A Gamification Model For E-Learning Platforms

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Abstract: The use of gamification in education has been viewed as an innovative approach to introduce benefits of games in a non gaming context. Instructively, for a successful gamification process in learning, motivational theories and behavioral outcomes for the learner have to be incorporated in design framework. Observably gamification projects particularly within the education domain for e-learning platforms have encountered challenges key amongst them, emanating from lack of appropriate gamification design framework. Subsequently the study sought through systematic literature review to investigate types of gamification design frameworks. 16 design frameworks were evaluated and only 2 frameworks were designed for gamification within an e-learning environment. However the two frameworks did not address motivational affordances, behavioral Outcomes and evaluations rigor. In view of this the study proposes a framework identifying games elements as motivational affordances that influence behavioral outcome of the learner.

Keywords: Gamification, design framework, motivation, behavioural outcome

1. Introduction

Play has been recognized and acknowledged as an integral component in cognitive development and learning [1]. The introduction of the concept zone of proximal development [2], posits play taking a lead factor in contributing to the growth of user enjoyment and engagement. As such play whether physical or digital is essential in learning and cognitive development as it influences learning through creating these zones. Play is typified as games. Games have been actively deployed in teaching and learning in form of game based learning, serious games, and gamification [3]. A key distinction of serious (SG) and gamification as opined by [3] is that SGs are ‘games primarily focus on education rather than entertainment’ but costly in development and implementation. Gamification offers a reprieve, as it still provides the gaming experience through use of game design elements at a reduce cost and without implementation delay.

Gamification as defined by [3] is ” the use of game design elements in non-game context “ whereas [4] elaborate gamification as the use of game mechanics, dynamics, and frameworks to promote desired behaviors . Gamification is the intentional use of game elements for a gameful experience of non-game tasks and contexts as elucidated by [5]. Game elements include patterns, objects, principles, models, and methods directly inspired from games as used in Education for student motivation and engagement in classroom, and by teachers as tools to guide, reward students and facilitate immersive learning [4]. Postulation by [6] on gamification is that it seeks to increase people’s engagement and promote certain behaviors. They argue that the key contribution of gamification in education is to increase the level of engagement of students, as such the aim is to extract the
game elements, adapt them and use the elements as motivational affordances in the learning. Instructively motivation and engagement are vital to learning.

Motivation [34], within the Self determination theory (SDT) is theoretical construct used to explain the energy, direction, persistence and quality of behaviour which greatly contributes to better performance, persistence, creativity and vitality. Whereas Engagement, as defined by [35] is the extent of students’ active involvement in learning. [35] Distinguishes between motivation and engagement where motivation is the force that energizes behaviour and its direction, borne out of unobservable psychological, neural, and biological process which is private, while engagement is the publicly observable behaviour which is its precedent. Engagement can categorized as either as behavioural engagement (participation in learning), cognitive engagement and emotional engagement (affective). When games elements (ICT artefacts) are used in learning for student motivation and engagement these are termed as motivational affordances [16].

In education, E-learning is a vital tool in pedagogy. E-learning can be described as a learning mode which encompasses web-based technologies or virtual learning environments in which learning process can occur electronically anytime and anywhere via the internet or intranets [7]. E-learning Platforms have a limitation of lacking emotion and engagement as would a teacher [36], hence they must compensate for this. Intuitively, gamification can be introduced to e-learning platform for better student learning, motivation and engagement. Many e-learning systems as noted by [37] do not achieve desired objectives due to non compliance and lack knowledge of techniques for development. Fortuitously, [8] [9] [11] aver that gamification has had some limited successes due to poor understanding on how to successfully design gamification and ad hoc implementation. This can be attributed to lack of formal process of proven design framework to support gamified e-learning hence, the need for formalization of the gamification design processes. Design frameworks as a real or conceptual structure can serve as a support or guide for construction process [10], hence the need for an e-learning gamification design framework.

2. Objectives

Gamification requires a specific and formal design process given that its purpose is different to that for games [9]. Further [12] cautions, without the suitable design and systematic design process, gamification of learning may not achieve the success particularly within the e-learning domain. As such the study sought to

- Review literature on the gamification frameworks suitable for e-learning platforms
- Identify design elements and constructs for an effective gamified e-learning system.
- Propose a gamification design framework for an e-learning platform.

3. Methodology

The study followed the systematic literature review method so as to achieve the study objectives. The collection of data was done on works relating to gamification design, particularly within the education domain. The review of works was carried out in indexed databases such as Scopus, Web of Science (WOS), ProQuest and Google Scholar, also in digital libraries such as ACM Digital Library, Science Direct (Elsevier), IEEE Xplore and Springer with the following search keywords of gamification frameworks in education, gamification design in education and gamification design frameworks in education, in the title, abstract, metadata and full-text, with the inclusion and exclusion criteria adapted from [10] as presented in Table 1, A complementary manual search using Google, for relevant Conferences and journals in the search area described.
### Table 1: Inclusion and Exclusion Criteria

<table>
<thead>
<tr>
<th>Classification</th>
<th>Inclusion criteria</th>
<th>Exclusion Criteria</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>English</td>
<td>Not in English</td>
<td>349</td>
</tr>
<tr>
<td>Gamification design process</td>
<td>Explicitly Discussed</td>
<td>Not Explicitly Discussed</td>
<td>70</td>
</tr>
<tr>
<td>Gamification Design framework</td>
<td>Explicitly Discussed</td>
<td>Not Explicitly Discussed</td>
<td>16</td>
</tr>
</tbody>
</table>

### 4. Findings

### Table 2: Summary of the Gamification Frameworks

<table>
<thead>
<tr>
<th>S.N</th>
<th>AUTHOR</th>
<th>THEORETICAL UNDERPINNING</th>
<th>DESIGN PRINCIPLES</th>
<th>SHORTCOMINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(Simões, Redondo, &amp; Vilas, 2012)</td>
<td>None</td>
<td>Social gamification framework, Action Research Experiment use</td>
<td>- Not evaluated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Motivation affordances</td>
<td>- No theoretical</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>● Underpinning</td>
</tr>
<tr>
<td>2</td>
<td>(Nicholson, 2012)</td>
<td>Organismic Integration Theory, Situational Relevance and universal design for learning.</td>
<td>Design must be user centered, Rewards are intrinsic, Play centered design for Proposal Motivational Affordance</td>
<td>- No empirical evaluation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- No e-learning Platform</td>
</tr>
<tr>
<td>3</td>
<td>(Nah, Telaprolu, Shashank Rallapalli, &amp; Venkata, 2013)</td>
<td>None</td>
<td>Uses Principles of gamification for Proposal, use Motivation affordances</td>
<td>- No empirical evaluation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>● No learner adaptivity</td>
</tr>
<tr>
<td>4</td>
<td>(Wongso, Rosmansyah, &amp; Bandung, 2014).</td>
<td>None</td>
<td>Use DSR method to develop the Guidelines of a Proposal, use</td>
<td>- No learner adaptivity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Motivation affordances</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>(Hamzah, Ali, Saman, Yusoff, &amp; Yacob, 2015)</td>
<td>ARCS model Vroom expectancy-value theory and MDA</td>
<td>Deploys the ARCS model design for experiment, use Motivation affordances</td>
<td>- No player /learner adaptivity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>(Klock et al., 2015)</td>
<td>None</td>
<td>MDA framework for Experiment use Motivation affordances</td>
<td>- Adaptivity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- No Evaluation</td>
</tr>
<tr>
<td>7</td>
<td>(Zachary Fitz, 2015)</td>
<td>Uses the Flow Theory, PAT model</td>
<td>Uses User centered design, Gameful design for Experiment, use Mobile platform use Motivation affordances</td>
<td>- No adaptivity, Length of study, sample population</td>
</tr>
<tr>
<td>9</td>
<td>(Lamprinou &amp; Paraskeva, 2015)</td>
<td>Based on SDT theory and MDA framework</td>
<td>Structural and meaningful gamification As experiment in e-learning platform</td>
<td>- No evaluation</td>
</tr>
<tr>
<td>10</td>
<td>(Mora, Zaharias, Gonzalez, &amp; Arnedo-Moreno, 2015)</td>
<td>None</td>
<td>Agile development for experiment, use</td>
<td>- No evaluation</td>
</tr>
<tr>
<td>11</td>
<td>(Baldeón, Rodriguez, &amp; Puig, 2016)</td>
<td>OBE theory Learning style theory</td>
<td>Uses User centered design, Gameful design for proposal, use Motivation affordances</td>
<td>- No evaluation</td>
</tr>
<tr>
<td>12</td>
<td>(Reem I. Malas &amp; Hamtini, 2016 )</td>
<td>None</td>
<td>Gamification and e-learning design aspects Experimented in e-learning use Motivation affordances</td>
<td>- Evaluation carried out</td>
</tr>
<tr>
<td>13</td>
<td>(Vermeulen, Gain, Marais, &amp; ODonovan, 2016)</td>
<td>Activity theory</td>
<td>Based on Activity theory for proposal, use Motivation affordances</td>
<td>- No adaptivity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>(Khaleel, Ashaari, Wook, &amp; Ismail, 2017)</td>
<td>User centred design, learning theories</td>
<td>User centered design principles for Experiment, use Motivation affordances</td>
<td>- No Adaptivity</td>
</tr>
<tr>
<td>16</td>
<td>(Morschheuser, Werder, Hamari, &amp; Abe, 2017)</td>
<td>Design science research philosophy</td>
<td>User centered for experiment, use Motivation affordances</td>
<td>- Yes but on Staff</td>
</tr>
</tbody>
</table>
4.1 Gamification Design Framework Review

The results of the systematic review findings of the design framework applicable with the e-learning environment are as presented in Table 2. This section discusses the results of the review in terms of design principles, games elements and results so as to address the study objectives

- Publication in respect of the Framework
- The Publications are distributed as shown in Table 3

<table>
<thead>
<tr>
<th>Year</th>
<th>No of Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>2</td>
</tr>
<tr>
<td>2013</td>
<td>1</td>
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<tr>
<td>2014</td>
<td>1</td>
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<tr>
<td>2015</td>
<td>6</td>
</tr>
<tr>
<td>2016</td>
<td>3</td>
</tr>
<tr>
<td>2017</td>
<td>3</td>
</tr>
</tbody>
</table>

The research focussed from year 2012 - 2017. The distribution is noted to have picked up in the last 3 years depicting an increase application and research interest of gamification studies, this can be attributed to systematic reviews of [9] and [10].

- Theoretical underpinning of the design frameworks
  - Any good design framework must be framed theoretically, from the review 38% of the studies have no theoretic underpinning. The most utilized theory for gamification development is the MDA (Mechanics, Dynamics and Aesthetics) design framework which is the bedrock of the computer games development, this is closely followed by Motivation theories of Flow theory and Self Determination Theory (SDT), followed by learning theories. [5] lament that there is a dearth in the application of theories away from the predominant ones, in the development of gamification projects. Hence there is need to consider other theories specific to the e-learning platforms.

- Design Principles
  - Principles are the guidelines that inform and direct the framework development, these can be derived from the theoretical framework or system development philosophy. 50% of the frameworks utilize the user centered design principle of [13], since the user is at the heart of the gamification effort, in which the structural gamification type is deployed to suit the intrinsic motivation dynamic suited to a user [10]. It’s instructive to note that there is mention of two research methodologies namely action research and design science research to act template in the framework formulation. In addition only study 12 has factored in design principles for e-learning for the gamification frameworks

- Implementation
  - Of the developed frameworks 38% were just proposals, with the rest be validated either within a Learning management system (LSM) or Web based platforms. From the review the implemented frameworks were appendages on the education platforms, with only 3 studies (5, 9, 12) where the framework was used in development of a gamified e-learning platform.

- Motivation Affordances
  - In all the design frameworks, motivational affordances were present either as game elements, gamification dynamics or gamification strategies. The most predominate been pointers, badges and leader boards (PBL). In gamification games elements are key components in the system.

- Shortfalls and challenges
  - A key notable concern has been lack of rigour in design of the evaluation of these gamification frameworks [5]. 80% of these frameworks are without effective evaluations, and as observed by [14] this has hampered the growth and establishment of successful
gamification projects in education, as there inadequacy of evidence for appropriate designs. This is attributable to lack of specific measurement elements in the gamification design frameworks. Further only 2 studies (6, 15) have embraced user adaptivity in gamification design, hence most lacked in personalization effort.

4.2 Synthesized Design Elements and Constructs

From the evaluation of the 16 frameworks, the critical design elements and constructs were

- Motivational affordance includes game elements, gamification dynamics or gamification strategies. Motivation is afforded when the features of an object (games) and abilities of subject trigger intrinsic satisfaction hence prompting for continued use as argued by [38]. Undoubtedly without motivational affordances featuring, then gamification efforts within the e-learning platform would not bear the intended engagement and motivation of the learner.

- Behavioural outcomes refers to the intended learner desired output. The aim of gamification is usually to ensure sustained user engagement and learning. Engagement can be of the various types cognitive, affective, behavioural and social.

- From the analyzed results evaluation rigor has been lacking in many of the implemented frameworks this can be attributed to lack of metrics for evaluations. The evaluation allows for establishment of the correct design principles of what is valid and gives output or not. Further the evaluation framework needs to be established to prove its effectiveness particularly within an e-learning platform.

5. Proposed Gamification Framework

Based on the review of literature, it’s evident that a gamification framework must be theoretically founded, to incorporate the theoretic frame, design principles and more importantly constructs identified above to allow for evaluation [5, 14]. For this, the researchers formulated model using the key Theories of: Self Determination theory, Motivational affordance theory [16], Flow theory, e-Learning theory, Technology task fit model and adaptivity.

Fig 1: Proposed Gamification Design Framework Model  Adapted From [15]
The main components of the gamification framework

- **Motivational affordance**
  Affordances are IT Artefacts that trigger occurrences, as such game elements are considered as affordances. According to SDT [17], there are three psychological needs: autonomy (ownership of behaviour), competence (ability to produce) and relatedness. If these are fulfilled they elicit intrinsic motivation which drives the need for achievement.
  Personalization would refer to the adaptivity aspect where each user of the system is provided with game elements according to some criteria, either learning style, personality or player type. The game elements are developed within the MDA framework.

- **Psychological Outcome**
  This focuses on the resultant effect on the use of the game elements in the systems, according to [18], the student feels challenged and up for the task at hand and at the same time there is fun. Further due to the challenge at hand the student selects one that fits the task at hand. These all in turn motivate the student to learn using the gamified system. As the learner uses games elements there are some mediating factors that need to be incorporated namely those related to learner demography of age, gender; learner related emanating for the learning style or behaviour; game related to type of gamification strategies.

- **Behavioral Outcome**
  Gamification seeks a desired outcome, which is the behavioural engagement of student in the learning processes. [19] Stipulates that engagement can be represented as learning outcome which can be evaluated using the metrics of recency, frequency, duration, virality, and ratings, all of which are indicative of the time a student spends on the systems carry out learning activities.
  The theoretical model presented can be used as frame for development of the gamification design framework, using the principles e-learning development framework discussed in [20], in particular to the design framework should incorporate user centred, MDA guidelines and adaptivity factor. In particular this gamification framework can be used in the development of gamified e-learning platform to teach ill-structured courses like programming, data structures and design and analysis of algorithms.

6. **Business Benefits of the Model**

E-learning Platforms are critical in modern day educational pedagogy; however they can be inefficient and ineffective if poorly designed particularly when gamification is introduced. A remedy to this, is to have a well-defined elaborated method for design and implementation, hence the focus of the research was identification of determinant elements for successful gamified e-learning platforms.

The gamification framework proposed provides a platform to philosophically, methodologically and analytically situate gamification research within an e-learning platform, as it builds on the various theories. It allows the researchers to have a lens for guidance on the research design, data collection procedures and tools and importantly enabling evaluation rigour in the study. The model illuminates the problem of lack of an effective design framework for gamification within an e-learning context whilst establishing the relationship between the key factors of motivational affordances, behavioural outcomes and rigour of study.

In particular, the model proposed allows the researchers to be guided in the next phase 2 which is the development of the design framework, implementation and its validation. The model will assist teachers, understand how gamified e-learning systems works and how to assist in making content suitable for the learners particularly bearing in mind that learners have different learning styles, habits and motivation.
To the policy makers to understand how gamification of e-learning can be introduced, identify the resources needed and how to evaluated the effectiveness of the system. Finally to the developers of gamification projects within an e-learning systems context it guides the setting of architectural layout and framework of the system, how the interaction within the system should be implemented and enhanced, and importantly to test the effectiveness of the system in a learning environment.

7. Conclusions
The study was a review of the gamification design framework and how it’s been adapted within the education domain. The study sought to examine the theoretical underpinnings, the design guidelines, implementation and evaluation, where key theoretical frames were elaborated, design guidelines illustrated, implementation efforts discussed and outcomes of evaluation. From the study, gamification design frameworks focusing on e-learning platforms are limited, only 1 design framework for e-learning has been developed and evaluated. This is attributable to lack of theoretical model for design and evaluation, of which the study proposed.

Gamification is vital in education, particularly since it provides for learner motivation and engagement. Pedagogy is now been propagated through E-learning and especially in higher education institutions (HEIs) as such there is need for concerted effort for assimilation of gamification through validated design frameworks and processes.

For a proper gamification framework suited for e-learning, its must be theoretical derived on user centred design, motivational theories, e-learning theories and vigorous validation. We intend to do further research by developing a gamified e-learning prototype and integrate it in a LMS such as Moodle based on the proposed gamification framework. Also the area of adaptivity and how this can be implemented to allow for personalization effort in learning should be explored as well.

Acknowledgment
This research was supported by the National Research Fund 2016/2017 grant award under the multidisciplinary-multi-institutional category involving Kenyatta University, University of Nairobi and The Cooperative University of Kenya.

References


