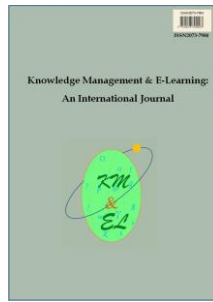# Effects of digital games on enhancing language learning in Tanzanian preschools

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Effects of digital games on enhancing language learning in Tanzanian preschools

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Abstract: This paper presents the effects of using digital games on improving language learning in Tanzanian preschools. A gamified learning prototype system was developed for making alphabetical sound articulation more engaging and fun. The study was conducted with twelve preschools in Tanzania. The results revealed that preschoolers' learning performance was improved when the game-based learning approach was incorporated into the sound articulation lesson. The findings inform educational stakeholders about the potential use of gamification in preschool education and propose ideas and means to standardize sound articulation and language learning to improve the overall quality of education.

Keywords: Digital games; Gamification; Preschool education; Language learning

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1. Introduction

Tanzanian preschoolers experience difficulties in alphabetical sound articulation. At present, there is no standardized way of pronouncing the alphabetical sounds for the second official language, English. This becomes a serious concern when a preschooler shifts from one preschool to another. Moreover, the preschoolers in Tanzania are a bit slower in attempting to articulate the sounds. Therefore, there is a call for developing a solution for standardizing sound articulation and for motivating preschoolers to learn the same. This is vital because, providing young children with stimulating educational and social experience in preschool strengthens their later school adjustment and achievement (Ongoro & Mwangoka, 2014; Zimmerman, 2002).

Information and Communication Technologies (ICTs) can provide efficient and effective learning resolutions for preschools (Oinas-Kukkonen & Harjumaa, 2008; Sohrabi, Vanani, & Iraj, 2019). ICTs that are known to be applied in the educational setting of the preschoolers universally are computers with appropriate digital content development and software such as audio, graphics, audio-visual, whiteboards as well as electromechanical kits (Plowman & Stephen, 2003). However, these available technologies may not be relevant, since they don't address the challenges experienced in the Tanzanian preschools' contexts. On the same note, the presence of ICTs in preschools has become widespread in recent years but it has been a piecemeal process and has not been driven by strategic planning in Tanzania (Mbelle, 2008).

Specifically, preschoolers in Tanzania are experiencing problems relating to insufficient knowledge of natural constituents and real-world objects that are available in their surroundings, which affect their proper intellectual development since the traditional approach of teaching does not relate real-world objects to classroom teaching. This is stated clearly by (McLeod, 2009; Piaget & Cook, 1952) that focused on cognition theory and assert that the preschoolers at preoperational stage (2-7 years) learn well when real objects are applied in teaching. Furthermore, Tanzanian preschoolers are distant from digital media a factor that demotivates and hinders achievement among our preschoolers.

The problem is revealed in the cognitive capability of a preschooler whose cognition is still in a state of preoperational level (McLeod, 2009) and the condition of multimedia which only delivers information in the digital visual-auditory format. To bridge the gap, multimedia should and need to embrace tangible objects in learning. This can be done using physical objects in the environment that learners see and are aware of and link it to the gamified-digital arena. However, there is absence of discussion on how the tangible digital media should be like as it is still a new area of examination in Tanzania (Ongoro & Mwangoka, 2019; Said, 2007).

At the same time, this is an era where the children are growing up with computers and video games. These games provide highly stimulating experiences, which shape the children's expectations of education and learning (Henderson, 2005; Prensky, 2003). This represents a great challenge for preschools, as pupils find it increasingly demotivating with old learning processes.

In light of this, a great body of research has been dedicated to thoughtful games that are created with learning as the main goal, and fun or entertainment as minor. The content in the games are often not all applicable for the Tanzanian preschoolers' curriculum, making the games more of a side-activity in a preschool classroom; leaving many thoughtful games impractical to use in real life educational settings in Tanzanian preschools (Teensma, 2016; Salen & Zimmerman, 2004).

Previous studies (Papastergiou, 2009; Girard, Ecalle, & Magnan, 2012) are of the opinion that digital game-based learning has the capability to motivate and enhance the teaching and learning process. Meanwhile, (Graham, 2006), emphasizes the importance of English language due to the rise of globalization that has an impact on the economy. Subsequently, Emelyanova and Voronina (2017) take a similar position and explore the attitudes and perceptions of the learners on the integration of blended foreign language learning in the classroom setting. They propose blended learning that involves smart technologies in combination with traditional approaches to language learning. Moreover, Li et al. (2016) insist that blended learning should be introduced to learners progressively. This is because positive results of online blended learning can only be achieved when learners are enthusiastically involved. This calls for motivation and enjoyment in the learning content. In their study, they developed a Facebook game that enhances motivation and fun. The game is learner centred, self-directed and very interactive as learners can post learning content and share with their peers at all times with internet access (Li et al., 2016).

While learners are content with blended learning, there is still limited use of digital learning technologies and content to motivate learners. This paper presents a prototype of gamified-language learning application on alphabetical sounds for preschoolers in Tanzania. The goal is to make work with sound articulation more engaging, motivating and fun. It also aims to help set up a standard format of pronouncing English alphabetical sounds and alleviate difficulties in identifying and reading the alphabetical sounds correctly. The prototype was implemented as a standalone application using LiveCode programming language (Holgate & Gerdeen, 2015).

2. Literature review

2.1. Gamification

Gamification is a term that refers to the application of the philosophy of games and the game mechanics in settings that are non–game like in order to inspire learners/players in unraveling demanding issues and changing people's behaviour. Among the areas that gamification has been used include creation of autonomy, physical exercises, businesses, learning and in improving engagement among the users as well as creating emotional feelings among the humans so as to perform at high levels (Prensky, 2003; Huotari & Hamari, 2012).

Among the many techniques used in gamification to complete required chores are rewards that can either include badges, points, completing a progress bar as well as computer-generated currency. Furthermore, competition is also one of the other elements that can be applied in gamification. It is essential to encourage learners or players to compete in games in order for the completion of tasks to be noticeable (Kim, 2009; Lee & Hammer, 2011). Making existing tasks feel more like games is another approach to gamification. This can be achieved by adding meaningful choices, increasing challenges, and adding narratives.

The techniques in gamification attempt to influence the preschoolers' cravings for self-expression, self-satisfaction/altruism, triumph and for ending chores that they feel are boring, for instance: filling in taxation forms or the questionnaires or else reading text-based books (Deterding et al., 2011).

Generally, at present time, gamification efforts are mainly dedicated around a few core game mechanics like points that have been used in this research work. Other game mechanics are levels and competition in the form of high score rankings (Prensky, 2003; Sadera et al., 2014). The various research work done on gamification, depict that gamification has positive impacts when used in driving a particular behaviour.

It is clear that gamification is recognized as having some potential to turn work, health and even education more engaging. With respect to this research, it is most interesting to look at gamifying education in Tanzanian preschools. According to the research of Lee and Hammer (2011) and Jung, Schneider, and Valacich (2010) on gamification and its potential use in education, the response is affirmative. Gamification could be a solution to the major challenges with the lack of standardized sound articulation and preschoolers' motivation that schools today are facing. This promises well for game mechanics based digitized-learning systems like the prototype presented in this research. Such systems have the potential of becoming real child-centred learning environments for Tanzanian preschoolers.

2.1.1. *Gamification versus thoughtful games*

Gamification is a tactic for influencing and motivating the behaviour of people, in this work preschoolers are explicitly dealt with in order to prompt alphabetical sound articulation behaviour. Thus, *gamification articulated as 'gay-muh-kay-shuhn'* in this paper can be defined as a process of integrating game dynamics in the alphabetical sounds designed for preschoolers to drive participation in sound articulation (Gåsland, 2011). Based on the definition, gamification, in essence, has no same meaning as a game since it predominantly applies the design thinking of games in settings that are not game-like turning them into games in some occasions (Sandford & Williamson, 2005).

Another term that is normally confused and is closely related to gamification is thoughtful/serious games. According to Deterding et al. (2011), games intended for improving some specific aspect of learning and not just pure entertainment are known as serious games. The similarity that exists between serious games and gamification is that they both apply game mechanics in enriching learning (Sandford & Williamson, 2005; Hamari, Koivisto, & Sarsa, 2014). However, serious games differ as they are designed for a specific purpose of being educational rather than providing pure entertainment. On the other hand, gamification normally employs the use of game mechanics to enhance learning making concepts much more inspiring and enjoyable and not just by making something a game.

Fundamentally, gamification is all about scores. If preschoolers learn alphabetical sounds, in the same way, all the time, it gets boring quickly. On the other hand, if they start capturing and displaying figures that is; how many times each child has scored high marks in articulating sounds, then the experience becomes more interesting. This helps to create another level to the game and motivate preschoolers to learn more. The scores become the game in essence.

While gamification uses game-design thinking on everyday activities and puts them into real-world problems to inspire preschoolers and make sound articulation enjoyable; serious games, on the other hand, changes the non-game-like activities in the physical world into games. As a result, it is possible to use gamification in any kind of field to transform the users into players with a target of bringing in inspiration and engagement in the respective task (Scharf, Winkler, & Herczeg, 2008).

2.1.2. Game mechanics versus game dynamics

These are both elements in game-based systems, which are closely related and sometimes used interchangeably. Game mechanics inspire the players in various aspects that lead to a change in behaviour. The instructions or rules that form the game, making it satisfactory and engaging is what is termed as game mechanics. The self-satisfaction and inspiration which users find when playing the game rise from their emotion and is what we call, game dynamics (Gåsland, 2011).

In this work, game mechanics are activities control mechanisms used to gamify the alphabetical sound articulation quiz. The actions and control mechanisms if taken together create a compelling and engaging preschooler experience leading to motivation, which is the so-called game dynamics.

Game elements are the set of components and features from video games that can be used in non-game contexts. Some of these game elements are used in this work to inform preschoolers about their performance and progress in the alphabetical quiz, other elements are used to reward learners and some other elements have to do with the dynamics of the game and the progression of the pupils. In our work, game elements are associated with the concepts such as feedback materialized through rewards which use points as game mechanics (Donker et al., 2013).

In general, game mechanics include points, levels, challenges, as well as leaderboards, while status, reward, achievement, self-expression, competition and selflessness represent game dynamics (Hamari & Koivisto, 2013). Furthermore, in this research, the alphabetical sounds articulation tasks designed has applied game mechanics and game dynamics in making sound articulation more challenging, inspiring and enjoyable for the Tanzanian preschoolers.

In this work, the authors focus on gamification because it can reflect on existing environments that the preschoolers are familiar with. Secondly, with gamification, the game elements seem not to be central but peripheral, which nurtures a widespread implementation of the game. This understanding is the first step towards an enhanced and enjoyable approach of learning that could be plugged on several applications in the Tanzanian preschool curriculum.

2.2. The cognitive theory

Constructivism also termed, as learning by doing has generated renewed interest in the digital world, being a typical approach to educational teaching. The significance of connecting game techniques in learning through digital media has been growing in the current era. At the same time, Navarro-Prieto, Scaife, and Rogers (1999) and Deutschmann and Nykvist (2009) assert that violent games have brought about contradicting views from the behavioral and cognitive perspective while on the other side (Dickey, 2011) believes that non-aggressive games have made known to be received positively.

Furthermore, it has been realized that some of the games depending on the simplicity or complexity can enhance how the brain functions while others draw back the intellectual capabilities in relation to the age. Thus, there is the need to make proper decisions before playing a particular game just as the sound quiz prototype developed in this work paid attention into the aspect of the age-appropriateness and applicability of the game-based content among Tanzanian preschoolers (Karat & Karat, 2003).

Bourgonjon et al. (2010) criticize the fact that constructivism has been in existence for ages nevertheless the teachers keep on spoon feeding the preschoolers instead of making learning child-centred. He suggests that each individual learner needs to be guided and not trained. He adds that this can be achieved when digital media is blended to the learning activities of the preschoolers making them attractive, interactive and motivating (Emelyanova & Voronina, 2017).

Within this angle, it is critical to realize that the main reason for learning is to be able to interpret and create meaningfulness in the educational arena through the attainment of computers, mobile, and web-based applications, which have become widely accessible. To be able to attain this, then looking into various researches done on schema theory, information processing theories of reasoning and problem-solving as well as general processing in memory which is part and parcel of cognition theory need to be taken into account (Kolås, 2010; Valencia-Vallejo, Lopez-Vargas, & Sanabria-Rodriguez, 2019). This is due to the fact that the constructivists have progressively emphasized that acquisition of new knowledge and understanding is achieved through active processes.

Piaget's theory of cognition has been significantly influential in the school level educational research. This is because Piaget hypothesized that intellectual abilities play a great role in building concepts instead of just being pumped with information. This assumption is supported by (Brown & Cairns, 2004; Wang, Vogel, & Ran, 2011) who assert that ideas are well comprehended when applied in the real world setting and not when taught theoretically, which is also in line with the constructivists who believe that learning should be child-centred and activity based.

Piaget revealed and described that human development involves a series of stages. As depicted in Fig. 1, each stage prepares the child for the succeeding levels. There are four development stages in his theory that begin when a child is born to the puberty stage. During these stages, language develops, the reasoning level increases, memory expansion, and moral growth are all observed. This work focuses on the second stage of Piaget's cognition theory called the preoperational stage that ranges between 2-7 years that our Tanzanian preschoolers fall in (Piaget, 2008).
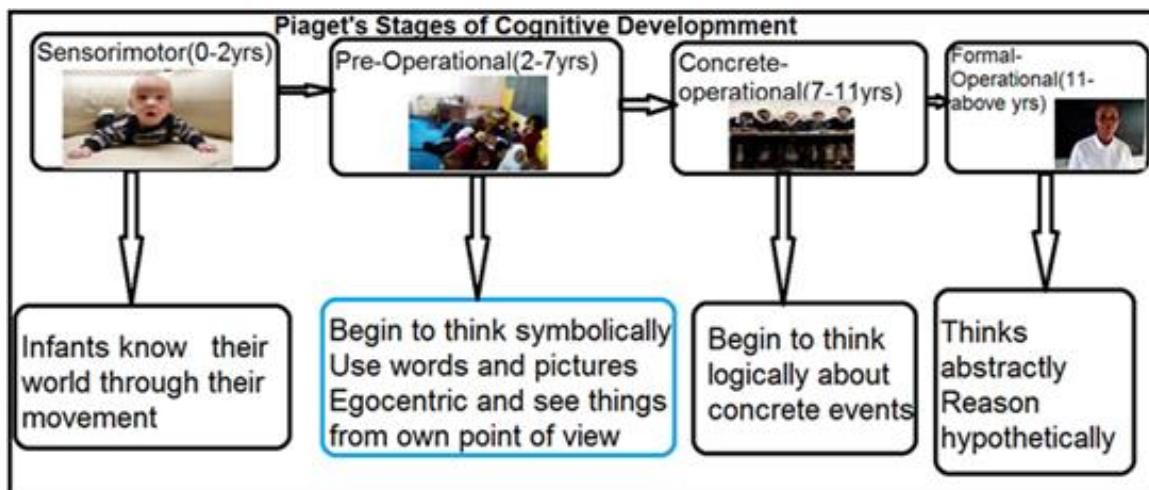

Fig. 1. Piaget's stages of cognitive development

2.2.1. Features of children at the preoperational stage

This is the second phase of Piaget's cognition theory that ranges to children between two to seven years. During this stage, language development occurs as children attain mental skills, representation of objects and events. Moreover, memory and level of imagination are also acquired. The most significant feature of this phase is that children think only in one way i.e. monologically in which they can solve one problem at an allocated time making it difficult to think and learn more than one concept at the same time.

Furthermore, Piaget revealed that at the preoperational stage children are egocentric implying that they are self-centred in which they just understand what goes on in life from their own point of view (Piaget, 2008; Piaget & Cook, 1952). It is at this stage that children play the roles of various characters in their respective societies; this includes the roles of their parents, siblings, teachers and even doctors. Bearing in mind that preschoolers are egocentric at the ages two to seven, the alphabetical sound articulation language learning prototype developed for the learners in this research has applied Piaget's theory and constructivism theories, where the tangible objects existing in the preschoolers' environment have been digitized and gamified to fit the abilities of the preschoolers and to make learning more enjoyable and fun.

3. Methodology

3.1. Description of the prototype design principles, architecture and its building blocks

The main approach to digitized game-based-learning, namely development of game-based Tanzanian Alphabetical Sound Quiz (TALSQ) for enhancing language learning in Tanzanian preschools was opted for. The approach is inspired by gamification. The goal of the approach is to make learning more fun and engaging. It is the authors' point of view that learning is and should be fun and self-driven. This philosophy is in line with gamification, which seeks to increase user engagement and own initiative.

Additionally, in order to ensure that the developed gamified language learning prototype has a probability of being used/feasible in the preschools, several elements were evaluated. The authors assessed on its applicability in Tanzanian preschools. This was whereby there was a strong proof for achieving the aims and targets of the preschool education with digital gamified learning.

Secondly, the game content was another element assessed. It was ensured that the created content reflected on what is existing in the Tanzanian curriculum. Further, knowledge appropriateness was also taken into consideration, in which the authors confirmed that the game content was suitable to the preschoolers' learning needs.

Moreover, appropriate Tanzanian culture that preschoolers are familiar with, was adopted by making use of the existing tangible objects in the environment into the digital-gamified learning program. This was purposively done to assist learners to connect physical objects they see in their respective surrounding and what exists in the digital world. Other elements assessed entailed the teachers' level of technology and skills for applying digital-game based learning. The support given by the administrators of the preschools were also put into the account. This is depicted in Fig. 2.
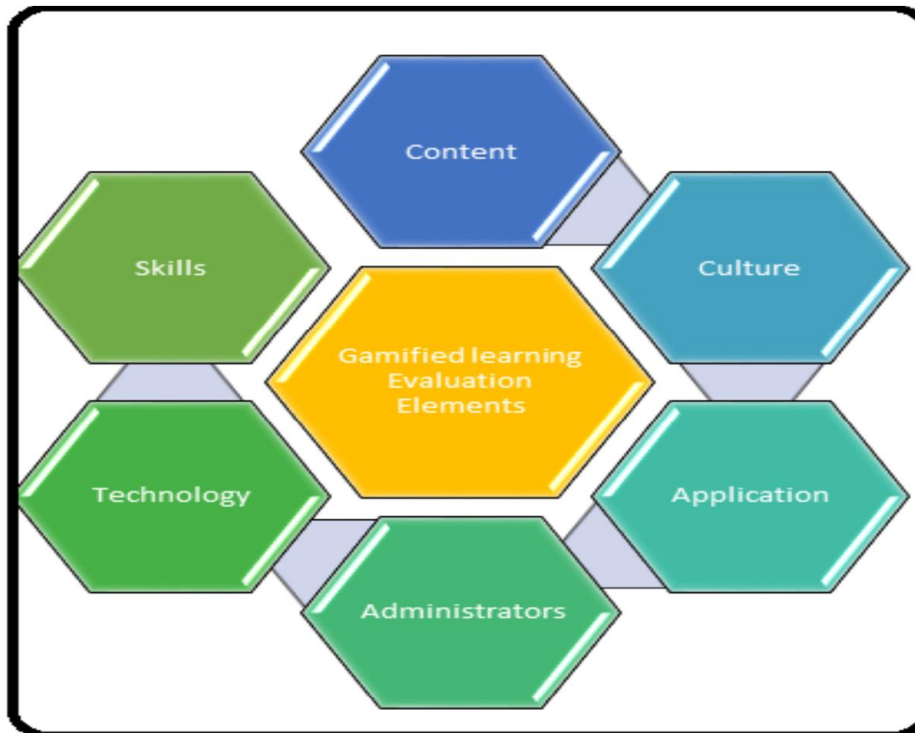
Fig. 2. Gamified language learning evaluation elements

3.2. Design principles

In designing the gamified-language learning TALSQ prototype it was ensured that the prototype created a set of tasks or games to provide multiple opportunities to learn, as one game does not fit all children, particularly young children, and provides the best opportunities for learning. There was also the fact that within one game, the same information was presented in multiple ways in order to help children make connections and because young children come to the game with a wide range of backgrounds, the prototype had letters, pictures, and provided audio instructions.

Moreover, visual objects were carefully selected, ensuring that each visual object had a purpose bearing the fact that preschoolers are limited to the amount of visual information that they can be presented to on the digital screen. The game was also designed with minimal audio signals since preschool classrooms are normally active and have loud learning environments (Rauscher, 2003; Frost, Wortham, & Reifel, 2001). The game involved animated pictures since children enjoy when games involve motion. The game designed further reflected on the context of what the learners were familiar with. The game also had challenging activities to help improve preschoolers' competence in alphabetical sound articulation. The feedback mechanism was carefully selected ensuring that the incorrect feedback had an audio response that had a strategy or hints to help solve the questions correctly.

3.3. Design process

With gamification in mind, a logic design process was reexamined, which then confirmed the goals of the research. Fig. 3 depicts a theory of change for TALSQ gamified-language learning content for preschoolers, which describes each aspect in their respective domain. Among the domains are research principles that involve the use of game-based approach, constructivism and Piaget's theory as discussed previously; design principles, which made use of game elements such as points and animations, design elements adopted from various researchers such as (Deterding et al., 2011; Gåsland, 2011). Further, from the language content itself; inputs include digital and physical objects that depict what exists in the real world and the learning context; preschoolers' activities involve varieties of tasks such as collaboration, playing and learning at both individual and group activities levels. This is for the reason that the children learn best when numerous activities are incorporated during learning sessions; learning approach in this theory of change involves a preschooler-centered approach and teacher-preschooler discussion because learning should be participatory for a better end-user outcome.

Finally, within this theory of change, are the outputs that can either be transitional by which the preschooler is hypothesized to articulate sounds better and provide more feedback on the game or the long-lasting output that will result in improved performance in language learning. It is to be noted that this theory of change has been formulated based on inputs of (Blythe et al., 2003; Gåsland, 2011) among other numerous researches that have analyzed the appropriate contexts for gamification in learning and conducive environments suitable for preschoolers to learn.
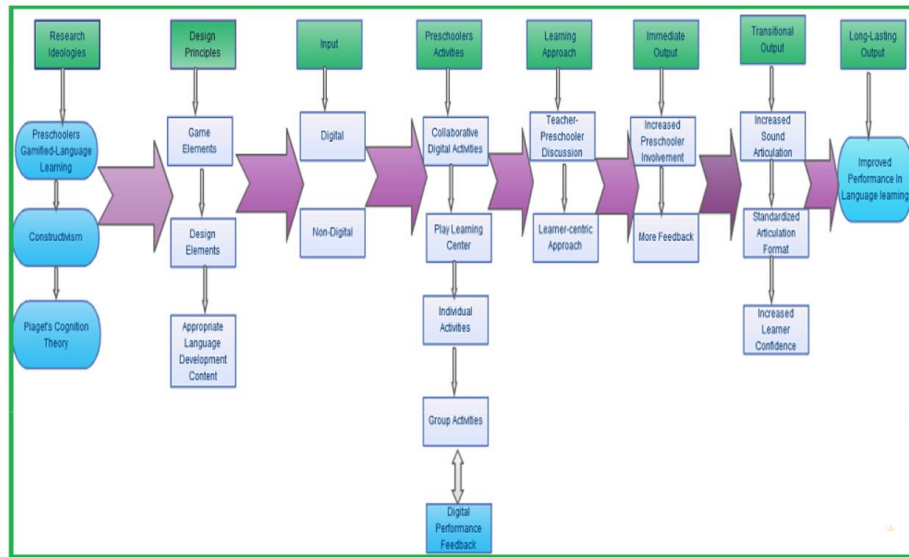

Fig. 3. Theory of change for gamified-language learning approach for preschoolers

3.4. TALSQ prototype development process

In developing the gamified-language learning TALSQ prototype, the design principles mentioned in section 3.2 were implemented. The TALSQ prototype comprised of challenging set of games providing multiple opportunities with supportive feedback.

Furthermore, the pictures of the alphabetical sounds were in motion and the audio sound had minimal signals. This was achieved after reviewing the literature, technology, and existing language-based games for preschoolers.

During this phase, prototyping uncovered LiveCode programming language to be the most appropriate application for constructing the early literacy program. LiveCode was used for developing the alphabetical sound quiz prototype because it makes it easy to turn concepts, ideas or designs into powerful applications. It also creates desktop, Internet, database and network applications. Furthermore, LiveCode includes a complete graphical user interface builder, as well as the tools needed to produce background applications. Apart from being object-based and a cross-platform application, LiveCode graphical application is more responsive to use than a Java application, and takes a twinkle of an eye to writing an application (Holgate & Gerdeen, 2015).

The work with this research contained developing a prototype of alphabetical sounds game mechanic based digitized-learning application for enhancing language learning in Tanzanian preschools. The application was named Tanzanian Preschoolers Alphabetical Listening Sound Quiz (TALSQ), to indicate the learner-centric approach, and to give associations to a tool that would help preschoolers in their lessons. Designing the alphabetical listening sound quiz entailed sketching, designing, and implementing a functional prototype of the system. The alphabetical sound listening quiz was designed in the form of a game. This was done to give an indication of the system's ability to make work with alphabetical sounds more engaging and fun. To give context, the emergent trend of gamification was exposed in the prototype. The interface had 4 multiple choices in each question, a picture, audio sound, and back and forth buttons.

A preschooler was alerted with dialog boxes in case he/she was right. Pictures of the respective sounds were revealed in case a child could not seem to identify the right sound. If a child was right, then the next button with green colour was displayed to prompt the child to go to the next question. In case the child was wrong then he/she was alerted with try again dialog boxes.

The program had also alphabetical sounds pronunciation in audio format. With this, the developers recorded all the 26 alphabetical sounds to help come up with a standard sound articulation format for preschoolers in Tanzania. The overall scores were displayed at the end of the quiz. Fig. 4 depicts how the prototype was sketched:
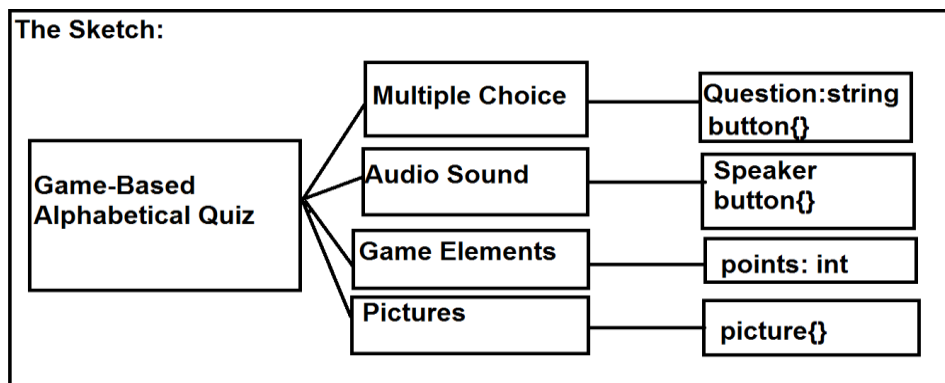

Fig. 4. Sketch for alphabetical listening quiz prototype

It was realized that multiple choice worked better than open-ended questions in designing the prototype. With multiple choices, it was easy to see children at their best. The quiz had 26 alphabetical letters all tested.

This system is distinctive in that it focuses on the preschooler primarily. It is the authors' point of view that good learning is only achieved when focusing on the preschoolers' needs and abilities. What is also unique is that the content is collaboratively created paying close attention to the Tanzanian curriculum for preschooler drawing inspiration of learning. It also represents an alternative way to study/remember with potential benefits. It has been realized that if gamification is used in designing digital content for preschoolers it brings in confidence since a child keeps on trying and children learn faster, and concepts are mastered easily.

The game mechanics were used to give continuous feedback to the preschoolers. The meta-data generated from preschooler working in the system could also be used to give better statistics and classroom data to teachers (Deterding, 2011; Ongoro, 2017). The game mechanic chosen was the points game mechanic whereby the player, in this case, the preschooler gains a point in case a sound is articulated correctly. The points were designed in the form of a fruit-bearing tree that catered for all the twenty-six alphabetical sounds. This choice was based on the studies of gamification that indicated that it was one of the most popular and successful game mechanics utilized in other efforts (Salen & Zimmerman, 2004). There are large opportunities with integrating the learning process itself into a digital manner. The prototype presented in this research represents commencement of "Gamified learning" in Tanzanian preschools.

As a final point, the system was tested in Tanzanian preschools, to obtain data on the practical implementation in a real-life educational setting. The flow chart of the entire gamified-language-learning prototype development process is presented in Fig. 5:

Fig. 5. Prototype development phases

4. Evaluation, results, and discussion

4.1. The survey with the teachers

The researchers had made arrangements with 12 preschools in Tanzania to allow the preschoolers to test the prototype in their respective classes. These preschools were having access to electricity, Information and Communication Technologies (ICT) facilities such as computers, television, and projectors. Among them, ten (10) were from private preschools using English as a medium of instruction and two (2) preschools were from public schools using Swahili as a medium of instruction. After releasing the alpha version to the entire teachers and preschoolers, a survey was administered to nine teachers in each school in the form of closed-ended questionnaires. A total number of one hundred and eight (108) teachers were purposively selected and administered to the questionnaires. One hundred and two (102) were female teachers, while six (6) were male teachers. The closed-ended questionnaires were administered to every teacher once the alpha version of the prototype had been seen and used by the preschoolers and teachers to provide a room for realistic comments and views. The preschools that took part in the study were distributed across three regions in Tanzania namely: Arusha, in which Nambala, Nganana, Hemani, and Tanganyika preschools took part in the study. Iringa was the second region that had preschools participate in the survey namely: Iringa International, St. Dominic Nursery, Ummu Salama Nursery school, and Highland Pre and Primary school. The third region was Dar es Salaam that included preschools namely: Hazina International, Kingdom Heritage Model School, Heritage English Medium Nursery and Primary School, and Atlas Schools.

The survey presents results received from the teachers when the TALSQ prototype was administered to the preschool teachers. A seven-item closed-ended questionnaire was administered to receive feedback on the TALSQ prototype. Table 1 depicts the written equivalent of the calculated mean. This has been designed to scrutinize the results in an effective manner that provides a good chance for teachers' opinions and comments to be vividly recognized for amendments and adaptation of the TALSQ prototype.

Table 1
Likert scale interpretation (the written equivalent of the calculated mean)

Mean	Written interpretation
1.00-1.69	Strongly Disagree
1.70-2.49	Disagree
2.50-3.29	Neither Disagree nor Agree
3.30-4.19	Agree
4.20-5.00	Strongly Agree

In Table 2, The results of the survey reveal that within the first category of the design appropriateness, 73% of the respondents strongly agreed and acknowledged that the graphical user interface with visuals and menus was suitable for the preschooler's language learning process while 7% disagreed. Over 50%, explicitly 58% of the teachers' respondents agreed that the design components were well incorporated and were motivational, while 8% strongly disagreed. The other item assessed was on the digital game content of the TALSQ prototype that revealed that 32% of the respondents agreed

that the developed content was taught in the curriculum and it made it easy in the articulation of alphabetical sounds. On the other hand, majority, 61% of the teachers' respondents strongly agreed that the developed content would bring in immense positive effects in the teaching and learning process. Regarding culture appropriateness, 67% of the respondents strongly agreed that the Tanzanian culture was adhered to because the objects and pictures of what exists in the environment were incorporated in the prototype. However, 18 % of the respondents agreed on the audio sounds and instant feedback provided by the prototype. Meanwhile, 66% of the teachers approved and strongly agreed on the instructions and hints provided to the learners in attempting the articulation of the alphabetical sounds.

Table 2
Percentages per scale of teachers' acceptance results

Criteria		SD	D	NAD	A	SA
Design Appropriateness	Q1	3%	7%	2%	15%	73%
	Q2	8%	4%	7%	58	23%
Digital Game based Content	Q3	3%	1%	3%	32%	61%
Culture appropriateness	Q4	4%	6%	5%	18%	6%7
	Q5	5%	7%	4%	18%	66%
Curriculum Suitability	Q6	7%	2%	4%	8%	79%
Technology Level	Q7	7%	22%	6%	55%	10%

Further, majority of the respondents, 79% strongly agreed on the suitability of the curriculum as the sound articulation at preschool level sets up a good foundation for proper language development of a child in later stages. Concerning technological skills, the majority, 55% of the respondents agreed that it is important to be acquainted with the computer before using the prototype. Nonetheless, a few 22% disagreed on the need for training because they claimed to be conversant with the use of technology. Basically, these were the young teachers that are moving with the trend of technology.

The survey results of the teachers conducted in the twelve preschools on the design appropriateness criteria that adhered on the user interface that proved to possess a lot of interactivity as well as the audio sounds and feedback acquired a mean of 4.53, categorized as "strongly agree". The mean of 4.21 categorized under "Agree", was acquired for well-designed instructions, pop up hints and instant feedback in the sound articulation quiz. In terms of cultural appropriateness, an average mean of 3.48 interpreted as "Agree" was depicted. On the other hand, the curriculum suitability gathered an average of 4.47 and was interpreted as "Strongly Agree" while 2.68 interpreted as "Neither Disagree nor Agree" was gathered for the technological level of the teachers at the preschool level.

The general views given by the teachers were as follows. The program would assist in enhancing learning because the child hears the sound, sees pictures and letters at the same go. This goes hand in hand with Piaget's preoperational cognitive theory mentioned in Section 2.2. Furthermore, the program can also be used by both teachers and parents when put in portable devices making it easy for parents to coach their children at home. Moreover, the gamified approach will facilitate standardization of pronunciation for alphabetical sounds required to be used all over Tanzania since almost every school uses a different pronunciation for innumerable sounds.

4.2. Observation of the children's performance

Demonstrations on how to use the designed game-based sound quiz prototype were conducted by the preschool teachers in the respective schools. The participating children took a period of twenty minutes in attempting the sound quiz. A snapshot showcasing the preschoolers using the gamified language-learning prototype is depicted in Fig. 6. The prototype's interface is illustrated in Fig. 7.

Fig. 6. Snapshot of preschoolers using the gamified language articulation prototype

Fig.7. Snapshot of interface for the gamified sound articulation lesson

From the observations made and the interview conducted on the preschoolers after using the alphabetical sound articulation prototype, various affirmative comments were made revealing how the preschoolers were thrilled and preferred using the early

literacy program developed on the alphabetical quiz. The children uttered simple sentences for instance: "We love learning the alphabetical sounds using computer", "We like hearing the sounds from the speaker", "We also want to listen to our voices on the computer", "We like the orange picture on the computer." The comments made by the preschoolers, portray a preschooler who falls in the second stage of Piaget's cognition theory, called the preoperational stage in which, children think egocentrically, i.e. as he/she sees life from his/her own point of view as (Piaget, 2008; Piaget & Cook, 1952) stated.

4.3. Experimental study

This work also evaluated the effectiveness of using the digital game-based language learning versus the traditional paper-based learning by conducting an experimental study in two preschools: Nambala Nursery School (public) and Hemani Nursery school (private). All the children (aged 3-6 years, 60 males, 59 females) in both schools participated in the study. They were assigned to two groups. The two groups had the same educational content on articulating alphabetical sounds.

The control group used the traditional approach (using print outs and chalkboard) to learn and articulate the sounds. The experimental group used the digital game-based sound articulation prototype.

The individual preschoolers in the control group were guided by their teachers and the researcher in which the teachers made a demonstration on how the children were to go about articulating and identifying the required sounds. The task of the preschoolers was to listen and follow what they were asked to do by their teachers.

Fig. 8 and Fig. 9 display snapshots of preschoolers undertaking the test using gamified and non- gamified approach.

Fig. 8. Snapshot of Preschoolers Using the Non-Gamified Approach

With the experimental group, children were also guided by the allocated teacher(s) and the researcher by using a computer with the standalone digital game-based alphabetical listening quiz prototype. The allocated time for completion of the articulation of sounds was twenty minutes for each group. The preschooler using the digital game-based content was first made familiar with how to use the prototype before attempting the sound articulation test in order to experience practicing with the game.

Fig. 9. Snapshot of preschoolers using the gamified approach

Table 3 shows a summary of the results for the average preschoolers' score, which reveals a positive impact of using digital-gamified learning for teaching alphabetical sound.

Table 3
Comparison of test scores of learners using the two approaches

	Gamified Language Learning	Non-Gamified Language Learning
N	59	60
Mean	22.71	14.63
Std.Deviation	1.98	3.34
Minimum	19.00	7.00
Maximum	26.00	21.00

As depicted in Table 3, the preschoolers articulating alphabetical sounds using digital-gamified learning significantly outperformed the control group using the traditional approach of articulating sounds as measured by the scores from the test.

Table 4 and Table 5 show that there is no significant difference in test scores between female and male children in the two approaches in sound articulation.

Table 4
Gender-based difference in test scores using the gamified approach

Gender	Mean	N	Std. Deviation
Male	22.7333	30	2.03306
Female	22.6897	29	1.96584
Overall	22.7119	59	1.98313

Table 5
Gender-based difference in test scores using the non-gamified approach

Gender	Mean	N	Std. Deviation
Male	13.6333	30	3.47884
Female	15.6333	30	2.93003
Overall	14.6333	60	3.3444

5.   Conclusion and future work

In this paper, a gamified alphabetical listening sound quiz program is developed for preschoolers to measure the effects and effectiveness of digital game-based Tanzania alphabetical sound articulation application among Tanzanian preschoolers and ways in which language learning can be improved.

Results show that digital game-based method is effective, though it can be more operational when cartoons are integrated with the digital game-based language learning prototype in the preschool education setting.

Based on the findings on preschoolers' computer usage and digital abilities observed while using the digital-gamified prototype, it is crystal clear that Tanzanian preschoolers are already acquainted with digital media and can be able to use them in the learning process. This highlights the importance of school heads and teachers incorporating digital game-based techniques in their lessons to achieve the teaching objectives.

There is a need for more quantitative and general research with larger experimental groups across Tanzanian preschools to examine the effects of the digital game-based sound articulation language learning approach. Future work will consider several aspects of using gamification for enhancing language learning in preschools. For example, it would be very motivating to use cartoons to design educational programs. Analysis of preschoolers' requirements towards the integration of the TALSQ prototype also needs to be further addressed.

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