS) but was significantly different from those taught with the Conventional Strategy (CS). Table 4.3 also reveals that the post-motivation to learn Physics mean score of students exposed to the Storytelling, Leaderboards and Badges Strategy is significantly different from their counterparts in the conventional strategy. This indicates that the significant difference reveals by the ANCOVA summary is due to the result of difference between the treatment groups and the control group (conventional strategy) and not between the two treatment groups as student's post-motivation to learn Physics is concerned.

Ho1b: There is no significant main effect of treatment on students' interest in Physics

Table 4.4: Analysis of Covariance (ANCOVA) of Post-Interest by Treatment, Gender and Computer self-efficacy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2312.372	12	192.698	40.709	0.000	0.703
Intercept	241.359	1	241.359	50.989	0.000	0.198
PreInterest	1805.269	1	1805.269	381.379	0.000	0.649
Treatment	134.171	2	67.085	14.172	0.000*	0.121
Gender	0.021	1	0.021	0.004	0.947	0.000
Computer self-efficacy	4.471	1	4.471	0.945	0.332	0.005
Treatment x Gender	4.508	2	2.254	0.476	0.622	0.005
Treatment x Computer self-efficacy	8.514	2	4.257	0.899	0.408	0.009
Gender x Computer self-efficacy	3.924	1	3.924	0.829	0.364	0.004
Treatment x Gender x Computer self-efficacy	0.652	2	0.326	0.069	0.933	0.001
Error	975.108	206	4.734			
Total	230626.000	219				
Corrected Total	3287.479	218				

R Squared = 0.70 (Adjusted R Squared = 0.69)   * denotes significant $p<0.05$

Table 4.4 shows that there is a significant main effect on students' interest in Physics ($F_{(2, 206)}$ = 14.17; $p<0.05$, partial η^2 = 0.12). The effect is 12.0%. This implies that 12.0% of the 69.0% variation (Adjusted R^2 = 0.70) in students' interest in Physics was as the result of the significant main effect of the treatment. Hence, hypothesis 1b was rejected. To explore the magnitude of the significant main effect across treatment groups, the estimated marginal means of the treatment groups were carried out and the result was presented in Table 4. 5.

Table 4.5: Estimated Marginal Means for Post-Interest by Treatment and Control group

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Storytelling, Points and Levels Strategy (SPLS)	34.10	0.41	33.31	34.90
Storytelling, Leaderboards and Badges Strategy (SLBS)	32.62	0.50	31.63	33.61
Conventional Strategy (CS)	30.61	0.52	29.60	31.63

Table 4.5 shows that students in Storytelling, Points and Levels Strategy (SPLS) treatment group 1 had the highest adjusted post-interest mean score in Physics (34.10) than their counterparts in the Storytelling, Leaderboards and Badges Strategy (SLBS) treatment group 2 (32.62) and the Conventional Strategy (CS) control group (30.61). This order was represented as SPLS > SLBS > CS. In order to determine which of the groups causes this significant main effect, the Bonferroni post-hoc analysis was carried out across the treatment groups and the result is presented in Table 4.6.

Table 4.6: Bonferroni Post-hoc Analysis of Post-Interest by Treatment and Control Group

Treatment	Mean	SPLS	SLBS	CS
Storytelling, Points and Levels Strategy (SPLS)	34.10			*
Storytelling, Leaderboards and Badges Strategy (SLBS)	32.62			*
Conventional Strategy (CS)	30.61	*	*	

Table 4.6 indicated that the post-interest in Physics mean score of students in Storytelling, Points and Levels Strategy (SPLS) was significantly not different from their counterparts in the Storytelling, Leaderboards and Badges Strategy (SLBS) but was significantly different from those in the Conventional Strategy (CS). Table 6 also indicates that the post-interest in Physics mean score of students exposed to the Storytelling, Leaderboards and Badges Strategy was significantly different from their counterparts in the conventional strategy. This indicates that the significant difference reveals by the ANCOVA summary was due to the result of difference between the treatment groups and the control group and not between the two treatment groups as students' post-interest in Physics was concerned.

Ho1c: There is no significant main effect of treatment (instructional strategy) on students' achievement in Physics

Table 4.7: Analysis of Covariance (ANCOVA) of Post-Achievement by Treatment, Gender and Computer self-efficacy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7513.039	12	626.087	66.200	0.000	.794
Intercept	838.883	1	838.883	88.700	0.000	.301
PreAchievement	3234.834	1	3234.834	342.037	0.000	.624
Treatment	306.255	2	153.128	16.191	0.000*	.136
Gender	10.940	1	10.940	1.157	0.283	.006
Computer self-efficacy	0.437	1	0.437	0.046	0.830	.000
Treatment x Gender	20.168	2	10.084	1.066	0.346	.010
Treatment x Computer self-efficacy	6.785	2	3.393	0.359	0.699	.003
Gender x Computer self-efficacy	1.013	1	1.013	0.107	0.744	.001
Treatment x Gender x Computer self-efficacy	24.776	2	12.388	1.310	0.272	.013
Error	1948.258	206	9.458			
Total	108747.000	219				
Corrected Total	9461.297	218				

R Squared = 0.79 (Adjusted R Squared = 0.78)   * denotes significant p<0.05

Table 4.7 indicates that there is a significant main effect of instructional strategy on students' achievement in Physics ($F_{(2, 206)}$ = 16.19; $p<0.05$, partial η^2 = 0.14). The effect size was 14.0%. This implies that 14.0% of the variation in students' achievement in Physics was due to the significant main effect of the treatment. Hence, hypothesis 1c was rejected. To explore the magnitude of the significant main effect across treatment groups, the estimated marginal means of the treatment groups were carried out and the result was presented in Table 4.8.

Table 4.8: Estimated Marginal Means for Post-Achievement by Treatment and Control group

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Storytelling, Points and Levels Strategy (SPLS)	23.13	0.59	21.96	24.29
Storytelling, Leaderboards and Badges Strategy (SLBS)	22.98	0.71	21.57	24.38
Conventional Strategy (CS)	18.03	0.74	16.57	19.49

Table 4.8 indicates that students exposed to the Storytelling, Points and Levels Strategy (SPLS) treatment group 1 have the highest adjusted post-achievement mean score in Physics (23.13) than their counterparts in the Storytelling, Leaderboards and Badges Strategy (SLBS) treatment group 2 (22.98) and the Conventional Strategy (CS) control group (18.03). This order was represented as SPLS > SLBS > CS. In order to determine which of the groups caused this significant main effect, the Bonferroni post-hoc analysis was carried out across the treatment groups and the result is presented in Table 4. 9.

Table 4.9: Bonferroni Post-hoc Analysis of Post-Achievement by Treatment and Control Group

Treatment	Mean	SPLS	SLBS	CS
Storytelling, Points and Levels Strategy (SPLS)	23.13			*
Storytelling, Leaderboards and Badges Strategy (SLBS)	22.98			*
Conventional Strategy (CS)	18.03	*	*	

Table 4.9 shows that the post-achievement in Physics mean score of students taught with the Storytelling, Points and Levels Strategy (SPLS) was significantly not different from their counterparts in the Storytelling, Leaderboards and Badges Strategy (SLBS) but was significantly different from those exposed to the Conventional Strategy (CS). Table 4.9 also indicated that the post-achievement in Physics mean score of students exposed to the Storytelling, Leaderboards and Badges Strategy was significantly different from their counterparts taught with the conventional strategy. This indicates that the significant difference revealed by the ANCOVA summary was due to the result of difference between the treatment groups and the control group and not between the two treatment groups as students post-achievement in Physics was concerned.

Ho2a: There is no significant main effect of gender on students' motivation to learn Physics

Table 4.1 reveals that there is no significant main effect of gender on motivation to learn Physics ($F_{(1, 206)} = 3.25$, $p>0.05$; partial $\eta^2 = 0.02$). Hence, hypothesis 2a was not rejected. This implies that students' gender had no effect on their motivation to learn Physics.

Ho2b: There is no significant main effect of gender on students' interest in Physics

Table 4.4 shows that there is no significant main effect of gender on interest in Physics ($F_{(1, 206)} = 0.004$, $p>0.05$; partial $\eta^2 = 0.00$). Hence, hypothesis 2b was not rejected. This implies that students' gender had no effect on their interest in Physics.

Ho2c: There is no significant main effect of gender on students' achievement in Physics

Table 4.7 shows that there is no significant main effect of gender on achievement in Physics ($F_{(1, 206)} = 1.16$, $p>0.05$; partial $\eta^2 = 0.01$). Thus, hypothesis 2c was not rejected. This means that students' gender had no effect on their achievement in Physics.

Ho3a: There is no significant main effect of computer self-efficacy on students' motivation towards Physics

Table 4.1 reveals that there is no significant main effect of computer self-efficacy on motivation towards Physics ($F_{(1, 206)} = 2.87$, $p>0.05$; partial $\eta^2 = 0.01$). Hence, hypothesis 3a was not rejected. This indicated that computer self-efficacy had no effect on students' motivation to learn Physics.

Ho3b: There is no significant main effect of computer self-efficacy on students' interest in Physics

Table 4.4 shows that there is no significant main effect of computer self-efficacy on interest in Physics ($F_{(1, 206)} = 0.95$, $p>0.05$; partial $\eta^2 = 0.01$). Hence, hypothesis 3b was not rejected. This means that computer self-efficacy had no effect on students' interest in Physics.

Ho3c: There is no significant main effect of computer self-efficacy on students' achievement in Physics

Table 4.7 shows that there is no significant main effect of computer self-efficacy on achievement in Physics ($F_{(1, 206)} = 0.05$, $p>0.05$; partial $\eta^2 = 0.00$). Thus, hypothesis 3c was not rejected. This means that computer self-efficacy had no effect on students' achievement in Physics.

Ho4a: There is no significant interaction effect of treatment and gender on students' motivation towards Physics

Table 4.1 reveals that there is no significant interaction effect of treatment and gender on motivation towards Physics ($F_{(2, 206)} = 0.01$, $p>0.05$; partial $\eta^2 = 0.00$). Hence, hypothesis 4a was not rejected. This implies that treatment and students' gender had no effect on their motivation to learn Physics.

Ho4b: There is no significant interaction effect of treatment and gender on students' interest in Physics

Table 4.9 reveals that there is no significant interaction effect of treatment and gender on interest in Physics ($F_{(2, 206)} = 0.48$, $p>0.05$; partial $\eta^2 = 0.01$). Hence, hypothesis 4b was not rejected. This means that treatment and gender had no effect on students' interest in Physics.

Ho4c: There is no significant interaction effect of treatment and gender on students' achievement in Physics

Table 4.7 reveals that there is no significant interaction effect of treatment and gender on achievement in Physics ($F_{(2, 206)} = 1.07$, $p>0.05$; partial $\eta^2 = 0.01$). Therefore, hypothesis 4c was not rejected. This indicated that treatment and gender had no effect on students' achievement in Physics.

Ho5a: There is no significant interaction effect of treatment and computer self-efficacy on students' motivation to learn Physics

Table 4.1 reveals that there is no significant interaction effect of treatment and computer self-efficacy on motivation towards Physics ($F_{(2, 206)} = 2.70$, $p>0.05$; partial $\eta^2 = 0.03$). Hence, hypothesis 5a was not rejected. This implies that treatment and computer self-efficacy of students had no effect on their motivation to learn Physics.

Ho5b: There is no significant interaction effect of treatment and computer self-efficacy on students' interest in Physics

Table 4.4 reveals that there is no significant interaction effect of treatment and computer self-efficacy on interest in Physics ($F_{(2, 206)} = 0.90$, $p>0.05$; partial $\eta^2 = 0.01$). Hence, hypothesis 5b was not rejected. This shows that treatment and computer self-efficacy had no effect on students' interest in Physics.

Ho5c: There is no significant interaction effect of treatment and computer self-efficacy on students' achievement in Physics

Table 4.7 reveals that there is no significant interaction effect of treatment and computer self-efficacy on achievement in Physics ($F_{(2, 206)} = 0.36$, $p>0.05$; partial $\eta^2 = 0.00$). Therefore, hypothesis 5c was not rejected. This indicates that treatment and computer self-efficacy had no effect on students' achievement in Physics.

Ho6a: There is no significant interaction effect of gender and computer self-efficacy on students' motivation towards Physics

Table 4.1 reveals that there is no significant interaction effect of gender and computer self-efficacy on motivation to learn Physics ($F_{(1, 206)} = 1.32$, $p>0.05$; partial $\eta^2 = 0.01$). Hence, hypothesis 6a was not rejected. This implies that gender and computer self-efficacy of students had no effect on their motivation to learn Physics.

Ho6b: There is no significant interaction effect of gender and computer self-efficacy on students' interest in Physics

Table 4.4 reveals that there is no significant interaction effect of gender and computer self-efficacy on interest in Physics ($F_{(1, 206)} = 0.83$, $p>0.05$; partial $\eta^2 = 0.00$). Thus, hypothesis 6b was not rejected. This indicated that gender and computer self-efficacy had no effect on students' interest in Physics.

Ho6c: There is no significant interaction effect of gender and computer self-efficacy on students' achievement in Physics

Table 4.7 reveals that there is no significant interaction effect of gender and computer self-efficacy on achievement in Physics ($F_{(1, 206)} = 0.11$, $p>0.05$; partial $\eta^2 = 0.00$). Therefore, hypothesis 6c was not rejected. This implies that gender and computer self-efficacy had no effect on students' achievement in Physics.

Ho7a: There is no significant interaction effect of treatment, gender and computer self-efficacy on students' motivation to learn Physics

Table 4.1 reveals that there is no significant interaction effect of treatment, gender and computer self-efficacy on motivation to learn Physics ($F_{(2, 206)} = 1.42$, $p>0.05$; partial $\eta^2 = 0.01$). Thus, hypothesis 7a was not rejected. This indicates that treatment, gender and computer self-efficacy of students had no effect on their motivation to learn Physics

Ho7b: There is no significant interaction effect of treatment, gender and computer self-efficacy on students' interest in Physics

Table 4.4 reveals that there is no significant interaction effect of treatment, gender and computer self-efficacy on interest in Physics ($F_{(2, 206)}$ = 0.07, $p>0.05$; partial η^2 = 0.00). Thus, hypothesis 7b was not rejected. Treatment, gender and computer self-efficacy had no effect on students' interest in Physics.

Ho7c: There is no significant interaction effect of treatment, gender and computer self-efficacy on students' achievement in Physics

Table 4.7 reveals that there is no significant interaction effect of treatment, gender and computer self-efficacy on achievement in Physics ($F_{(2, 206)}$ = 1.31, $p>0.05$; partial η^2 = 0.01). Therefore, hypothesis 7c was not rejected. Treatment, gender and computer self-efficacy had no effect on students' achievement in Physics.

4.2 Discussion of Findings

4.2.1 Treatment and Secondary School Students' Motivation towards Physics

The findings from the study indicated that there was a significant main effect of treatment on SS II students' motivation in Physics between the two levels of experimental and control groups. This implied that gamified strategy has significant effect on students' motivation to learn Physics. In other words, students who were exposed to this strategy had the highest post-motivation to learn Physics than students in the control group. The inherent potentials of gamification to actively engage students and stimulate their interest could have been responsible for their motivation towards it after the treatment**.** From this findings, gamification has proven to actively motivate students and stimulate their interest could resulting to improvement in students 'motivation to learn Physics. The findings support the research done by Rose (2015) on introductory physics course and made Life Science students to undergo tests using gamified multiple choice quizzes against a control group. Strong evidence was found to support the hypothesis that students taking gamified quizzes have higher levels of motivation than students taking more traditional quizzes. These corroborates the findings that students placed in a gamified instructional setting showed signs of significant improvement in student motivation (Adachi & Willoughby, 2013; Grimley et al., 2011; Grimley et al., 2012; Tuzunet al., 2009; Banfield & Wilkerson, 2014). The result is in support of findings by kuo and chuang (2016), Mekler et al. (2017), Hamari (2013). The findings of the study showed that effects of individual game elements significantly increased academic performance and user's motivation. This is contrary to the findings of Hanus and Fox (2015), De-Marcos et al. (2014) and Ahn *et al* (2014) which showed mostly negative results from gamifying an educational course which found out that "students in the gamified course showed less motivation and had lower academic achievement than students enrolled in the non-gamified version of the course.

Findings also revealed that senior secondary students in storytelling, points and levels mode was significantly not different from their counterparts in the storytelling, badges and leaderboards mode but was significantly different from those taught with the conventional strategy. The learning advantage of combination of game elements storytelling, points and levels instruction and storytelling, badges and leaderboards mode may be due to the findings of Mekler, Brühlmann, Opwis, and Tuch, 2013b; Meyer, 2008; O'Donovan, Gain & Marais, 2013) that game element must be used in combination with other elements of gamification as a potential learning strategy to enhance students' motivation. Elements of gamification contribute to increased engagement and motivation for some students; however, these elements cannot stand alone (Deterding, 2014; Gåsland, 2011; Mekler et al., 2013b). Kotluk and Kocakaya (2016) in their study affirmed that digital stories have positive effect on high school students' motivation, attitude and interest towards Physics.

4.2.2 Treatment and Secondary School Students' Interest in Physics

The findings from the study indicated that there was a significant main effect of treatment on SS II students' interest in Physics across the two levels of experimental and control groups. This implied that gamified strategy had significant influence on students' interest in Physics. In other words, students who were exposed to this strategy had highest post-interest in Physics than students in the control group. This affirms the study of Cronk (2012) in the implementation of a reward-based system to improve college students' interest and engagement in the form of a virtual tree that would grow in response to points assigned in class. This study reported an increase in students' interest after the experiment. This also corroborate the study of Hanus and Fox (2015) who found out that students showed positive interest when they are engaged in gamified course thereby improving their interest in the subject. The findings in this study also support the studies of Barata, Gama, Jorge and Gonçalves, 2013; Werbach and Hunter, 2012 that game elements used in gamification can make learning more fun and interesting for students.

4.2.3 Treatment and Secondary School Students' Achievement in Physics

The findings from the study indicated that there was a significant main effect of treatment on SS II Physics students' achievement. This implied that the gamified strategy had significant influence on Physics students' achievement. In other words, students who were exposed to this strategy performed better in Physics achievement than students in the control group. The inherent potentials of gamification to actively engage students and stimulate their interest could have been responsible for this improvement in students' achievement after the experiment. Some of the critical factors that had been documented in literature to be responsible for students' poor achievement in Physics were due to teacher and student-related factors, poor motivation to learn the instructional content and lack of interest in the subject matter and these could largely be associated with the teaching approach employed by many teachers in instructional delivery process. Reports had indicated that many students consider Physics a difficult subject due to the teaching method employed by the teachers to deliver the instructional content.

Barata *et al*. (2013) affirmed that there was an increase in the number of students attaining the highest grades, as well as a decrease in the difference between the lowest and highest student grades when instructions were presented in gamified format. This is consistent with the findings of Mekler *et al*. (2013b), who found that gamification significantly increased performance of the students, as it fostered active engagement in instructional tasks. Three studies reported increased student participation (Charles, Charles, McNeill, Bustard, and Black, 2011; Barata *et al*., 2013; Li *et al*., 2013) and lecture attendance (Charles *et al* 2011; Barata *et al.*, 2013;) as a result of gamification. Increased student attendance has been shown to correlate positively with improved student performance (Adegoke, Salako and Ayinde, 2013). Mayer and Johnson (2010) aver that students learn faster and better able to transfer knowledge when the teacher adopted gamification instructional strategy. Similarly, Charles *et al*. (2011) determined that poor levels of engagement lead to non-progression within a course and that when gamification was introduced into a first-year computer course, there was a 12.9% reduction in the number of failures.

4.2.4 Gender on Secondary School Students' Motivation, Interest and Achievement in Physics

The findings revealed that there was no significant main effect of gender on Secondary School Students' motivation, interest and achievement in Physics. This means that students' gender had no effect on motivation, interest and achievement in both experimental and control groups in Physics after being exposed to gamified instruction. These could be attributed that the treatment was suitable to both sexes as it provides both male and female the equal learning conditions to participate actively in the learning process. This result is in line with the findings of Akingbemisilu (2017), Adedoja and Fakokunda (2015), Oguntunde (2014), Efuwape and Aremu (2013), Aremu, and Morakinyo (2009). However, their study fails to give directions on how gender of learners have no impact on learners motivation, interest as well as achievement in Physics subject. Furthermore, learners motivational idea used to fluctuating when it is comes to gender ability. High ability learners with physical strength found to be more motivated than their counterparts that had low physical strength when it comes to contending or challenges that involve learners face-to-face ability. Also, female found to be easily lost interest in the challenges. All these gave male counterparts added advantage to outperform their counterpart academic achievement most especially in science-oriented subjects. These among other factors had been discover in previous studies that suggest that sex may not have influence learners achievement in Physics, even with the use of technology such as gamified approach. It opposes the findings of Alexander *et al*., (2010); Bonanno and Kommers, (2008), Murphy and Whitelegg, (2006) Stadler, Duit and Benke (2000) that male are more aspired in learning Physics-related concepts than female student. In their studies, it was discovered that female learners do not always enjoy the difficulties that were peculiar with learning Physics as well as their efforts of interest towards subject matter always not encouraging.

Similarly, learning content could be alleged to be stereotyped or to have been gender sensitive in such a way that it means different things to both sexes. Also, relationship or interaction of learning could simply lead to a kind of phenomena that result in a situation where a gender group was being favoured or being at advantage to another. However, their study failed to indicate Werther package like game-based were been used to learn or teach Physics concepts. Moreover, teaching-learning process with the use of game actually shows no difference in the interest and motivation of the participants thus both sexes were performed wonderfully in their academic advancement.

4.2.5 Computer Self-Efficacy on Secondary School Students' Motivation, Interest and Achievement in Physics

Findings from the study showed that there were no significant main effects of computer self-efficacy on the secondary school students' motivation, interest and achievement in Physics. In other words, computer self-efficacy was found to have no significant influence on secondary school students' motivation, interest achievement in both experimental and control groups after being exposed to gamified instruction. This could be due to the fact that students in this 21st Century are digital natives and they live in media saturated environments and are increasingly adopting the use of technology for different purposes These findings corroborate with findings of Olufunmilayo and Aire (2017), Abubakar and Adetimirin (2015) Emwanta, and Nwalo (2013) Achuonye (2012), Jeong-Bae, Thomas and Indra (2012), Koh, (2011).). Efficacy has a strong tie with Physics academic achievement. However, it was found that in some cases learners efficacy has no impact on their progress in terms of science subject. This could be as a result of technology approach integrated into learning process which learners have already used to most especially gamified system that gives room for learners to interact or mediate with learning concepts as well as collaborate with their peers. Similarly, as digital native generation learners already developed a special skills that help them to get acquitted with learning via use of technology approach.

4.2.6 Treatment and Gender on Secondary School Students' Motivation, Interest and Achievement in Physics

The findings revealed that there was no significant two-way interaction effect of treatment and gender on senior secondary students' motivation, interest and achievement in Physics. This implies that treatment and gender had no effect on senior secondary students' motivation, interest and achievement in Physics. In other words, it showed that the interaction effect of treatment and gender did not mutually influence the dependent variables (motivation, interest and achievement) to produce a combine effect. The finding confirms the effectiveness of gamified based instruction to improve students' motivation, interest and achievement in Physics irrespective of their gender.

This suggests that treatments and gender had no communication impact on their' inspiration (motivation), interest and achievement in Physics. In other words, it showed that the interaction effect of intervention used in the study and gender did not mutually influence the dependent variables (motivation, interest and achievement) to produce a combine effect. The finding confirms the effectiveness of gamified instruction to improve students' motivation, interest and achievement in Physics irrespective of their gender. And as such, the effectiveness does not largely depend on interaction of intervention on gender and their interest in learning Physics. Therefore, treatment can be effective in motivating learners as well as arousing their interest to learn which would eventually improve their academic performance. On the teacher's part, it will help apply appropriate teaching methodology to simplify difficult perceived subjects such as Physics.

Fakuade and Ariyibi (2017) as well as Lawrence and Fakuade (2021) indicated that there is strong connect between learners achievement and their motivation as well as learners interest towards learning science oriented subjects. However this also have to do with the type of methodology and learning approached been adopted in the process. Therefore, the intervention of gamifying use in this study also gender sensitive, has no connection with the influence of learners motivation, interest and achievement, but not that intervention does not influence learners academic progress. Thus, the report of this study has been constantly indicated in direction that intervention and gender has no impacted linking with learners interest towards Physics as well as their academic achievement. It is found that the above assertion is not in line with their certain studies. (Deci and Ryan 2015, Vallerand 2012, Gottfried 2017).

4.2.7 Treatment and Computer Self-Efficacy on Motivation, Interest and Achievement in Physics

The findings revealed that there was no interaction effect of treatment and computer self-efficacy on senior secondary students' motivation, interest and achievement in Physics. This might be distinct with the fact that the treatment provided equal learning condition for all the senior secondary II students, regardless of their computer self-efficacy levels. Studies have shown that there is a link in the study interventions with variables used in the study, but not in line with the outcomes of the reports. (Miller 2014; Pajares and Kranzler 2015; Nielsen and Moore, 2013). The relationship could be linked with the work of Bandura" theory which suggest that person or learners that have high self-efficacy tends to be more motivated and interested in learning than those that have low self-efficacy. According to these scholar, self- efficacy learners are always more effective in self-learning most especially when it is technology related approach than their mates that are less motivated and having low interest in learning. This however would affect their progress in terms of learning. On the contrary, findings have found no impact in gamification and self-efficacy over learners' motivation as well as their interest in Physics concepts.

This could be due to the fact that technology is greatly influencing all aspects of human endeavours and whether students are exposed to computer-based learning or conventional learning strategy, they need to interact with technological devices to function effectively in this modern society. This showed that the improvement in senior secondary students' motivation, interest and achievement in Physics is due to the gamified-based instruction used in the Physics instructional delivery.

4.2.8 Gender and Computer Self-Efficacy on Secondary School Students' Motivation, Interest and Achievement in Physics

The findings revealed that there was no interaction effect of gender and computer self-efficacy on senior secondary students' motivation, interest and achievement in Physics. This implies that gender and computer self-efficacy had no effect on senior secondary students' motivation, interest and achievement in Physics. This could be as a result of learners' peculiarity with use of ICT, whether male or female, are well aware of using computer in their wards. This condition has built-up into consciousness of learners as result of able and have access to computer for learning and other social engagement. However, using computer to learn Physics would likely not make any fundamental impact on their academic advancement. Thus, the report was not consistent with study that girls seem to be less privileged with the use of technology than male counterparts because female avoids more complex and technical task than male counterparts. Girls usually have low interest in vocational tasks that demand more of physical strength that male counterparts. Since Physics require practical tasks therefore males were expected to perform better than their counterpart in academic achievement as well in motivation and interest towards subject concepts. (Saribiyik, 2004).

4.2.9 Treatment, Gender and Computer Self-Efficacy on Students' Motivation, Interest and Achievement in Physics

The result obtained showed that the three-way interaction effects of treatment, computer self-efficacy and gender on senior secondary students' motivation, interest and achievement in Physics were not significant. This means that if the same treatment is given to male and female students from high and low computer self-efficacy level, similar results would be obtained in motivation, interest and achievement in Physics

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

The findings of this study are summarised thus:

1. There was a significant main effect of treatment on senior secondary students' motivation towards Physics. Storytelling, points and levels-based treatment group had the highest adjusted post-achievement mean score followed by storytelling, badges and leaderboards treatment group. This implied that storytelling, points and levels based, and storytelling, badges and leaderboards strategies were the main sources of significant differences in treatment.
2. There was a significant main effect of treatment on senior secondary students' interest in Physics. The effect size was 70.0%. Storytelling, points and levels-based treatment group had the highest adjusted post-interest mean score followed by storytelling, badges and leaderboards treatment group. This implied that storytelling, points and levels based, and storytelling, badges and leaderboards strategies were the main sources of significant differences in treatment
3. There was a significant main effect of treatment on senior secondary students' achievement in Physics. The post-achievement in Physics score of students exposed to storytelling, points and levels-based mode was not significantly different from their counterparts in storytelling, badges and leaderboards group. This indicated that storytelling, points and levels based, and storytelling, badges and leaderboards strategies were the main sources of significant differences in treatment.
4. There were no significant main effects of gender on senior secondary students' motivation, interest and achievement in Physics.
5. There were no significant main effects of computer self-efficacy on senior secondary students' motivation, interest and achievement in Physics.

6. There were no significant two-way interaction effects of treatment and gender on senior secondary students' motivation, interest and achievement in Physics.
7. There were no significant two-way interaction effects of treatment and computer self-efficacy on senior secondary students' motivation, interest and achievement in Physics.
8. There were no significant two-way interaction effects of gender and computer self-efficacy on senior secondary students' motivation, interest and achievement in Physics.
9. There were no significant three-way interaction effects of treatment, gender and computer self-efficacy and achievement on senior secondary students' motivation, interest and achievement in Physics.

5.2 Conclusion

Based on the findings of this study, it is established that both storytelling, points and levels based, as well as storytelling, badges and leaderboards strategies are effective in improving the learning outcomes in Physics instructions than the conventional method. This study investigated the impact of gamified concepts on motivation, interest and achievement in Physics on senior secondary II students in Ondo city, Nigeria. Gamified package was developed to concretize the perceived difficult concepts in Physics on intact class of senior secondary school II Physics students. The storytelling, points and levels and storytelling, badges and leaderboards strategies were found to have contributed significantly to improved motivation, interest and achievement of SS II Physics students than the conventional lecture method. Therefore, the study had provided a better understanding of the strategic roles gamification could play in reducing the level of abstraction in classroom. It also makes teaching of Physics instruction interesting and connected to real life situation. This study had affirmed the efficacy and appropriateness of gamified strategy in proffering solutions to the myriads of challenges confronting the teaching and learning of Physics at the secondary school level. It could, therefore, be concluded that Physics teachers need to adopt this pragmatic approach to demystify perceived difficult topics in Physics by leveraging the capabilities of gamified strategy in instructional delivery. This would go a long way in making Physics more interesting and connected to real life situation. The two gamified instructions offered senior secondary school students' opportunity to be actively engaged in the learning process, to receive instruction through a variety of multi-media, to work at their own pace, and received immediate feedback.

5.3 Educational Implications of Findings

The findings of this study have following implications:

i. Gamified instructions have been found to be a viable strategy to complement conventional mode of teaching pre-service teachers.

ii. It provides students with the opportunities to demystify difficult concepts in Physics using the gamified instruction.

iii. The two modes of gamified instruction enhance active engagement in the instructional content which has resulted in concretising the abstraction of the difficult concepts.

iv. The study provides empirical evidence that gamified instruction affects both cognitive and affective domains of students. Thereby, this improves the way students interact with the contents and learn at their own pace.

v. Also, gamified instruction engenders the interaction due to the quiz embedded in the package and this has resulted in improved motivation and interest which lead to improved achievement to Physics.

5.4 Recommendations

The following recommendations are made based on the findings from this study:

i. Physics teachers should integrate gamified instruction into classroom as it has proved to be effective in reducing the level of abstraction associated with the teaching and learning of this concept at the secondary school level of education.

ii. Physics teachers should leverage on the capabilities of gamification to improve senior secondary school students' motivation, interest and achievement in Physics at all secondary school.

iii. Secondary school teachers and students in Nigerian secondary schools should be computer literate in order to use the gamified instructions in Physics instructions

iv. Physics teachers should be adequately sensitised through workshops, seminars and conferences of Educational Media and Technology Association of Nigeria (EMTAN), and Science Teachers Association of Nigeria (STAN) on the use of gamified instruction for instructional delivery at secondary school level by the Federal Ministry of Education.

v. Preservice Physics teachers should incorporate of gamified strategy into method of teaching Physics courses.

vi. Curriculum planners and developers of Nigeria secondary level of education should emphasize the need to continuously use innovative strategies such as gamified instruction to improved instructional delivery.

5.5 Contributions to Knowledge

This study has contributed to knowledge in the following ways:

i. The study has been able to establish the fact that gamified instruction is effective in improving senior secondary school student' motivation, interest and achievement in Physics.

ii. The study has provided justification for gamified instruction as a viable way that enriches the conventional teaching method employed by Physics teachers at the secondary level of education.

iii. The class activities in gamified package afforded senior secondary school students the opportunity to engage and give attention to the details in the instructional contents.

5.6 Limitations of the Study

i. The study was limited to SS II Physics students excluding Physics students from other levels.

ii. The study covered six secondary schools in Southwest, Nigeria.

iii. Gender and computer self-efficacy were the moderator variables considered among numerous variables that could have effect on the outcome of the study.

iv. Three topics from SS II Physics topics were covered in the study.

5.7 Suggestions for Further Studies

Based on the limitations to the study, the following suggestions are made for further study:

i. Gamified instruction has been affirmed as an effective instruction to engage students at all levels of education. Therefore, this study could be replicated at secondary, polytechnic and university levels of education and in other subjects.

ii. The instruction could be used for other aspects of Physics at the secondary levels of education.

iii. Gamified packages could be developed to cover other topics in Physics. The study should be carried out on a longitudinal scale, to check if the instruction would continue to significantly improve the learning outcomes.

iv. It would be of good benefits to supplementary do a study on factors that affect learners' motivation and interest while using gamify approach as well as discover way it can be integrated in educational system in other to further improve learners academic progress most especially in Physics concepts.

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APPENDIX I

UNIVERSITY OF IBADAN
DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

QUESTIONNAIRE ON STUDENTS' MOTIVATION IN PHYSICS (QSMP)

Dear Respondents,

This questionnaire is necessary to obtain data from senior secondary students on their motivation towards learning of Physics; your cooperation is therefore required to assist the researcher in achieving success in this study. Kindly complete this questionnaire with every sense of honesty.

All information provided will be kept confidential.

Thank you.

Section A

(Kindly complete section A as appropriate)

GENDER: Male ( ) Female ( )

AGE: 10-12years ( ) 13-15years ( ) 16-18years ( ) 18years and above ( )

SCHOOL: **CLASS:**

Section B

Kindly tick (√) which is applicable to you, please note that SA-Strongly Agree, A-Agree, D-Disagree, SD-Strongly Disagree

S/N	**ITEMS**	**SA**	**A**	**D**	**SD**
	ATTENTION				
1.	There is nothing interesting in physics instruction that got my attention.				
2.	The components of the instruction are eye-catching.				
3.	The quality of the content of helped to hold my attention in physics classroom.				

4.	This course is so abstract that it is sometimes hard to keep my attention in classroom activities.				
5.	The method used by the teacher in physics classroom does not encourage me to learn the content.				
6.	Physics concepts look dry and unappealing to the students.				
7.	The way the information is presented usually encourage me to learn physics.				
8.	This course has components that stimulate my curiosity to learn physics.				
9.	The way this course is being presented makes it boring.				
10.	The approach adopted by physics teacher is appealing and encourages me to learn more in the course.				
	RELEVANCE				
11.	It is clear to me how the instructional content is related to things I already know in physics.				
12.	Their stories, pictures and examples showed me how realistic the physics concepts could be.				
13.	The instructional content stimulates my desire to actively participate in the classroom activities.				
14.	The content of this material makes me feel that physics concepts are worth knowing.				
15.	The content makes physics not relevant to my needs.				
	CONFIDENCE				
16.	The content contains elements that make physics really easy for me to learn.				
17.	I feel confident that the instructional content				

	would make learning physics to be interesting.				
18.	This material contains elements that make learning physics to be difficult.				
19.	The exercises in this content are too difficult to encourage students to learn.				
20.	The systematic organization of the content makes me be confident that I could gain from physics instruction.				
	SATISFACTION				
21.	Completing the exercises in physics instruction gave me a satisfying feeling of accomplishment.				
22.	I enjoy this course so much that I would like to know more about it in future academic pursuit.				
23.	The content makes me enjoy different topics in physics.				
24.	The content of the course does not encourage me to pursue physics in the nearest future.				
25.	I feel good to participate in this course because the content is engaging.				

Adapted from instructional materials motivation survey (IMMS) by Keeler (2010)

APPENDIX II

UNIVERSITY OF IBADAN
DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

PHYSICS STUDENTS' INTEREST QUESTIONNAIRE (PSIQ)

SECTION A

Dear Respondents,

This questionnaire is necessary to obtain data from senior secondary students on their interest towards learning of Physics; your cooperation is therefore required to assist the researcher in achieving success in this study. Kindly complete this questionnaire with every sense of honesty.

All information provided will be kept confidential.

Thank you.

Section A

(Kindly complete section A as appropriate)

GENDER: Male ( ) Female ( )

AGE: 10-12years ( ) 13-15years ( ) 16-18years ( ) 18years and above ( )

SCHOOL: **CLASS:**

Section B

Kindly tick (√) which is applicable to you, please note that SA-Strongly Agree, A-Agree, D-Disagree, SD-Strongly Disagree

S/N	ITEMS	SA	A	D	SD

	ATTENTION				
1.	There is nothing interesting in physics instruction that would make me like it.				
2.	I feel concepts in physics are very interesting to learn				
3.	The content of physics fascinates me to learn the subject.				
4.	The method used in teaching physics makes me excited about the subject.				
5	The way our teacher teaches physics concepts make the class very boring.				
6	I believe the instructional content has motivating elements that make physics to be interesting to learn.				
7	I would like to learn physics because the content is applicable to real-life situation.				
8	To me, physics is fascinating that I would like to learn it always.				
10	Physics instruction means nothing to me as the content looks so abstract.				

Adapted from Career Interest Questionnaire by Tandra, Gerald and Rhonda (2010)

APPENDIX III

UNIVERSITY OF IBADAN
DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

PHYSICS ACHIEVEMENT TEST

Instruction: kindly complete the information required in section A, tick the correct answer in section B from option A-E

Section A

GENDER: Male ( ) Female ( )

AGE: 10-12years ( ) 1 3 -15years ( ) 16-18years ( ) 18years and above ( )

SCHOOL: **CLASS:**

Section B

Instruction: Each question is followed by four options lettered A to E. find out the correct option for each question and tick as appropriate

1. In an experiment to determine the relative density of cork, the following recordings were made:
    i. weight of sinker in water = x
    ii. weight of sinker in water and cork in air = y 3.weight of both sinker and cork in water = z which of the following fractions gives the relative density of cork? a) y/z + x - b) x/ y-z c) y-x/ y-z d) z/ x -y e) z-y/x-z
2. Two forces A and B act at a point at right angles. if their resultant is 50N and their sum is 70N, their magnitudes are: a) 50N and 20N b) 20N and 40N c) 40N and 30N d) 60N and 10N e) 45Nn and 25N
3. which of the following combinations will increase the stability of an object? a) wide base and low C.G b) narrow base and low C.G c) narrow base and high C.G e) wide base and high C.G
4. The maximum displacement of particles of a wave from their equilibrium positions is called a) amplitude b) wave velocity c) period d) wavelength e) frequency

5. which of the following is not a mechanical wave? a) wave propagated in stretched string b) waves in closed pipes c) radio waves d) water waves e) sound waves
6. Transverse and longitudinal waves travelling in the same direction in a medium differ essentially in their a) wavelength b) amplitude c) direction of vibration of the particles of the medium d) frequency e) period of vibration of the particles of the medium
7. The quantity of heat required to change the temperature of a unit mass of a substance by 1^0c is called a) heat capacity of fusion b) specific heat capacity of vaporization c) specific latent heat d) specific heat capacity e) specific heat
8. Calculate the heat energy required to vaporize 50g of water initially at 80^0c if the specific heat capacity of water is 4.2 $Jg^{-1}k^{-1}$ (specific latent heat of vaporization of water is $2260Jg^{-1}$) a) 533000J b) 230200J c) 117200J d) 113000J e) 4200J

9. The amplitude of a wave is the a) distance between two successive troughs of the wave b) separation of two adjacent particles vibrating in phase c) maximum displacement of the wave particle from the equilibrium position d) distance travelled by a wave in a complete cycle of its motion

10 .The basic difference between a transverse wave and a longitudinal wave travelling in the same direction in a medium is in the a) amplitude of the waves b) wavelength of the waves c) direction of the vibration of the particles of the medium d) period of vibration of the particles of the medium e) distance between the waves

11 The S.I unit of the moment of a force is: a) kgm b) Nm c) Jm d) Nm^{-1} e) Jm^{-1}

12 Three non-parallel forces which can be represented both in magnitude and direction by the three sides of a triangle, taken in order a) make a body oscillate b) make a body rotate c) keep a body in equilibrium d) move a body in a straight-line e) always produce vertical motion of body

NB: Correct options are underlined

APPENDIX 1V

UNIVERSITY OF IBADAN
DEPARTMENT OF SCIENCE AND TECHNOLOGY EDUCATION

COMPUTER SELF EFFICACY QUESTIONNAIRE (CSEQ)

SECTION A

Dear Respondents,

This questionnaire is necessary to obtain data from senior secondary students on their Computer Self Efficacy Skill; your cooperation is therefore required to assist the researcher in achieving success in this study. Kindly complete this questionnaire with every sense of honesty.

All information provided will be kept confidential.

Thank you.

Section A

(Kindly complete section A as appropriate)

GENDER: Male ( ) Female ( )

AGE: 10-12years ( ) 1 3 -15years ( ) 16-18years ( ) 18years and above ( )

SCHOOL: **CLASS:**

Section B

Kindly tick ( ) which is applicable to you, please note that SA-Strongly Agree, A-Agree, D-Disagree, SD-Strongly Disagree

S/N		SA	A	D	SD
1	Most difficulties I encounter when using computer are usually solved				
2	Working with computers is very easy				
3	I am unsure of my abilities to use computer				

-

4	Difficulties are usually experienced with most of the packages I have tried to use				
5	Computer frightens me				
6	Working with computers is fun				
7	I find computers get in the way of learning				
8	DOS – based computer packages don't cause many problems for me				
9	Computers make me much more productive				
10	Difficulties are often encountered when trying to learn how to use a new computer package				
11	Most of the computer packages I have had experience with, have been easy to use				
12	I am very confident in my abilities to use computer				
13	Using computers to do what I want them to do is very difficult				
14	At times, I find working with computers very confusing				
15	I would rather that we did not have to learn how to use computers				
17	Using a new software package is easy to learn				
18	using computers makes learning more interesting				
19	I always seem to have problems when trying to use computer				
20	Some computer packages definitely make learning easier				
21	Computers are far too complicated for me				
22	Computer jargons baffles me				
23	Using computer is something in rarely enjoy				
24	Computers are good aids to learning				

25	Sometimes when using a computer, things seem to happen and I don’t know why				
26	As far as computers go, I don’t consider myself to be very competent				
27	Computer help me to save a lot of time				
28	Working with computer is very frustrating				
29	I consider myself a skilled computer user				
30	When using computers, I worry that I might press the wrong button and damage it				

APPENDIX V
TEACHER'S GUIDE FOR STORYTELLING, POINTS AND LEVELS

Storytelling, Levels and Points Instructional Guide (Lesson One)

Step I: Introduction: The teacher describes how students would be able to learn the concept of force through digital storytelling, levels and points gamified strategy and creates friendly environment to stimulate their interest.

Step II: Presentation of the Content: Students are exposed to the content of the gamified package by allowing them watch the story on the computers.

Step III: Students would be asked to click on "have fun" button and log in with the username.

Step IV: Students click on the topic "force" and click on "proceed to learn" button.

Step V: The teacher asks students to click on "interpretation of the story" button.

Step VI: Class Activities: Students would be instructed to click on "proceed to learn" icon to interact with series of activities including the topics, exercises and assignments. As student proceeds and interacts with the package, levels are increased and points are gained.

Storytelling, Levels and Points Instructional Guide (Lesson Two)

Step I: Introduction: The teacher describes how students would be able to learn the concept of heat energy through digital storytelling, levels and points gamified strategy and creates friendly environment to stimulate their interest.

Step II: Presentation of the Content: Students are exposed to the content of the gamified package by allowing them watch the story on the computers.

Step III: Students would be asked to click on "have fun" button and log in with the username.

Step IV: Students click on the topic "force" and click on "proceed to learn" button.

Step V: The teacher asks students to click on "interpretation of the story" button.

Step VI: Class Activities: Students would be instructed to click on "proceed to learn" icon to interact with series of activities including the topics, exercises and assignments. As student proceeds and interacts with the package, levels are increased and points are gained.

Step VII: Conclusion: To finish each topic, 8 levels would be reached and 60 points gained.

Step VIII Summary and Evaluation: The teacher gives more explanation on the concept that had been watched in the gamified package to ensure that students understand the topic in the story. The following questions would be asked to confirm the attainment of instructional objectives:

1. Defines heat capacity
2. Differentiate between heat capacity and specific water capacity
3. Explain the process in the measurement of heat energy

Storytelling, Levels and Points Instructional Guide (Lesson Three)

Step I: Introduction: The teacher describes how students would be able to learn the concept of waves through digital storytelling, levels and points gamified strategy and creates friendly environment to stimulate their interest.

Step II: Presentation of the Content: Students are exposed to the content of the gamified package by allowing them watch the story on the computers.

Step III: Students would be asked to click on "have fun" button and log in with the username.

Step IV: Students click on the topic "force" and click on "proceed to learn" button.

Step V: The teacher asks students to click on "interpretation of the story" button.

Step VI: Class Activities: Students would be instructed to click on "proceed to learn" icon to interact with series of activities including the topics, exercises and assignments. As student proceeds and interacts with the package, levels are increased and points are gained.

Step VII: Conclusion: To finish each topic, 8 levels would be reached and 60 points gained.

Step VIII Summary and Evaluation: The instructor gives more clarification on the idea that had been watched in the gamified bundle to guarantee that understudies comprehend the subject in the story. He characterizes wave as an unsettling influence which goes through a medium and moves energy starting with one point then onto the next without bringing on any lasting relocation of the medium. The following questions would be asked to confirm the attainment of instructional objectives:

1. define the term “wave”.
2. differentiate between transverse waves and longitudinal waves.
3. explain the concept of wave front

APPENDIX VI
TEACHER'S GUIDE FOR STORYTELLING, BADGES AND LEADERBOARDS

Storytelling, Badges and Leaderboard Instructional Guide (Lesson One)

Class: SS II **Population**: **Duration**: 40 minutes

Step I: Introduction: The teacher describes how students would be able to learn the concept of force through digital storytelling, badges and leaderboard gamified strategy and creates friendly environment to stimulate their interest.

Step II: Presentation of the Content: Students are exposed to the content of the gamified package by allowing them watch the story on the computers.

Step III: Students would be asked to click on "have fun" button and log in with the username.

Step IV: Students click on the topic "force" and click on "proceed to learn" button.

Step V: The teacher asks students to click on "interpretation of the story" button.

Step VI: Class Activities: Students would be instructed to click on "proceed to learn" icon to interact with series of activities including the topics, exercises and assignments. As students proceed and interact with the gamified package, leaderboards colour changes from purple, white to yellow, brown, blue, peach, white and lemon. Also, badges are won, ranging from determined badge, excellent badge, skilful badge to marketable badge.

Step VII: Conclusion: To finish each topic, 8 colours of leaderboards and 5 badges are won by the student. The teacher checks and records the number of colours of leaderboards gained and badges won by each of the students on the gamified activities.

Step VIII Summary and Evaluation: The teacher gives more explanation on the concept that had been watched in the gamified package to ensure that students understand the topic in the story.

Storytelling, Badges and Leaderboard Instructional Guide (Lesson Two)

Step I: Introduction: The teacher describes how students would be able to learn the concept of heat energy through digital storytelling, badges and leaderboard gamified strategy and creates friendly environment to stimulate their interest.

Step II: Presentation of the Content: Students are exposed to the content of the gamified package by allowing them watch the story on the computers.

Step III: Students would be asked to click on "have fun" button and log in with the username.

Step IV: Students click on the topic "force" and click on "proceed to learn" button.

Step V: The teacher asks students to click on "interpretation of the story" button.

Step VI: Class Activities: Students would be instructed to click on "proceed to learn" icon to interact with series of activities including the topics, exercises and assignments. As students proceed and interact with the gamified package, leaderboards colour changes from purple, white to yellow, brown, blue, peach, white and lemon. Also, badges are won, ranging from determined badge, excellent badge, skilful badge to marketable badge.

Step VII: Conclusion: To finish each topic, 8 colours of leaderboards and 5 badges are won by the student. The teacher checks and records the number of colours of leaderboards gained and badges won by each of the students on the gamified activities.

Step VIII Summary and Evaluation: The teacher gives more explanation on the concept that had been watched in the gamified package to ensure that students understand the topic in the story.

Storytelling, Badges and Leaderboard Instructional Guide (Lesson Three)

Class: SS II **Population**: **Duration**: 40 minutes

Topic: Waves

Sub-Topic: Properties of Waves

Instructional Objectives: At the end of the lesson, students in the class should be able to;

1. define the term "wave".
2. differentiate between transverse waves and longitudinal waves.
3. explain the concept of wave front

Step I: Introduction: The teacher describes how students would be able to learn the concept of waves through digital storytelling, badges and leaderboard gamified strategy and creates friendly environment to stimulate their interest.

Step II: Presentation of the Content: Students are exposed to the content of the gamified package by allowing them watch the story on the computers.

Step III: Students would be asked to click on "have fun" button and log in with the username.

Step IV: Students click on the topic "force" and click on "proceed to learn" button.

Step V: The teacher asks students to click on "interpretation of the story" button.

Step VI: Class Activities: Students would be instructed to click on "proceed to learn" icon to interact with series of activities including the topics, exercises and assignments. As students proceed and interact with the gamified package, leaderboards colour changes from purple, white to yellow, brown, blue, peach, white and lemon. Also, badges are won, ranging from determined badge, excellent badge, and skilful badge to marketable badge.

Step VII: Conclusion: To finish each topic, 8 colours of leaderboards and 5 badges are won by the student. The teacher checks and records the number of colours of leaderboards gained and badges won by each of the students on the gamified activities.

Step VIII Summary and Evaluation: The instructor gives more clarification on the idea that had been watched in the gamified bundle to guarantee that understudies comprehend the point in the story. He characterizes wave as an unsettling influence which goes through a medium and moves energy starting with one point then onto the next without bringing about any lasting uprooting of the medium. The following questions would be asked to confirm the attainment of instructional objectives:

1. defines the term "wave".
2. differentiate between transverse waves and longitudinal waves.
3. explain the concept of wave front

APPENDIX VII
GAMIFIED STORY TELLING TO TEACH PHYSICS CONCEPTS

Tortoise and his three sons -Using story to teach Equilibrium of Force

Once upon a time, tortoise had three sons. News were all over that tortoise children stole from people in the village. Tortoise warned his sons severally, but all to no avail, so he would lock them in the room when he and his wife went to the farm to fetch for food. When they return, he would open the door while their mother prepares dinner. when the food is done, their mother will serve them the food and after they had eaten, when their father was asleep, she would counsel them to stop stealing and the tells them the consequences involved in doing so. The three sons came up with a plan to deceive their parents, so that they would think they have stopped the act of stealing for a while, they behaved very well in their presence, even reporting other animals that were behaving badly. This plan worked so their father stopped locking them up when he goes to farm, but told their mother to always watch over them.

One day, when it was noontime, they were playing outside their backyard, under the watch of their mother, when their father returned, , their mother instructed them to wash their hands from the tap outside their house before eating. The eldest son turned on the tap and they all washed their hands, trying not to splash around as they did so, because their mother was watching them. When they finished , he gently turned off the tap, making a show of it for their parents. His two brothers where snickering at his back, because they knew that was not what he used to do when their parents were not watching.

After they had eaten the delicious porridge that their mother prepared, their father told the youngest to bring him his cup from the cupboard. As he was about to take the cup, he mistakenly hit his leg on a table, which made the cup to stagger and but luckily it did not fall or hit other cups, it actually returned to its original position. He was so glad, because if the cup fell, his father would have punished him. He could not imagine what the punishment would have been this time. The last time, he was asked to pick all the stones in their compound. It was not a pleasant task, with his brothers jeering at him. He went to give his father the cup, he was so happy that the cup did not break.

As he was rushing to meet his brothers to tell them what happened, he hit their mother's washing bucket which their mother was about to use to wash their cloth – and it tilted a little bit away from its original position. On getting to their room to meet his brothers, they were already asleep.

He tried to sleep but he couldn't because he was still hungry. Recently, he noticed that he used to feel very hungry after dinner. They had their dinner early, their mother said it needed to digest. So after dinner, they would work a bit and play. By bedtime, because he could not sleep of as quickly as his brothers, his stomach would start making sounds, indicating his hunger.

He went to the kitchen to see if the food their mother cooked remained. And when he opened the pot, there was no more food and this made him unhappy and as he was heading back to their room, he mistakenly hit the bucket they use in storing water in the kitchen- which was half filled- and the bucket fell and the water in it poured away. Realizing that his mother would be very angry with him, he quickly cleaned it up and after cleaning he went angrily to his room but as he was going he saw a piece of bread on the sack his father takes to the farm and immediately- without thinking of the outcome of taking what he wasn't given- he ate it and went to their room to sleep. He already prepared an answer in his mind that if their father asked of the bread, he would say that he doesn't know who ate it.

When it was morning, tortoise woke and prepared to go to farm, he picked up the sack and realized that the bread wasn't on the sack anymore so he asked his wife if she ate it, but the wife said she didn't. He told his wife to ask his children if they took the bread. The first and second son were in the room and their mother came in and asked them if they had seen the bread. And they replied, 'no we didn't see any bread'. And the mother went in search of the last son and after calling him severally, she saw him outside the house and asked him if he had seen the bread his father kept beside his sack and he replied, 'mummy I didn't eat it'. Immediately tortoise wife knew it was the last son who ate the bread and she asked again 'so you didn't see the bread'. And he replied 'no'.

Their father, tortoise who does not take his farm work with levity told the children that he would revisit the case when he comes back from the farm. Their mother sat them down and asked them one after the other and after asking severally with treat, the last son confessed that he ate the bread, but he didn't eat the bread alone, he said his brothers also ate out of the bread. So, their mother waited for their father to return so she could tell him what the last son said. The first and second son were very annoyed at the last son for lying against them. When their father arrived, since tortoise did not say anything initialy, the last son thought their father had forgotten about the bread.

After their dinner, their father called them and asked them to confess to him. The last son repeated the same thing he told their mother. And after their father heard it, he said why would you lie against your brothers because yester night I saw the floor of the kitchen wet and I saw footsteps so I traced it and it led me to my sack and led me to your bed- the last sons bed. Then I didn't notice it was the bread that was missing, it was this morning I noticed it because I wanted to use the bread as a bait for a bush meat. So, after saying all that, tortoise flogged the last son and asked him to apologize to his brothers.

The next morning the three children went out to steal as their usual habit. When they were going

they saw crowd of people shouting "OLE! THIEF! THIEF! OLE!

OLE!". They followed them heading to the palace of the king. When they got there, the old woman whose money was stolen said she saw two children around her house and when she got home she couldn't find her money on the table where she kept it. Immediately, she shouted and her neighbors helped her to catch the children. And all the people said we should bring them to the king.

The king asked the children if they knew anything about the old woman's money, they said no. so the king asked them 'can you swear to prove your innocence', they said yes- not knowing the repercussion. And when they got to the river the king told the three children to put their shoes in the river and if it doesn't sink, it means they are innocent. The first son shoe didn’t sink, the second son shoe sank, and third son shoe also sank. The king and everybody looked for sticks and began to beat the two children till they fainted. They left them, and their parents came to carry them when everybody had left.

The three sons of tortoise saw all these and they felt remorse on their actions. They were also very ashamed of themselves. When they got home they promised their parents that they would never steal again and they never did again. Their parents were very happy that their children have finally made a genuine promise never to steal again as a result of the public disgrace given to them.

Interpretation of the Story to the concept of Equilibrium of Forces

- The eldest son turned on the tap and they all washed their hands, trying not to splash around as they did so, because their mother was watching them.-------------- this points to the concept of moment of a force, which depends on the product of a force * the perpendicular distance.

- “. As he was about to take the cup, he mistakenly hit his leg on a table, which made the cup to stagger and but luckily it did not fall or hit other cups, it actually returned to its original position” ------------------This points to the concept of stable equilibrium which made the cup to stagger and returned back to its original position -------------This points to the concept of stable equilibrium.
- “As he was rushing to meet his brothers to tell them what happened, he hit their mother’s washing bucket which their mother was about to use to wash their cloth – and it tilted a little bit away from its original position..” -------- This points to the conceptThe bucket that tilt a little bit away from the original position is said to be in an unstable equilibrium.
- “And when he opened the pot, there was no more food and this made him unhappy and as he was heading back to their room, he mistakenly hit the bucket they use in storing water in the kitchen-which was under half filled- and the bucket fell and the water in it poured away” ------------This points to the concept of neutral equilibrium which made the bucket that fell is said to be in neutral equilibrium.

- The first son shoe didn't sink because his density was lesser than that of water
- The second and third son shoe sank because their density is higher than that of water.
- "their mother sits outside…" This points to the concept of equilibrant force, which is the force that keeps any object motionless and acts on virtually every object in the world that is not moving.

APPENDIX VIII

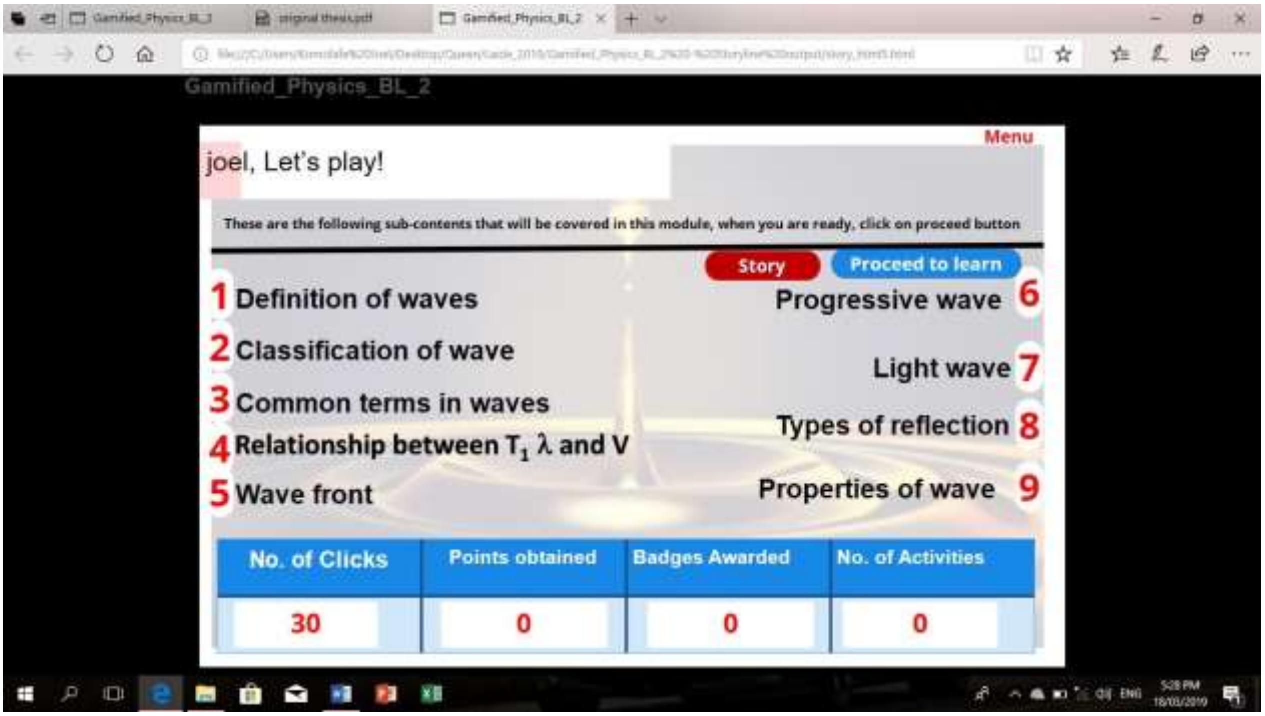
GAMIFICATION PACKAGE SCREEN SHOT

Screen 1

Screen 2

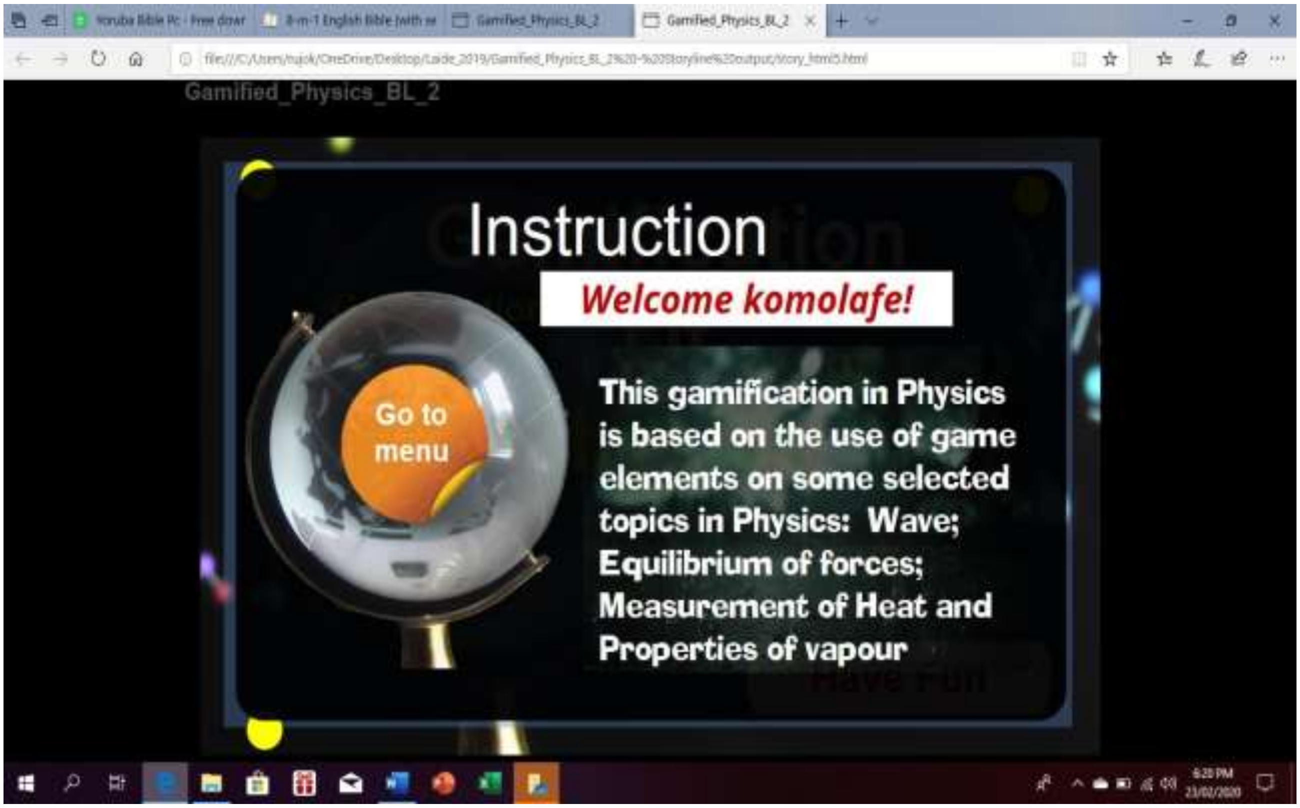

Gamified_Physics_Contents
INSTRUCTION
Welcome LAIDE!
GO TO MENU
This gamification in Physics is based on the game elements on some selected topics in Physics: Wave; Equilibrium of forces; Measurement of Heat and Properties of vapour
Activate Windows
Type here to search

Screen 3



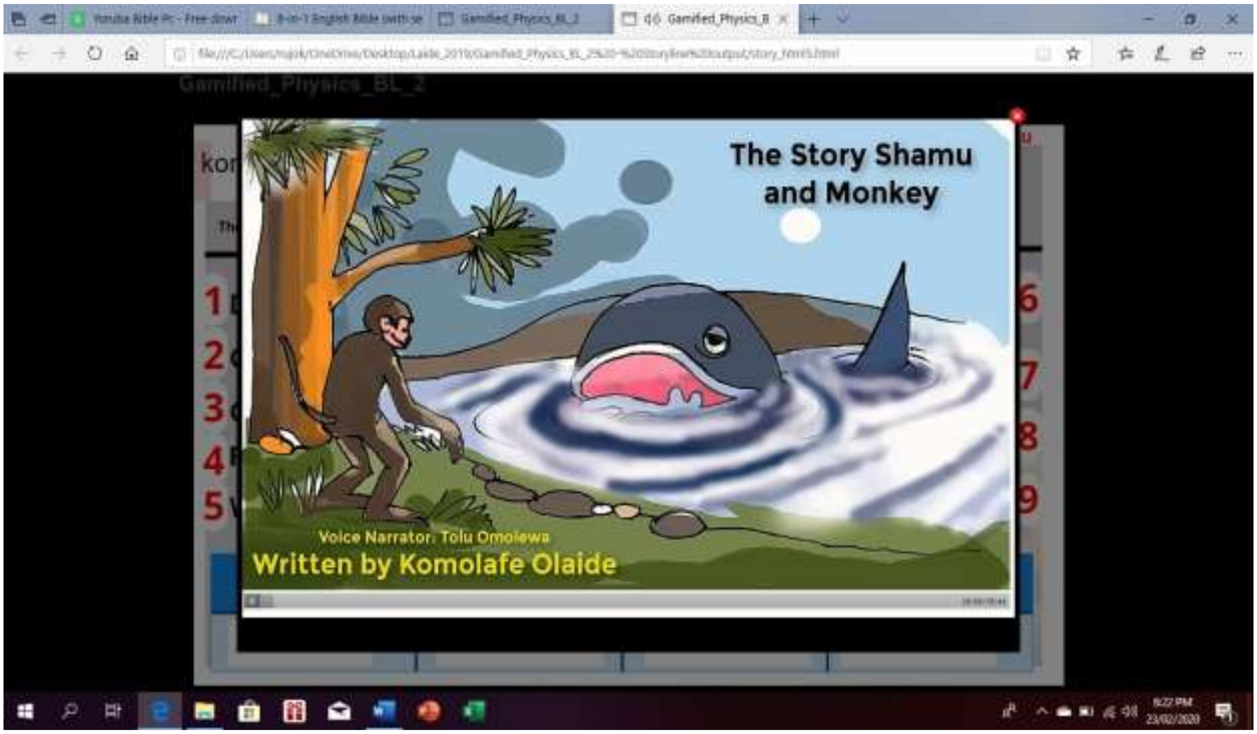
Gamified_Physics_BL_2
Menu
joel, Let's play!
These are the following sub-contents that will be covered in this module, when you are ready, click on proceed button
Story
Proceed to learn
1 Definition of waves
2 Classification of wave
3 Common terms in waves
4 Relationship between T, λ and V
5 Wave front
Progressive wave 6
Light wave 7
Types of reflection 8
Properties of wave 9
No. of Clicks
Points obtained
Badges Awarded
No. of Activities
30
0
0
0

Screen 4 - 5

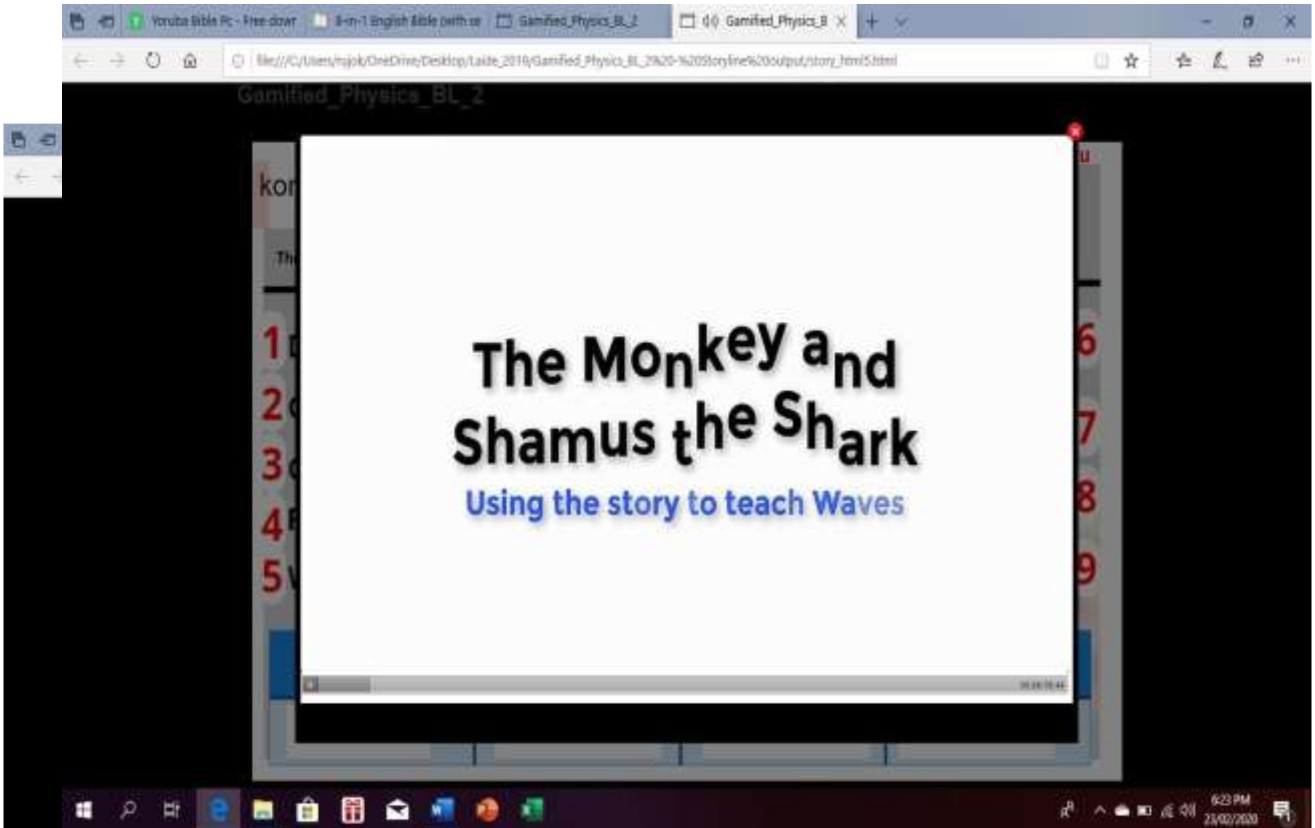

Gamified_Physics_BL_2
Instruction
Welcome komolafe!
Go to menu
This gamification in Physics is based on the use of game elements on some selected topics in Physics: Wave; Equilibrium of forces; Measurement of Heat and Properties of vapour


Gamified_Physics_BL_2
Welcome komolafe!
Wave
Equilibrium of Forces
Measurement of Heat
Properties of Vapour

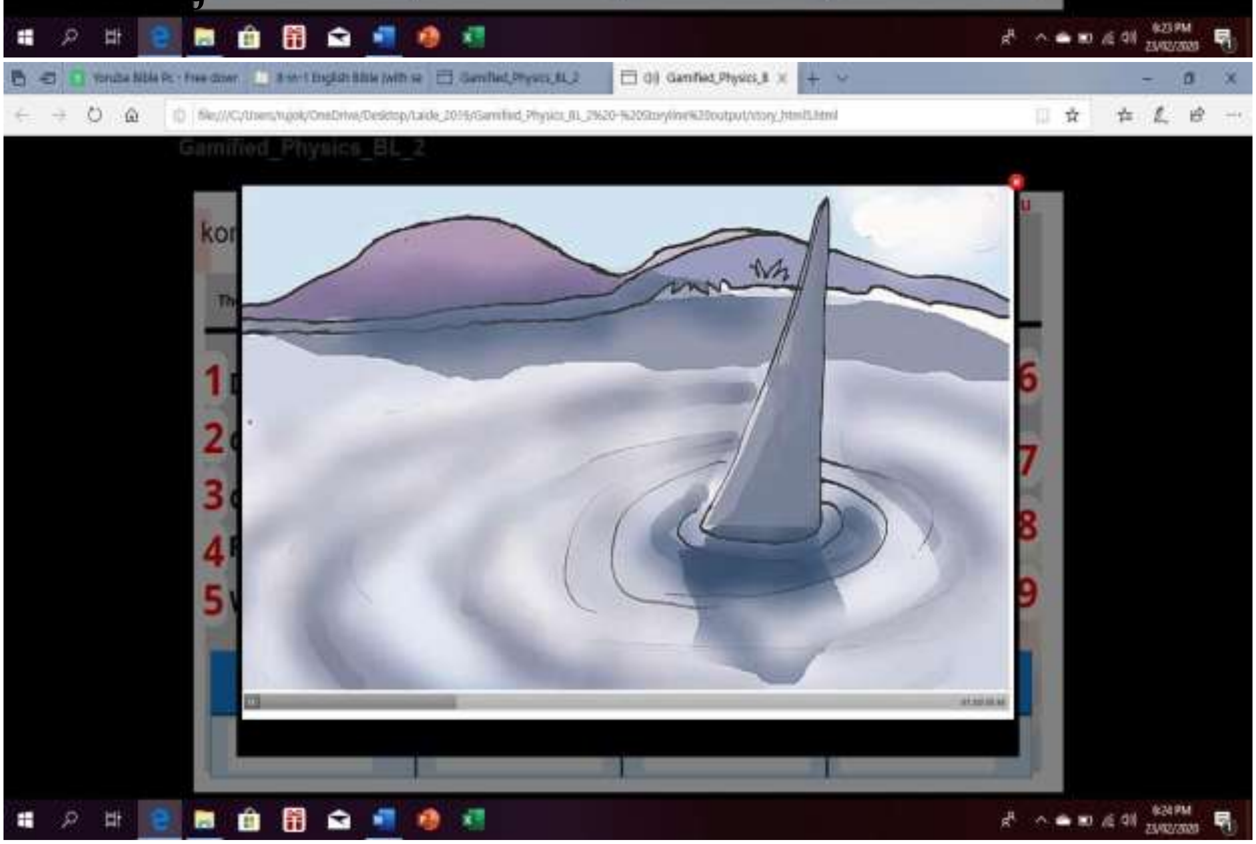
Screen 6



Screen 7

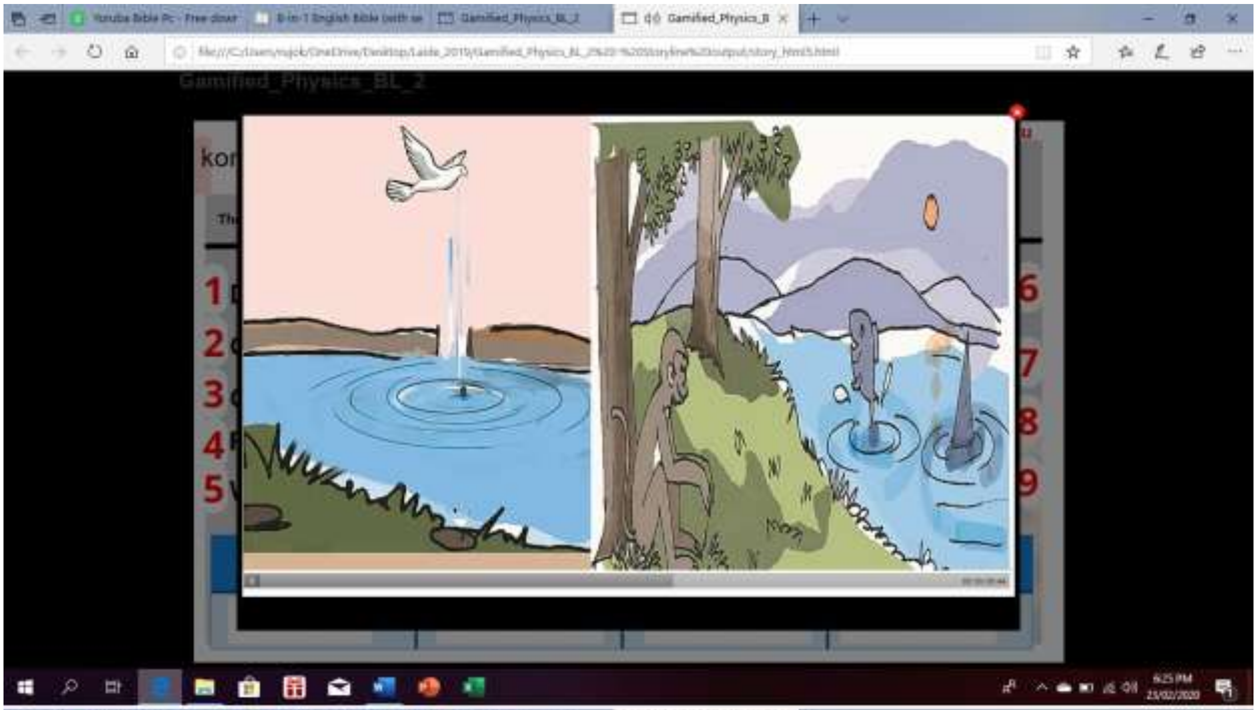

Gamified_Physics_BL_2
The Monkey and Shamus the Shark
Using the story to teach Waves

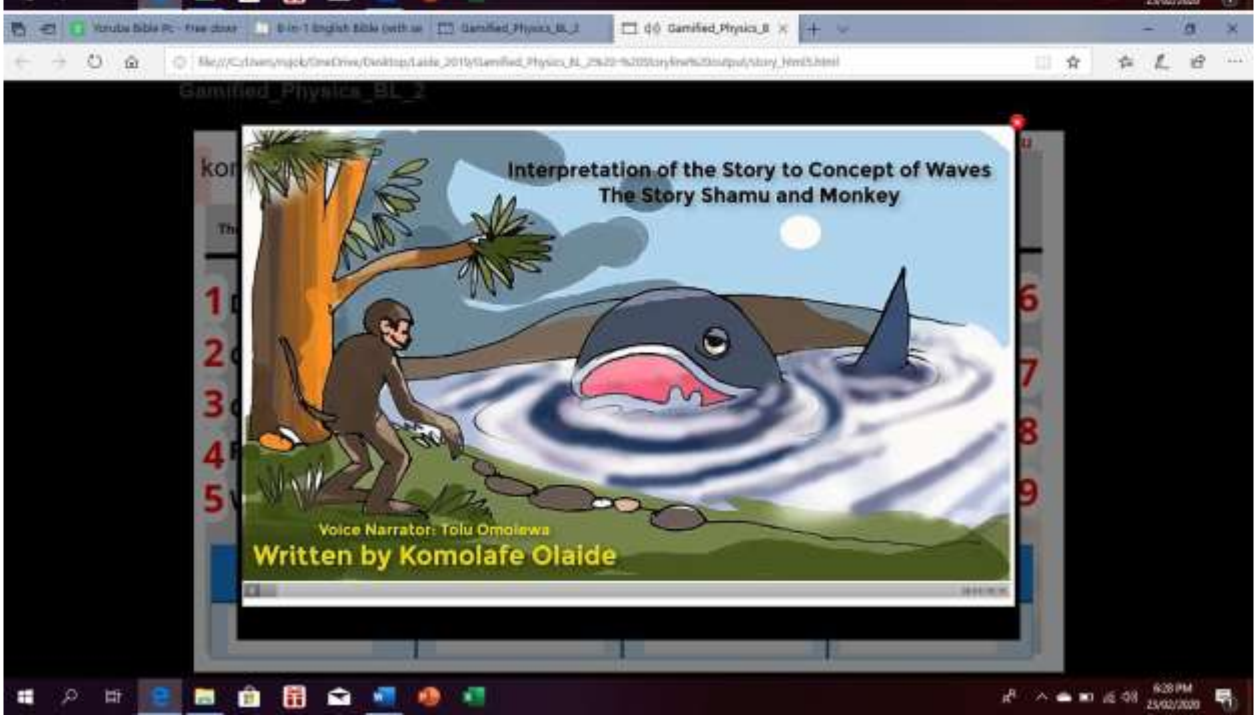
9


Gamified_Physics_BL_2

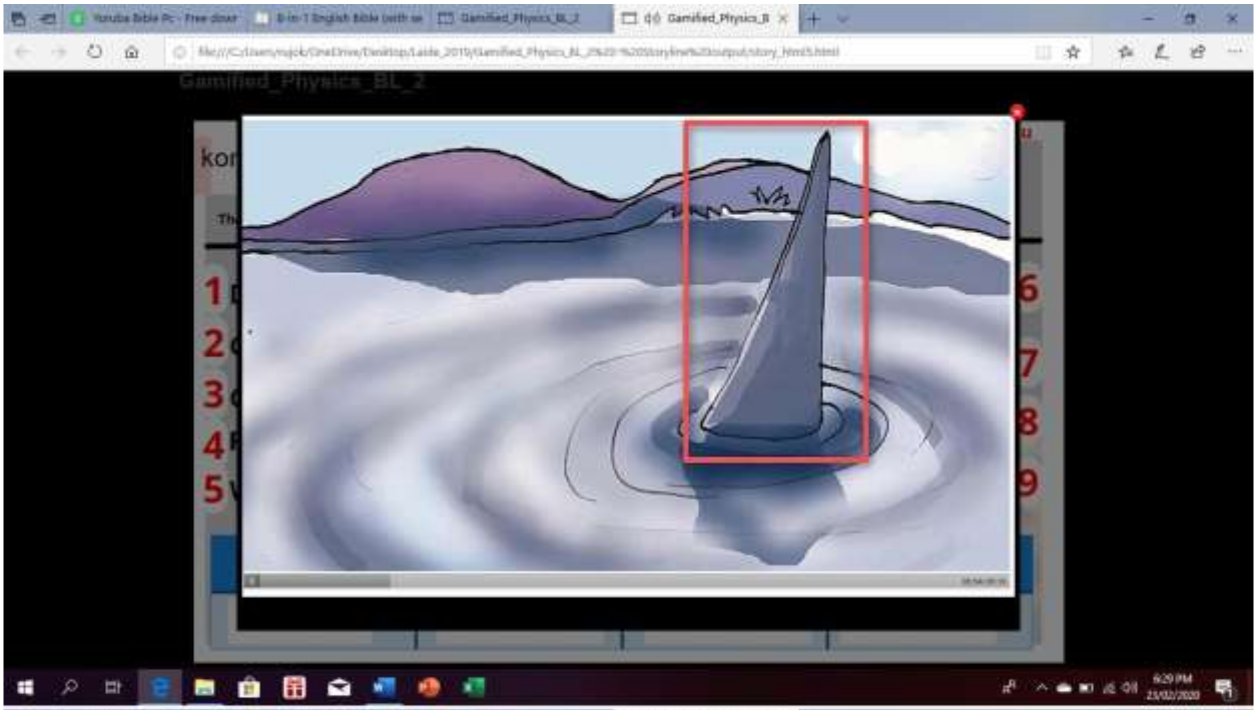
Screen 10 - 11

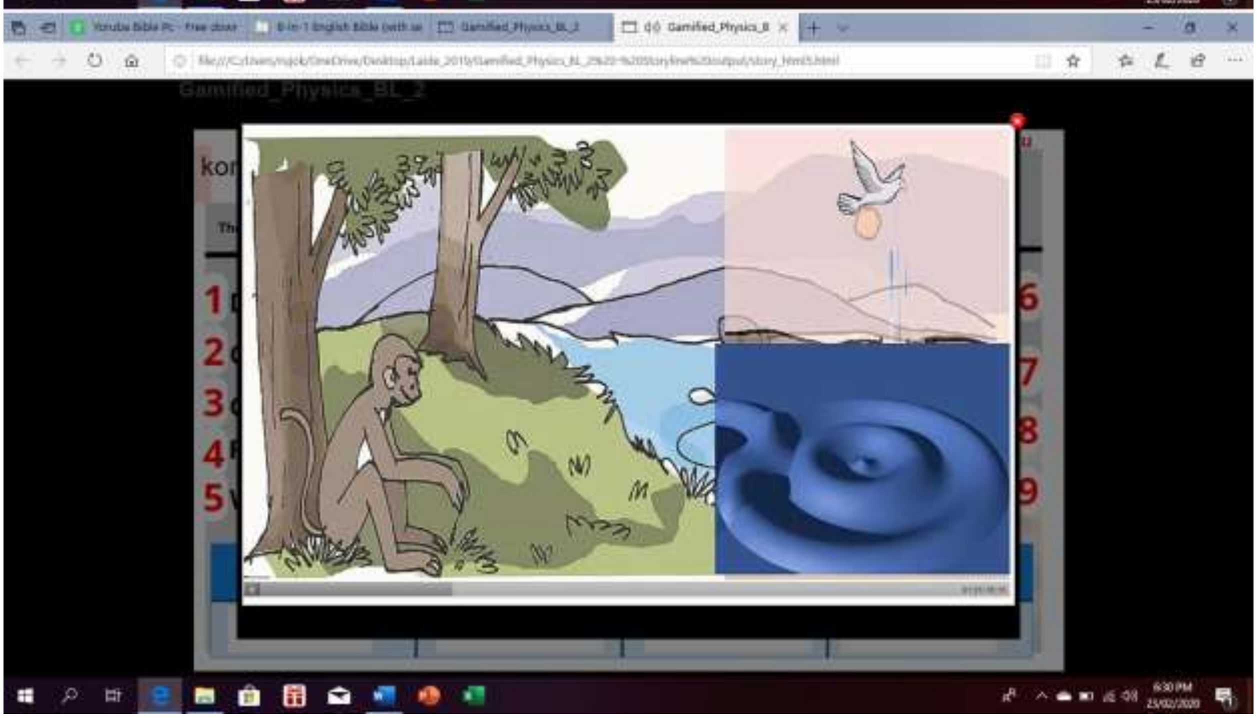
Screen 12 - 13


Gamified_Physics_BL_2

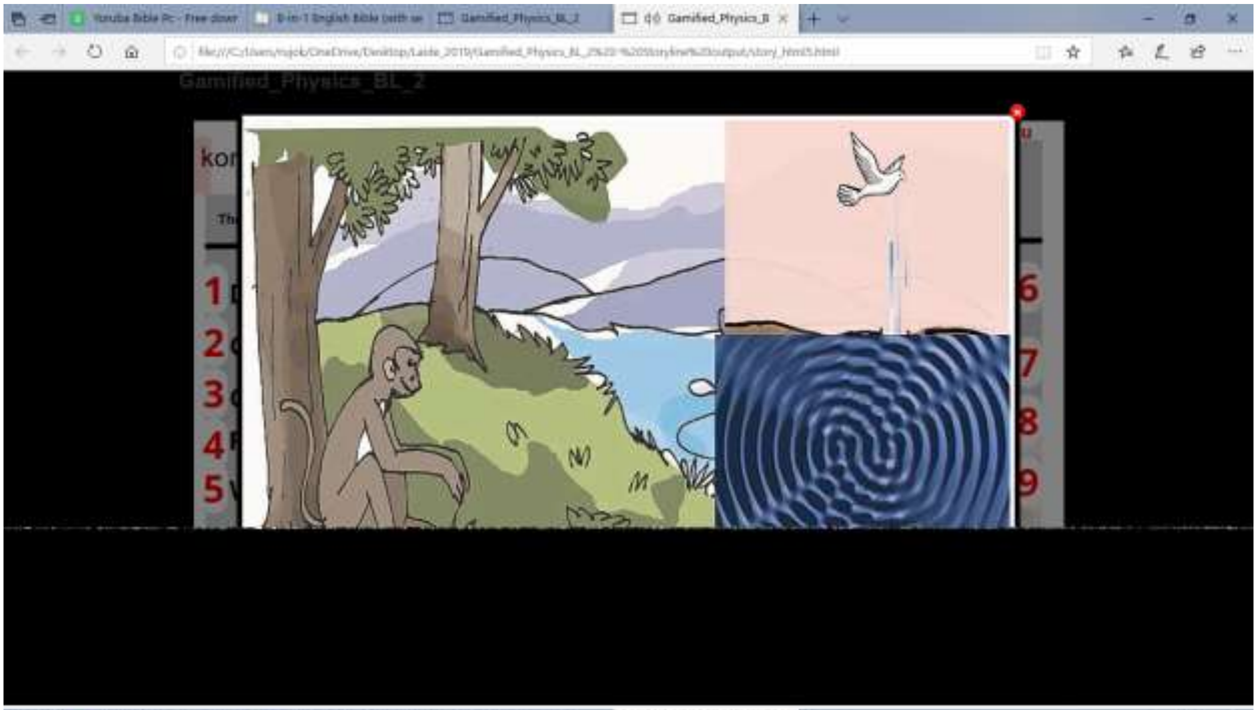

Gamified_Physics_BL_2
Interpretation of the Story to Concept of Waves
The Story Shamu and Monkey
Voice Narrator: Tolu Omolewa
Written by Komolafe Olaide

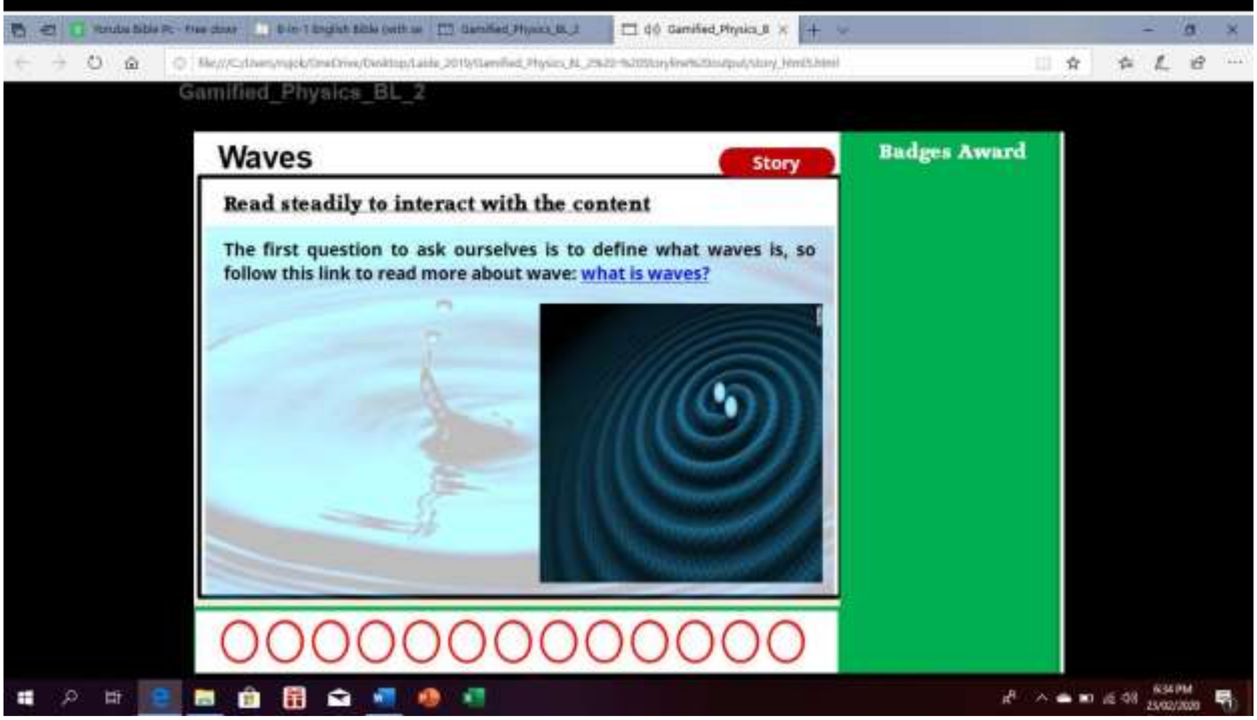
Screen 14 - 15





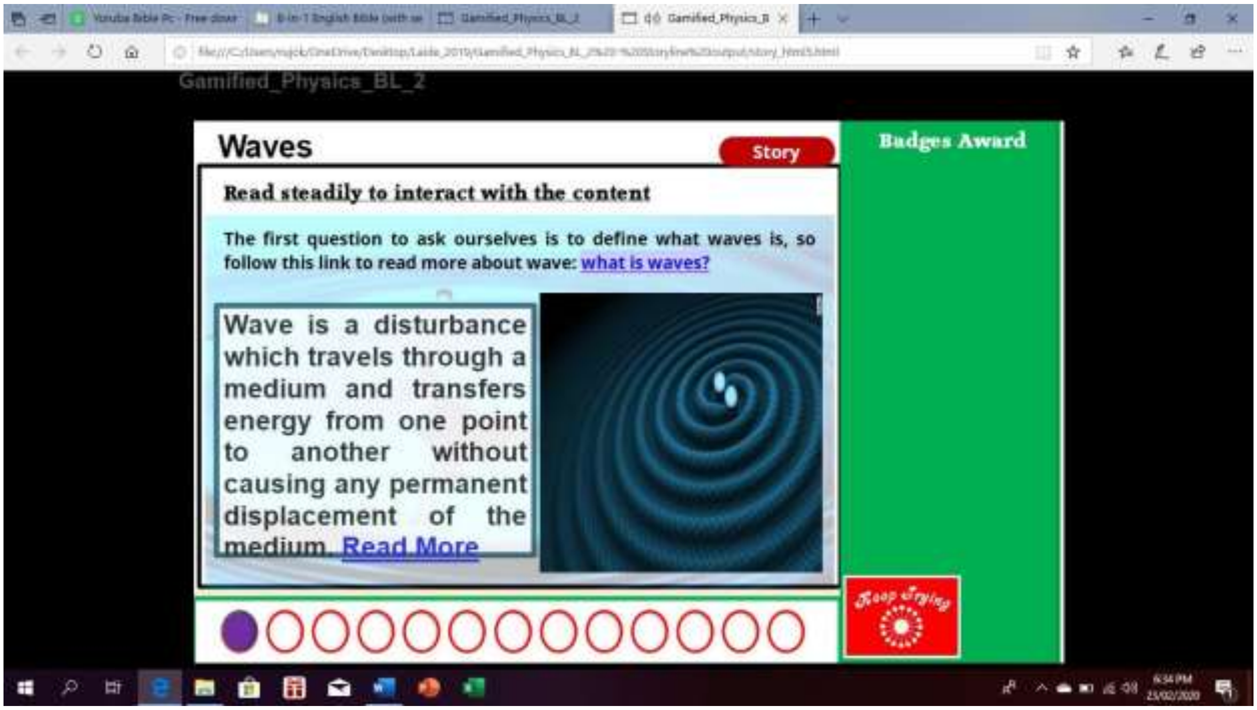
Screen 16 - 17



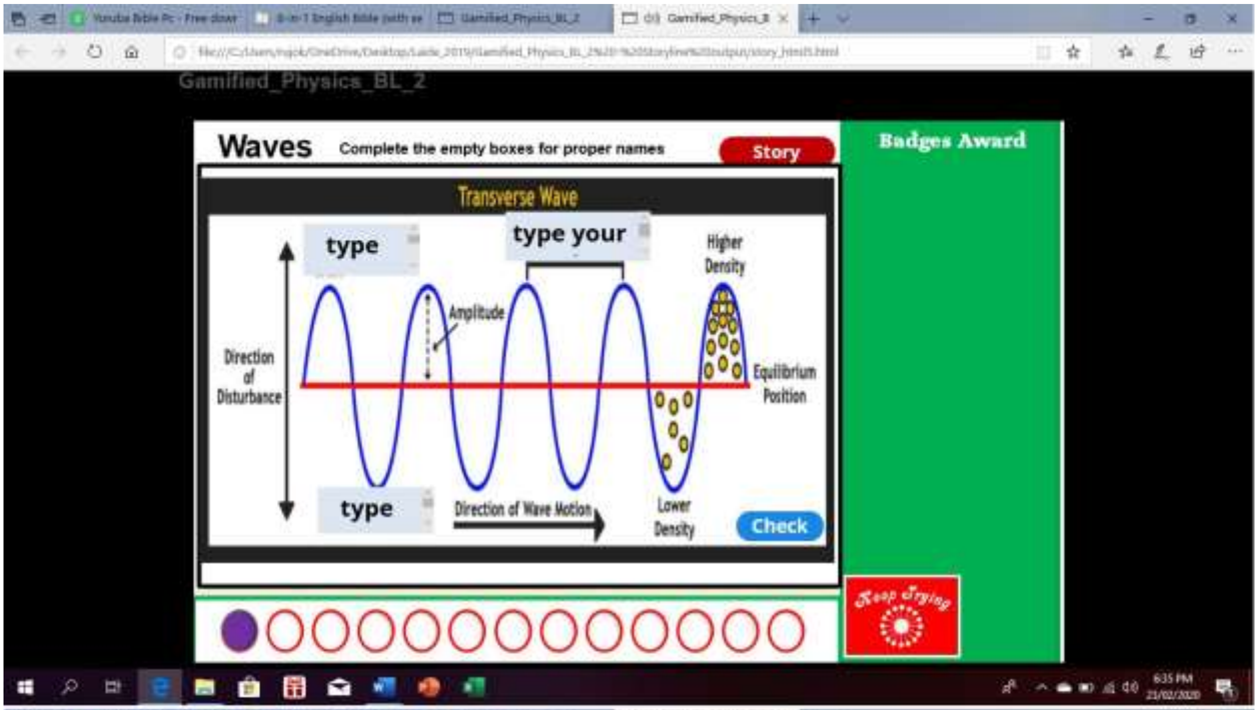

Gamified_Physics_BL_2
Waves
Story
Badges Award
Read steadily to interact with the content
The first question to ask ourselves is to define what waves is, so follow this link to read more about wave: what is waves?

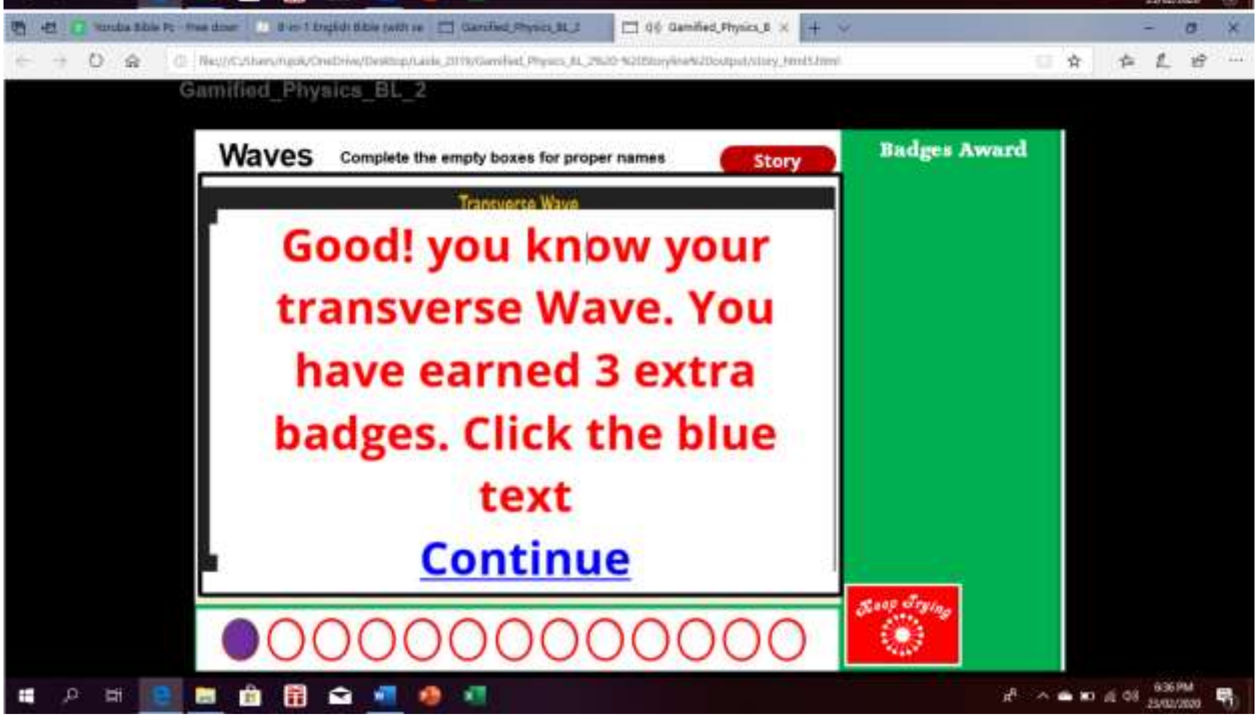
*

Screen 18

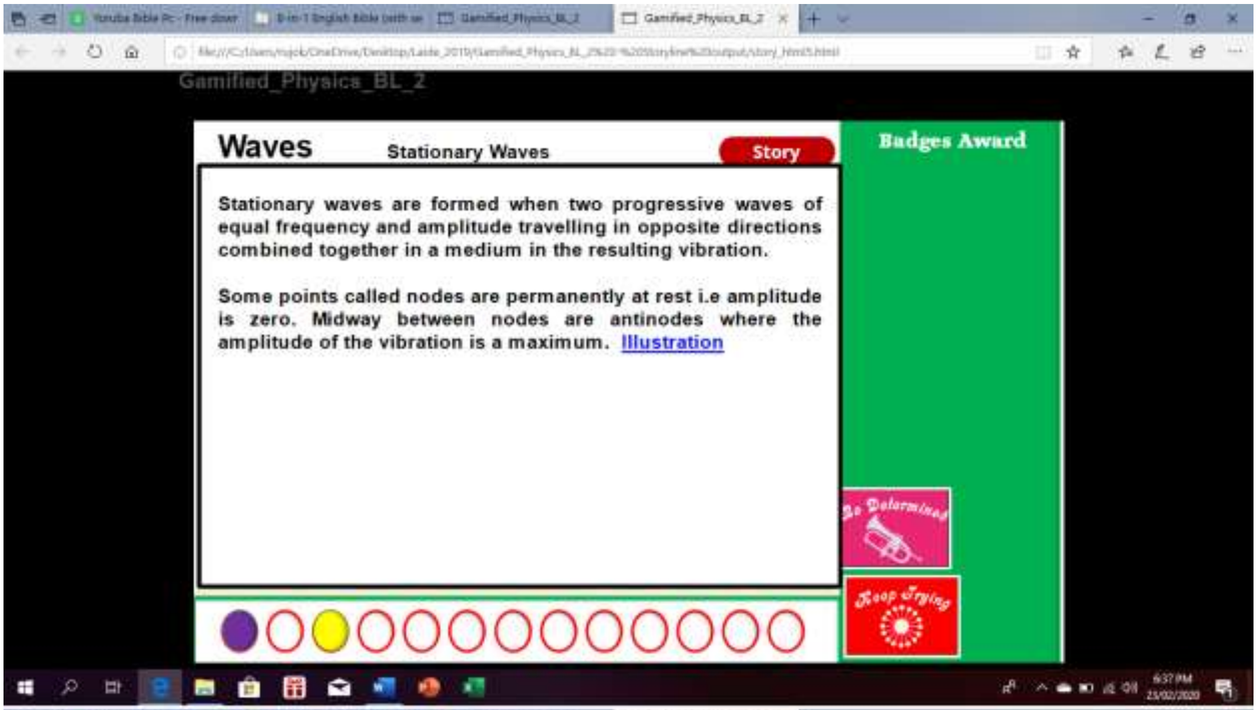

Gamified_Physics_BL_2
Waves
Story
Badges Award
Read steadily to interact with the content
The first question to ask ourselves is to define what waves is, so follow this link to read more about wave: what is waves?
Wave is a disturbance which travels through a medium and transfers energy from one point to another without causing any permanent displacement of the medium. Read More

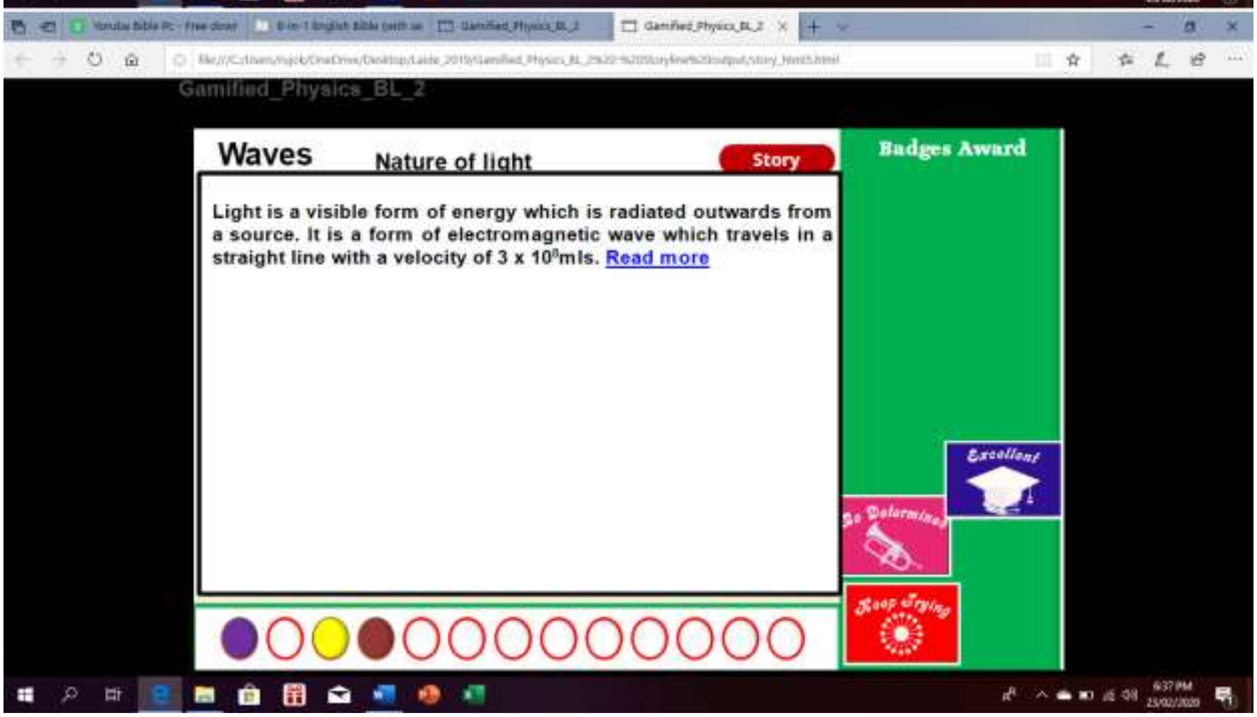
Screen 19 - 20


Gamified_Physics_BL_2
Waves
Complete the empty boxes for proper names
Story
Badges Award
Transverse Wave
type
type your
Higher Density
Amplitude
Direction of Disturbance
Equilibrium Position
type
Direction of Wave Motion
Lower Density
Check
Keep Trying

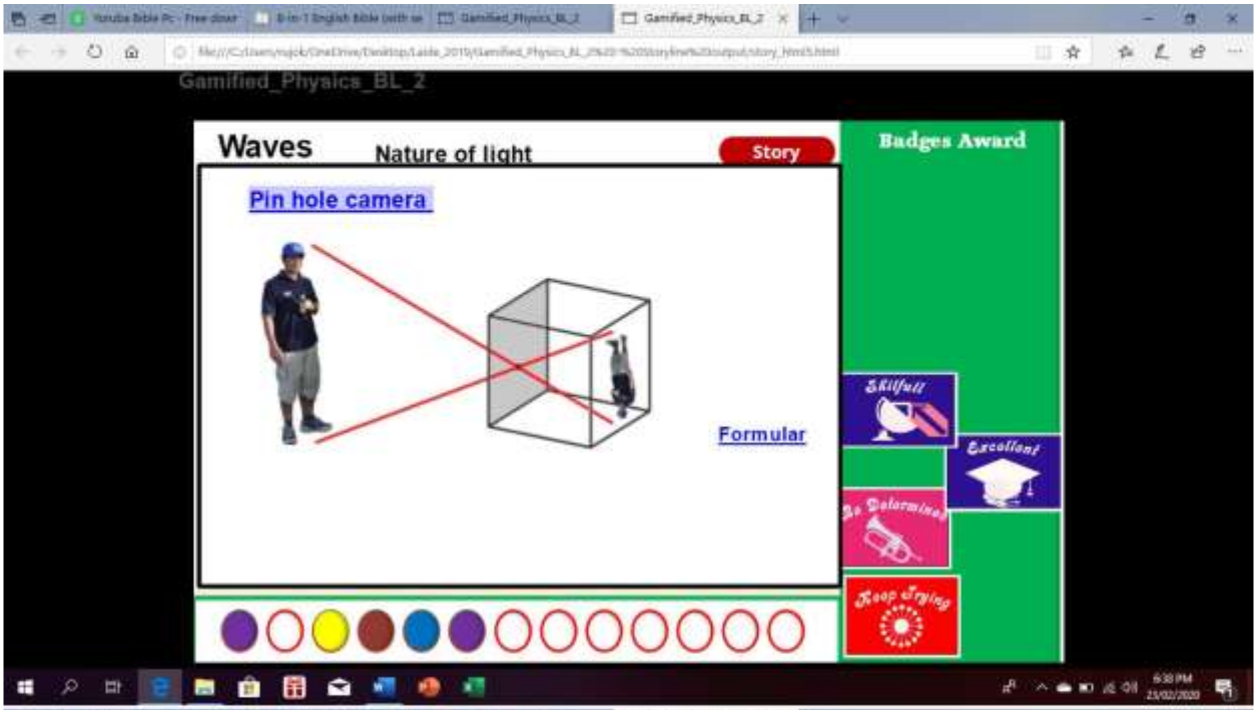

Gamified_Physics_BL_2
Waves
Complete the empty boxes for proper names
Story
Badges Award
Transverse Wave
Good! you know your transverse Wave. You have earned 3 extra badges. Click the blue text
Continue
Keep Trying

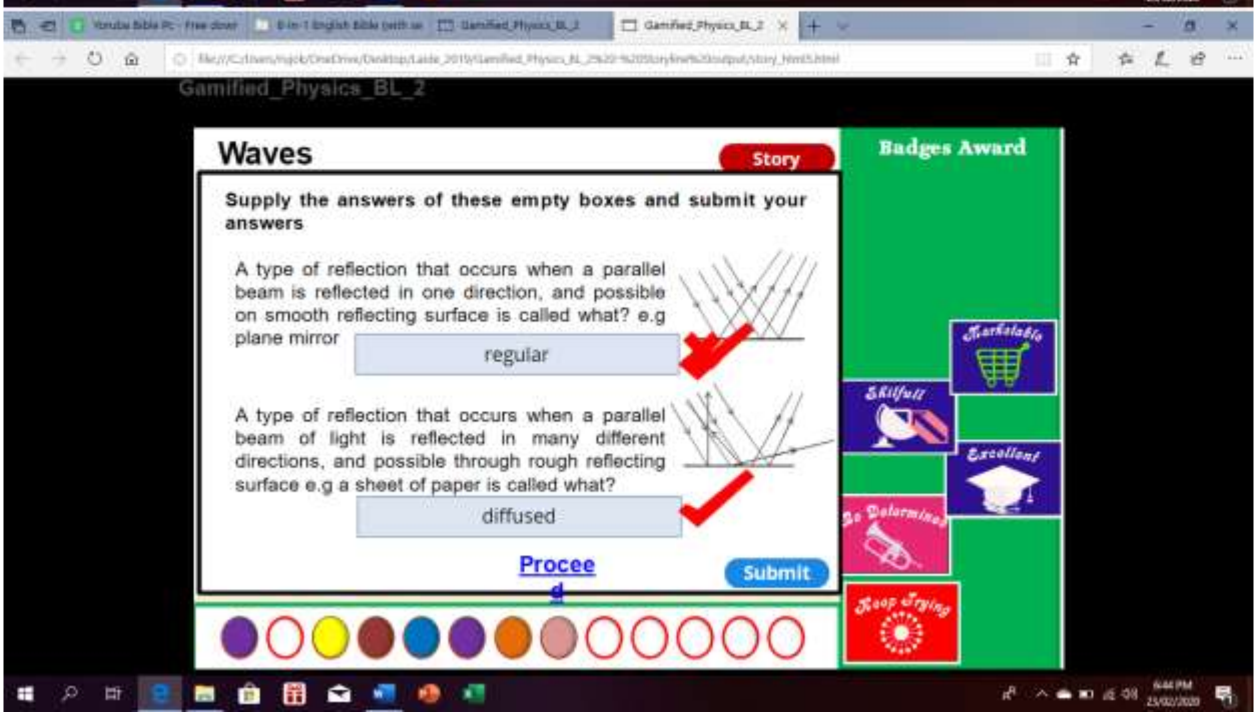
Screen 21 -22


Gamified_Physics_BL_2
Waves
Stationary Waves
Story
Badges Award
Stationary waves are formed when two progressive waves of equal frequency and amplitude travelling in opposite directions combined together in a medium in the resulting vibration.
Some points called nodes are permanently at rest i.e amplitude is zero. Midway between nodes are antinodes where the amplitude of the vibration is a maximum. Illustration
Be Determined
Keep Trying

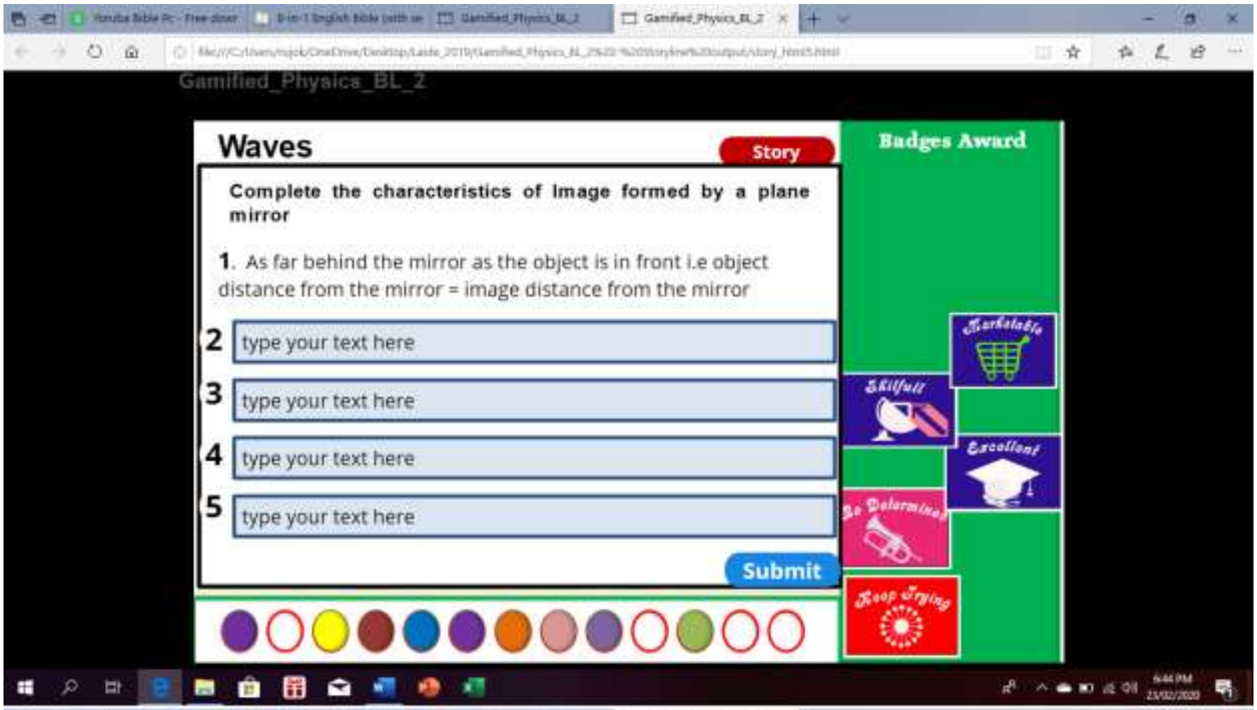

Gamified_Physics_BL_2
Waves
Nature of light
Story
Badges Award
Light is a visible form of energy which is radiated outwards from a source. It is a form of electromagnetic wave which travels in a straight line with a velocity of 3 x 10⁸m/s. Read more
Excellent
Be Determined
Keep Trying

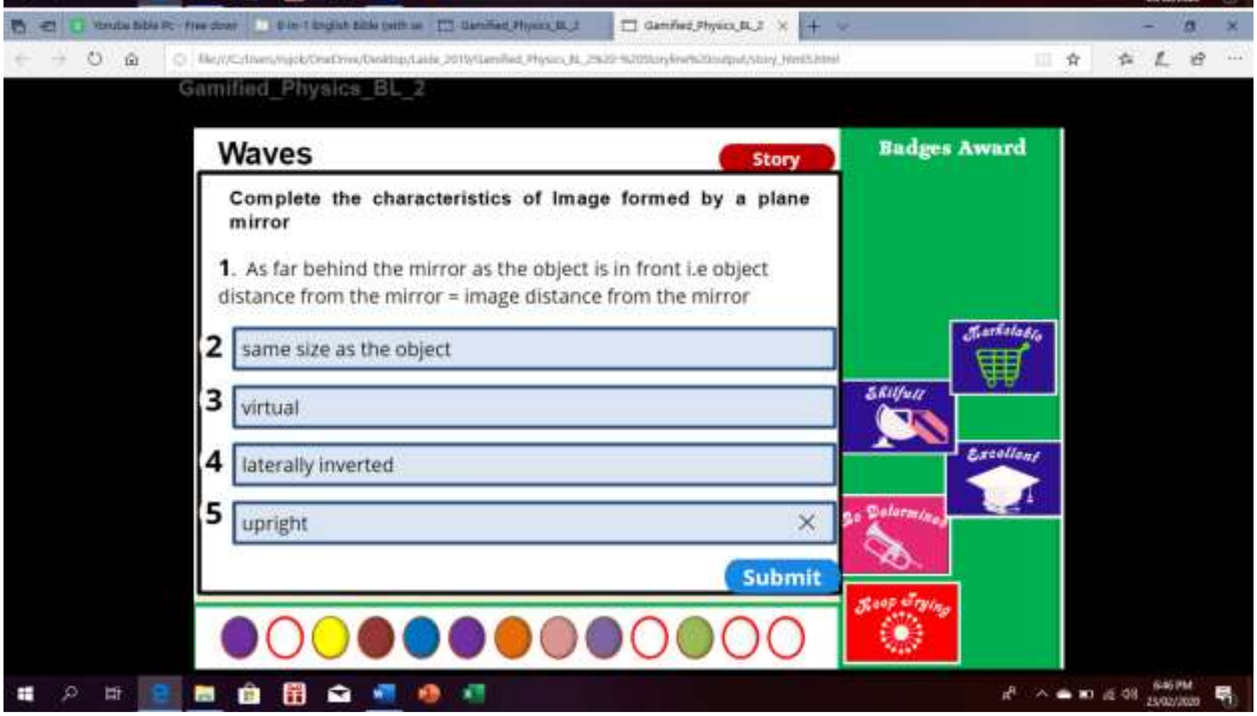
Screen 23- 24


Gamified_Physics_BL_2
Waves
Nature of light
Story
Badges Award
Pin hole camera
Formular

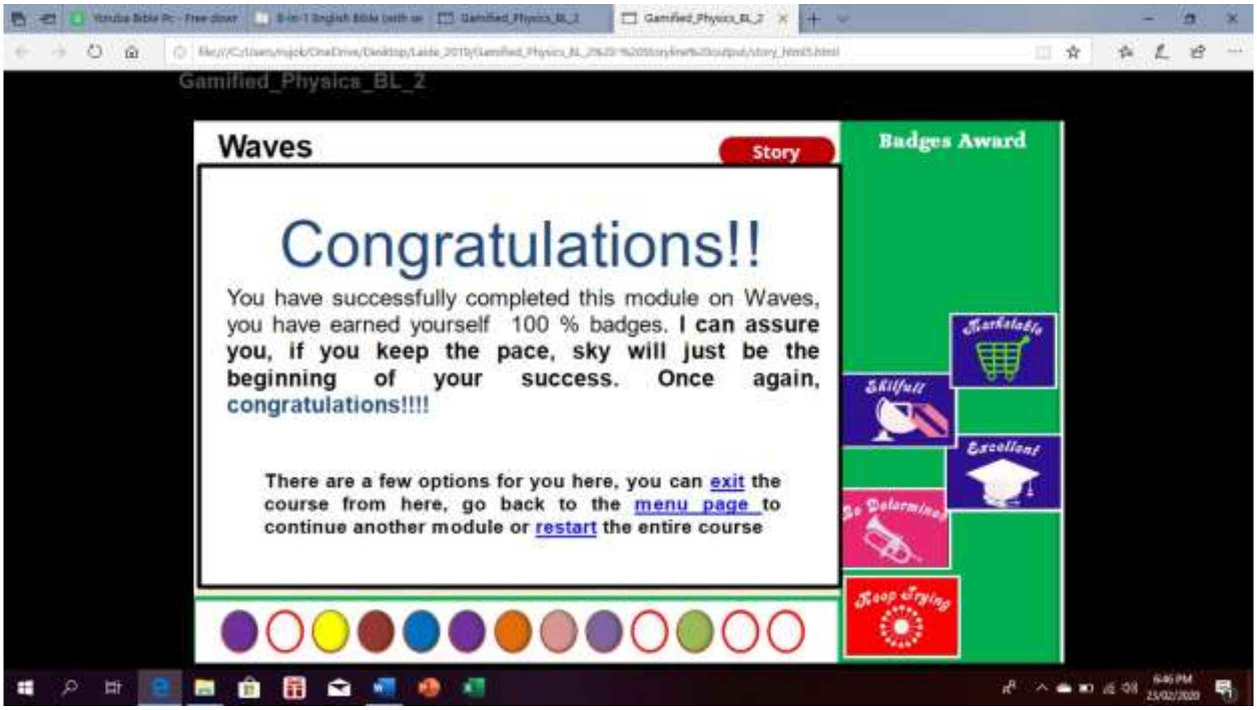

Gamified_Physics_BL_2
Waves
Story
Badges Award
Supply the answers of these empty boxes and submit your answers
A type of reflection that occurs when a parallel beam is reflected in one direction, and possible on smooth reflecting surface is called what? e.g plane mirror
regular
A type of reflection that occurs when a parallel beam of light is reflected in many different directions, and possible through rough reflecting surface e.g a sheet of paper is called what?
diffused
Proceed
Submit

Screen 25 - 26


Gamified_Physics_BL_2
Waves
Story
Badges Award
Complete the characteristics of Image formed by a plane mirror
1. As far behind the mirror as the object is in front i.e object distance from the mirror = image distance from the mirror
2 type your text here
3 type your text here
4 type your text here
5 type your text here
Submit
Skilfull
Excellent
Keep Trying


Gamified_Physics_BL_2
Waves
Story
Badges Award
Complete the characteristics of Image formed by a plane mirror
1. As far behind the mirror as the object is in front i.e object distance from the mirror = image distance from the mirror
2 same size as the object
3 virtual
4 laterally inverted
5 upright
Submit
Skilfull
Excellent
Keep Trying

Screen 27


Gamified_Physics_BL_2
Waves
Story
Badges Award
Congratulations!!
You have successfully completed this module on Waves, you have earned yourself 100 % badges. I can assure you, if you keep the pace, sky will just be the beginning of your success. Once again, congratulations!!!!
There are a few options for you here, you can exit the course from here, go back to the menu page to continue another module or restart the entire course
Skilfull
Excellent
Keep Trying

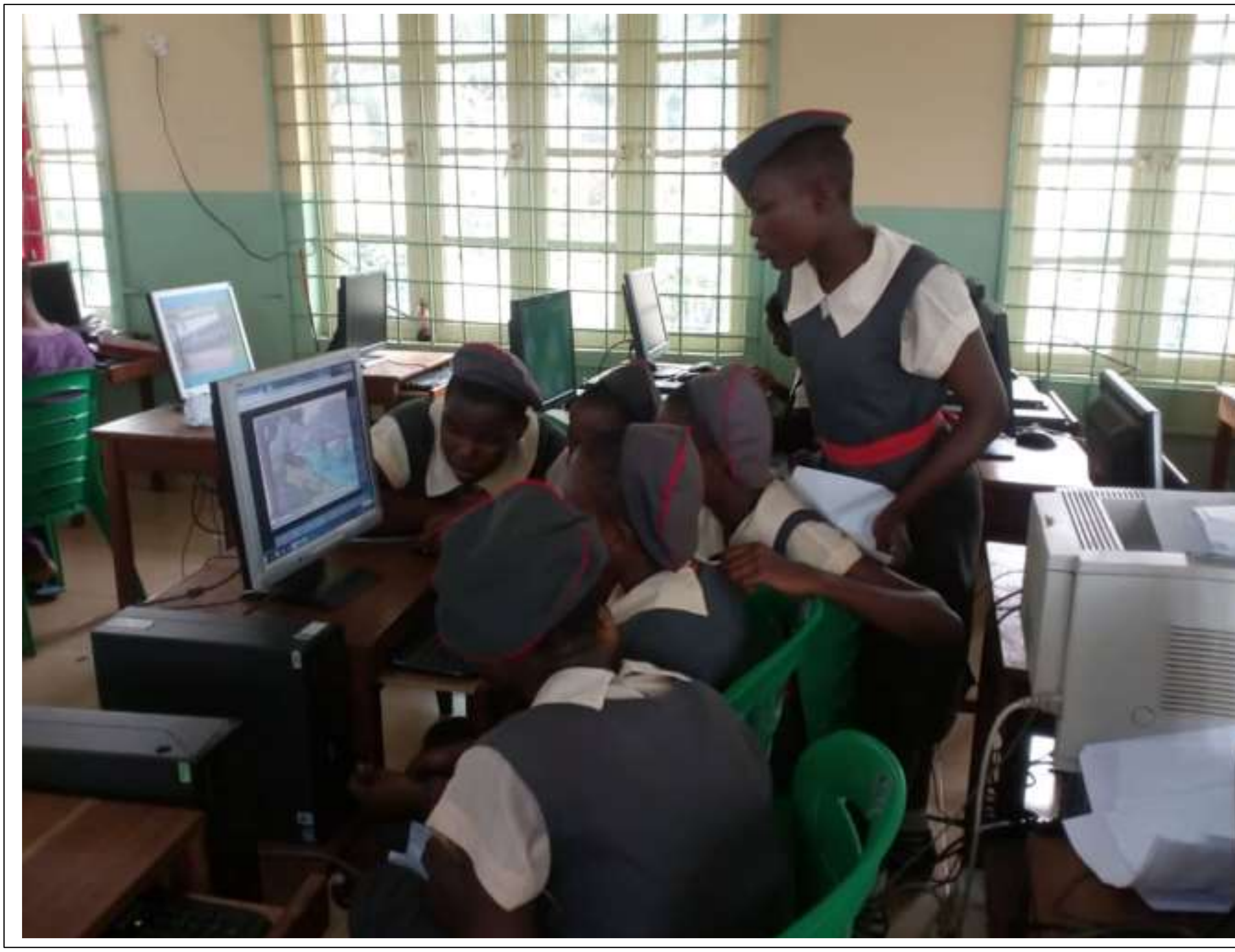
APPENDIX IX
SCREEN SHOT OF STUDENTS USING STORYTELLING, POINTS AND LEVELS

SCREEN SHOT 1

SCREEN SHOT 2

SCREEN SHOT 3

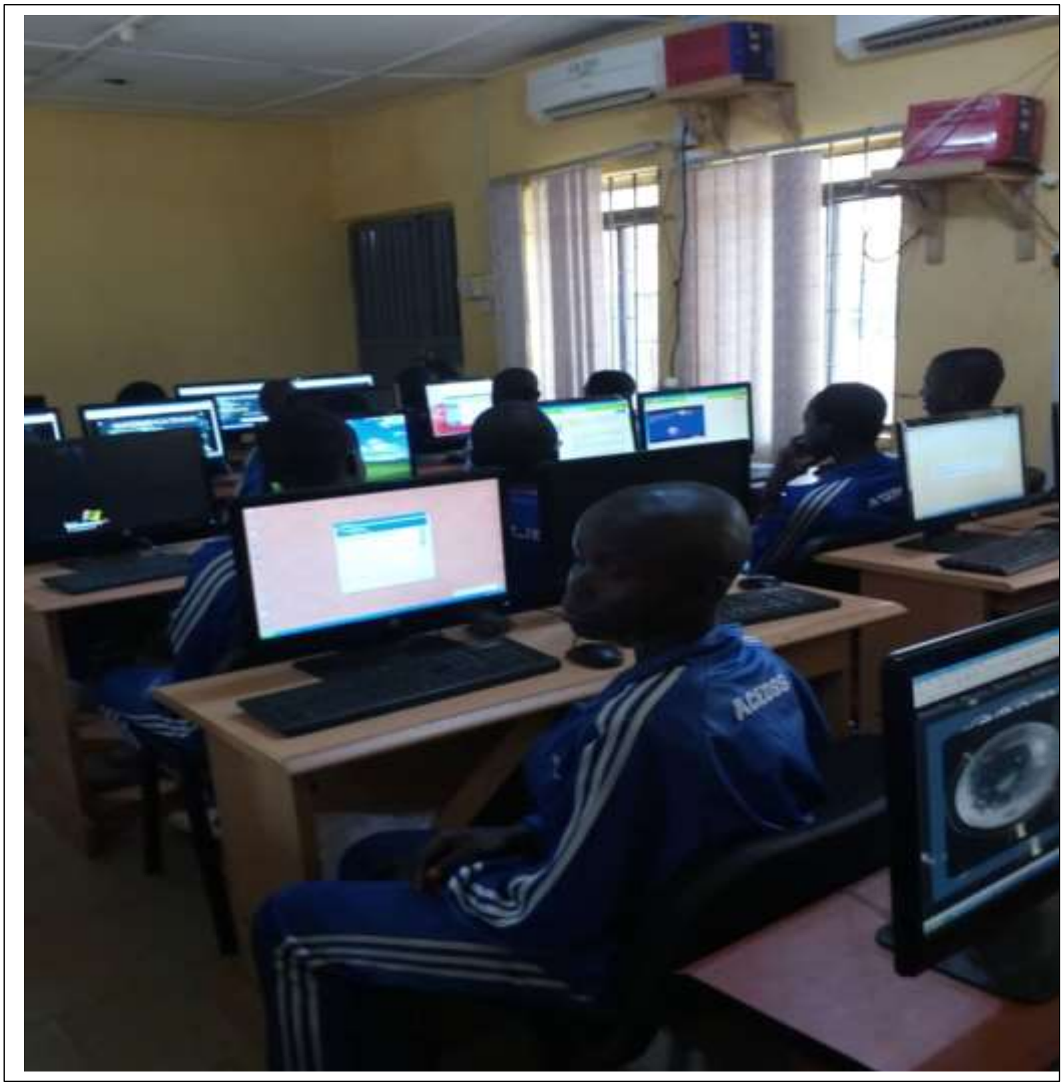
SCREEN SHOT 4



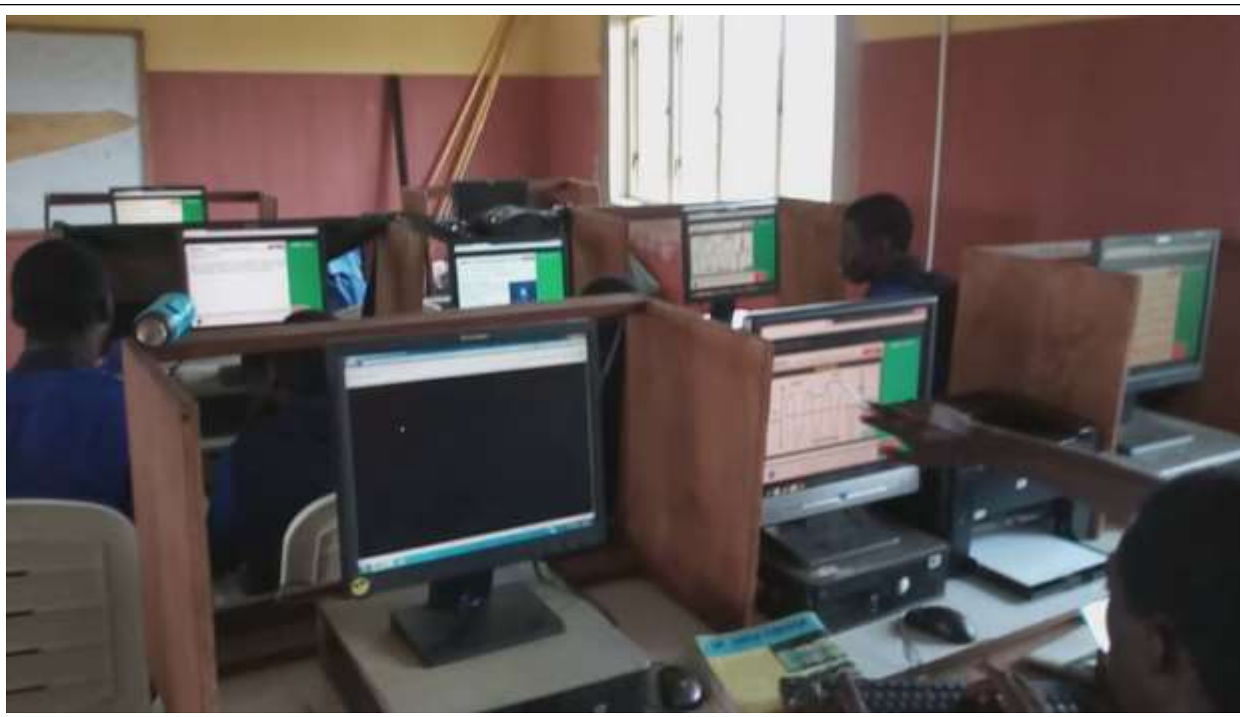
APPENDIX X
SCREEN SHOT OF STUDENTS USING STORYTELLING, BADGES AND LEADERBOARDS

SCREEN SHOT 1

SCREEN SHOT 2



SCREEN SHOT 3



APPENDIX XI
SCREEN SHOT OF STUDENTS USING CONVENTIONAL STRATEGY