A Game Based Innovative teaching and learning environment to enhance progression and performance of students.

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Abstract

Activity-based and game-based learning environment significantly enhances the learning experience and stimulates interest and increases the attention span and concentration of learners. Game-based or activity-based learning becomes essential to achieve the learning objectives and overall comprehension of students of a particular concept. Several game-based classroom activities have been proposed in the past and implemented with quite a success rate. This research study proposes a game-based activity that is intended not only for enhancing attention span or generating interest in learning in students however it addresses several issues and takes into consideration (1) the importance of revision of topics and (2) the importance of identifying topics that students have not been able to fully or partially comprehend (3) feedback on the topics delivered (4) ensuring individual progress of students (5) enhances attention span of students (6) stimulates competitive environment, (7) enhances intrinsic motivation amongst students, and (8) enhances comprehension of concepts & progression of students.

Keywords: Game-based learning, innovative learning, Technology-assisted learning, innovative learning to enhance student performance, KALI learning environment.

1. Introduction

An average attention span for students during a session is 15-20 minutes and then gradually it becomes very difficult for a facilitator to deliver the concepts that are well comprehended by the students. The attention gradually decreases with time, and it declines to a significant level while reaching the end of a 50-minute session (Bradbury, 2016). In the delivery of topics at the engineering level where long-duration lectures are the norm, students may have to attend four-hour lectures with a 10-minute break after every 50 minutes session. Overall, it is extremely challenging for facilitators to keep students' attention. The focus of students may easily be diverted especially if a single kind of delivery approach is opted for by the facilitators. It is extremely important to engage students with a flavor of learning practices. Activity-based learning, game-based learning, group discussions, brainstorming, etc. are some of the typical examples through which students can be engaged. A flipped class is also a very good way of engaging students in certain conditions and is certainly suitable for the kind of topic that is being discussed. Game-based learning ensures that students are not bored with a single way of learning, it ensures student participation, stimulates competition amongst peers, and enhances intrinsic motivation (Plass et al., 2015; Prensky, 2003a; Tobias et al., 2014a). The activity-based and game-based learning environment ensures individual learning, enhances the student experience, ensures timely feedback, and provides facilitators with a clear picture of a cohort's performance. However, some of the game-based learning environments provide one or few of the features, although all the game-based learning techniques result in enhanced attention levels of students and also ensure student participation and interest. However, many of the other aspired features may not be available in every game-based learning environment. Game-based learning environments should also not be complicated and time-consuming and should have compatibility with available devices and applications. The game-based learning environment that this research study is introducing has most of the features that are desired by academicians/facilitators especially teaching university-level students. This game-based learning environment introduces a comprehensive game with which students can be engaged in an interactive classroom environment. The innovative game has been designed in such a manner so that it ensures individual participation of every member of the cohort, provides revision of topics, enables the facilitator to identify those topics that are not well comprehended by the students, it enhances the interaction of students, and certainly increases intrinsic motivation amongst students. It is very difficult to convince students at any level to be active participants in a learning process. However, in most of the teaching and learning activities, maximum students opt to be passive learners. Even, at times very desperate efforts of facilitators are not sufficient to convince students to participate in a learning process. It is very important to conceive a learning environment that would enable students to engage and may result in students volunteering to participate in a learning environment. This research study proposes a KALI game-based learning environment for addressing most of the issues that are discussed above. KALI game-based learning environment enables students to effectively revise topics, identifies the shortcomings, enables corrective measures, and stimulates a competitive classroom environment. The KALI game-based learning environment has the following components.

a. KALI Application
b. KALI cloud-based repository
c. KALI cloud-based analytics

The above three components of the KALI game-based learning environment are responsible for providing a comprehensive competitive learning environment with significant desired features that enhance the student experience to a great extent and at the same time provide enhancement in various aspects. The components of the KALI game-based learning environment are discussed in the below section.

2. KALI Game-Based Learning Environment

KALI game-based learning environment is a meticulous innovative game-based learning environment that has various features and facilitates interactive sessions that yield significant benefits in terms of student comprehension of concepts, progression, and overall learning experience. KALI environment is intended to host several types of games that can be played in the classroom for 20-30 minutes sessions, the inclusion of games into the KALI environment is based on several aspects of teaching and learning. This research paper highlights one of the games of the KALI learning environment. However, before explaining the game, let us first understand the different components of the KALI learning environment and how these would contribute to the enhanced learning experience of students.

2.1 KALI Application

KALI application is a thoughtfully designed web and mobile application that accommodates several learning games. These games are included based on research and feedback collected from several students and academicians. A specific game in the KALI learning environment attempts to address a specific learning issue faced by the students or the facilitators. The initial KALI Application would be equipped with a single game and analytics that can assist students and academicians. The Application interface would be compatible with several devices like laptops, smartphones, tablets, and other portable devices to provide maximum levels of flexibility in use. KALI Application is intended to get frequent updates because of new games being added, feedback from stakeholders, and other improvements. The KALI Application would provide an appropriate environment for facilitators to configure game data based on the specific requirements of modules and topics. The KALI Application would have three different types of users Students, Academic Faculty, and an account that would be interested in getting analytics or results. The academic faculty would be able to manage their respective session, include users to have access to their sessions, manage session settings and configuration, and download results and analytics for their respective sessions. The KALI application is intended to be an advanced application compatible with various teaching and learning innovative devices that can be installed to accumulate data that would be very beneficial in understanding various aspects of learning and identifying shortcomings. Although at the initial stage this application is simply providing a single game interface so that it can be played and used in a flexible manner inside the classroom. However, gradually this application is expected to host more learning games, data analytics, learning analytics, learning repositories, compatible devices to acquire data from the classroom and several other features to develop a comprehensive learning application.

2.2 KALI cloud-based repository

KALI Cloud-based repository would be responsible for the storage of entire application data. The KALI application data would be hosted over the cloud. This cloud storage at the initial stage is intended to be taken from a public cloud service provider however if required in the future a dedicated data center facility for the application can be developed, this would be required if the KALI Game-based learning environment has a large number of users. The cloud-based repository is expected to provide the backend data for the application and at the same time, it would provide the repository for academicians and students so that different learning material related to various modules and topics can be accessed through the application itself. Several applications are using cloud-based storage for providing flexible global access to their users (Mishra et al., 2012) (*Cloud Based Storage for Mobile Application - Google Scholar*, n.d.). This approach is quite suitable for newly developed interfaces due to the less to moderate numbers of users and secondly in the mobile or web applications used for learning purposes, there are fewer security and privacy concerns for the data. The public cloud service would be well suitable for the KALI game-based learning environment. The cloud-based repository and services have been utilized for a variety of educational applications and purposes (A. Bhat et al., 2021; A. Bhat, Kameshwari, et al., n.d.; A. Bhat, on, et al., n.d.; A. Bhat, Singh, et al., n.d.; Muhsin et al., n.d.; Singh et al., n.d.).

2.3 KALI cloud-based analytics

KALI cloud-based analytics is a component of the KALI game-based learning environment that would provide useful analytics about student participation, learning, progress, and performance in a specific module or topic. This component of the KALI game-based learning environment would be hosted over the cloud and analytical capabilities would also be as appropriate to the facilities (Analytics facilities) provided by the public cloud service provider. The role of analytics components in the initial stages would be restricted to providing results analytics of the games. However, with improvement and the addition of different features the analytics component would become versatile providing different analytics to different types of users. This component would have a huge role to play as the KALI game-based learning environment is embedded with the capabilities of

different devices to gather data from different sessions and classrooms. The data analytics part would play a huge role not only in providing support to the students and faculty however in may provide some excellent analytics to the administrators and management for the enhancement of teaching and learning and the overall planning and development of the institution. KALI cloud-based analytics has a huge scope for future development and can deliver a lot, however, at the beginning this component would be responsible for simple analytics related to the use and performance of students in different sessions while using the gaming environment. Analytics for specific sessions would be made available to the faculty members and specific analytics related to a particular student of a cohort would be made available to the specific student. This component can be extended by providing data from diverse sources. These sources can be currently used in information systems or learning management systems so that learning analytics can also be made available to students and faculty members. This component has a huge scope for future improvement and innovation.

3. KALI RAISE Game

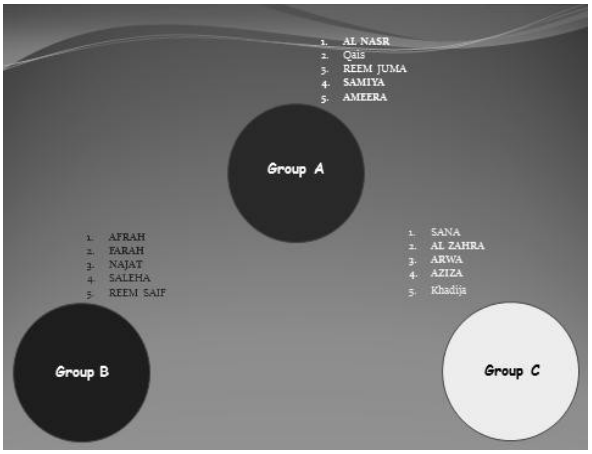
KALI RAISE game is designed keeping several aspects of learning in consideration. It is an important aspect of every learning that effective revision of concepts should take place from time to time to grasp them completely, attention span needs to be enhanced, identification of concepts that are not completely understood by the students, and enhancement of intrinsic motivation. All these aspects of learning have been considered while designing the KALI RAISE game. RAISE is an acronym as follows.

R: stands for Revision of concepts.
AS: has been used for Attention span.
I stands for identification of concepts that are not well comprehended by students.
E: stands for enhancing the intrinsic motivation of students.

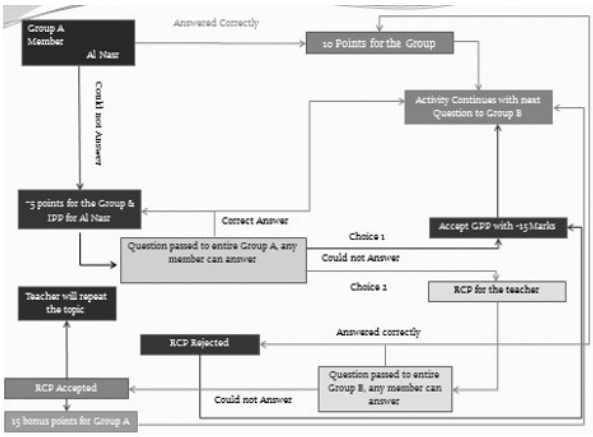
In other words, KALI RAISE game provides an effective environment in a classroom for student to revise their syllabus topics, the interactive learning environment helps students to maintain their attention, and the game helps students and teachers to identify those topics that are not well comprehended, and the game enhances intrinsic motivation by stimulating competition between peers. Several game-based environments have been proposed in the past (A. Z. Bhat, 2014) (Perrotta et al., 2015; Prensky, 2003b; Tobias et al., 2014b). These game-based environments are taking into consideration various aspects of learning and the needs of various subjects and topics. Several models have been suggested to enhance the motivation and attention span of the students (Bhat, 2012). KALI RAISE game has been designed keeping several aspects of learning discussed above into consideration. The KALI RAISE has an innovative design that keeps every aspect of learning, even individual concentration on students into consideration. The KALI RAISE design is explained below sub-section.

3.1 Game Design

The KALI RAISE provides a simple and easy-to-use interface that has features for enrolling the students of a cohort by providing their name, college ID, gender, and CGPA, all these parameters are provided by the respective facilitator/professor of the concerned subject. The CGPA and gender is taken so that groups of diverse nature can be formed who would compete. The system automatically creates groups with a mix of low, medium, and high CGPA students. The system has also an option to segregate boys and girls and create groups with boys only and girls only.



After forming the groups in the cohort, the rest of the configurations can be done by the teacher concerned like the configuration of various questions that are going to be posed during the game is played in a classroom. As the configuration part is done, the game operates in the following manner.



A question related to the module curriculum is displayed on the screen for a specific member of a

particular group. In case the respective member of the group answers the question *correctly*, *10 points* are given to that particular group. In case the respective member *fails to answer a question, -5 points* are given to the group with *IPP (Individual Presentation Penalty)* for the respective member. IPP means that the student who has failed to answer the question will have to prepare a presentation for the topic in question in the next class. Moreover, the same question is asked to the group to which the respective member belongs and in case none of the group members could answer the question, there are two choices provided for the group.

i *Accept GPP (Group Presentation Penalty) with -15points.*

Or

ii *Opt. for RCP (Repeat Class Penalty to the teacher) without any penalties to the group members or negative points to the group.*

Repeat class penalty can be accepted by the module instructor only in case *all the members* in the *next group* could not *answer the question*, and if the case is so BIIT (Bonus for identifying inadequately delivered topic) *15 bonus points* areprovided to the group for identifying the inadequately delivered topic. This game is very innovative and takes into consideration every member of the cohort including the facilitator. The participation of every member is ensured by the game itself and the very design of the game ensures competition inside the group as well as between group members. The design of the game concentrates on intrinsic motivation which is a motivation driven from the inside that may not have material benefits or prizes. Intrinsic motivation refers to engaging in an activity for its own sake, for the enjoyment, challenge, interest, or natural fulfillment of curiosity(*Barry, K. & King, L. (2000). Beginning Teaching and... - Google Scholar*, n.d.). Motivation plays a significant role in a student's learning and development. It is part of teachers' pedagogy to develop in students the desire for new knowledge and understandings, known as intrinsic motivation (Valerio, 2012). It is therefore very essential to enhance the intrinsic motivation of the students. This game-based activity engages students and provides enjoyment, challenge, and interest, stimulates competition, and curiosity, and equally poses a challenge to facilitators to deliver those topics differently if not comprehended by the students. The penalties that are imposed individually are not just for students however in case a particular concept or question cannot be completely answered by two groups, a teacher is also penalized, and a bonus is given to the group for identifying a topic. The teacher has to repeat the lecture or the concept if it is not satisfactorily answered by two of the groups. In the same manner, it poses a challenge for students individually as well as for groups. The presentation penalty ensures that the student studies the concept of the topic completely and again it is an intrinsic motivation that comes to play a role here. A student prepares for the topic to save himself/herself from the embarrassment or humiliation of not being able to deliver a topic in front of the classroom. This intrinsic motivation plays a significant role in motivating the student to prepare for the topic in question as it must be presented in the next class. The game also stimulates competition between the groups as the numbers are given for each of the groups. The winner group can be announced for each week and if possible, a memento or a gift can be given to the winning group each week. This will give a sort of recognition to the work that is being done by the students and would result in a kind of extrinsic motivation. Extrinsic motivations are normally driven by external benefits like money, trophies, loyalty discounts, etc. The combination of intrinsic and extrinsic motivations that are stimulated by the game provides an excellent result as far as creating a competitive environment is concerned. The game benefits are manifold and significant benefits of using the game are provided below in points.

a. An optimum interface for the revisioning of topics.
b. Stimulates competition innovatively.
c. Generates interest and increases attention span.
d. Enhances the individual performance of students by allowing preparation of topics that are not well comprehended.
e. Identifies those topics that are not comprehended well by most of the students.
f. Increases accountability of facilitators/ professors and enables redelivery of lectures as needed.
g. Stimulates motivation by focusing on certain elements that enhance intrinsic motivation.
h. Allows weak students to interact and focus on their studies and attain better results.
i. Allows good students to achieve a better understanding of topics and share their learning with others and maintain their grades.
j. Promotes a student-centered approach to learning.

The KALI RAISE game provides an excellent and suitable environment in most situations and subjects and provides an innovative approach to teaching and learning. KALI RAISE may not be assisting in the delivery of a particular topic however it certainly provides significant benefits as described above and results in an enhanced student experience.

4. Conclusion

Game-based learning is going to be the norm in 21st-century classrooms. The intention to transform to Education 4.0 and Education 5.0 necessitates to have significant transformation in the conventional classroom and game-based learning environments are not a new phenomenon. The game-based innovative learning environment that is proposed in this research study is not merely a single game that is intended for the learning environment. This research study showcases one of the games that are a part of the ***KALI Game-based learning environment***. The games would continue to be included based on the research, feedback, requirements, and recommendations of various academicians. KALI Game-based learning environment certainly showcases a learning environment that has a huge scope for future development and research and has a very huge scope for contributing towards teaching and learning. The innovative learning environment would certainly need continuous upliftment in terms of the addition of features and facilities that the environment offers for its users. The environment can have a significant contribution towards assisting the academician with appropriate and effective delivery of topics and subjects of varying nature. The environment would also enable academicians to monitor their students and provide individual support that is required for each student. Overall, the KALI Game-based learning environment may result in a significant impact on the overall learning, results, progression, and performance of the students.

5. Recommendation and Future work

KALI game-based learning environment is in its infancy and needs a lot of development, innovation, and upliftment. It is a promising learning environment that can yield a lot of benefits for the learners and academicians however significant work needs to be done for developing it into a useful product. The Application interface needs to be designed that can support and deliver advanced features. There has to be comprehensive research taking into consideration the inputs provided by various stakeholders of higher education institutions like students, academicians, and academic administrators. The feedback should be incorporated to meet the expectations of the users. Moreover, currently, the KALI game-based learning environment has a single game interface however it needs to uplift to include more and more innovative games that can cater to the needs of different modules, situations, and topics. The KALI game-based environment needs enhancement so that it can facilitate innovative delivery of lectures, assist in the explanation of concepts, provided effective communication between users belonging to the same cohorts, and provide advanced analytics for professors and students.

In the future KALI game-based learning environment can develop into a standard learning environment like others that can be provided to a variety of educational institutions and a diverse community of learners can be getting benefitted from it.

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References

1. BhatMeer Inspirational Model for Student Centered Teaching and Learning. *Iaeng.Org*. Retrieved September 10, 2022, from http://www.iaeng.org/publication/WCECS2012/WCECS2012_pp297-302.pdf
2. *Barry, K. & King, L. (2000). Beginning Teaching and… - Google Scholar*. (n.d.). Retrieved September 10, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Barry%2C+K.+%26+King%2C+L.+%282000%29.+Beginning+Teaching+and+Beyond+%283rd+edn%29.+Katoomba%2C+NSW%3A+Social+Science+Press&btnG=
3. Bhat, A., Kameshwari, L., International, B. S.-2020 I. 5th, & 2020, undefined. (n.d.). MathCloud: a discrete cloud implementation to enhance learning experience in mathematics. *Ieeexplore.Ieee.Org*. https://doi.org/10.1109/ICCCA49541.2020.9250875
4. Bhat, A., on, I. A.-2016 3rd M. I. C., & 2016, undefined. (n.d.). Big data for institutional planning, decision support and academic excellence. *Ieeexplore.Ieee.Org*. https://doi.org/10.1109/ICBDSC.2016.7460353
5. Bhat, A., Singh, B., International, A. S.-2017 6th, & 2017, undefined. (n.d.). Learning resources as a service (LraaS) for Higher Education Institutions in Sultanate of Oman. *Ieeexplore.Ieee.Org*. Retrieved September 10, 2022, from https://ieeexplore.ieee.org/abstract/document/8342486/
6. Bhat, A., Singh, B., & Mohsin, T. (2021). *Cloud Implementation to Assist Teachers of English to Speakers of Other Languages in HEI's in Sultanate of Oman*. https://osf.io/2q8kg/download
7. Bhat, A. Z. (2014). Inspiring creative minds. *Lecture Notes in Electrical Engineering*, *247 LNEE*, 483–496. https://doi.org/10.1007/978-94-007-6818-5_34
8. Bradbury, N. A. (2016). Attention span during lectures: 8 seconds, 10 minutes, or more? *Advances in Physiology Education*, *40*(4), 509–513. https://doi.org/10.1152/ADVAN.00109.2016
9. *cloud based storage for mobile application - Google Scholar*. (n.d.). Retrieved September 9, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=cloud+based+storage+for+mobile+application&btnG=

10. Mishra, J., Dash, S., Computer, S. D.-I. C. on, & 2012, undefined. (2012). Mobile cloud: A framework of cloud computing for mobile application. *Springer*, *86*, 347–356. https://doi.org/10.1007/978-3-642-27317-9_36
11. Muhsin, T., Bhat, A., Ahmed, I., Research, M. K.-J. of S., & 2019, undefined. (n.d.). Systematic Approach for Development of Knowledge Base in Higher Education. *Jsr.Org*. Retrieved September 10, 2022, from https://www.jsr.org/index.php/path/article/view/999
12. Perrotta, C., Featherstone, G., Aston, H., NFER, E. H.-S., & 2013, undefined. (2015). Game-based learning: Latest evidence and future directions. *Nfer.Ac.Uk*, *50*(4), 258–283. https://doi.org/10.1080/00461520.2015.1122533
13. Plass, J., Homer, B., psychologist, C. K.-E., & 2015, undefined. (2015). Foundations of game-based learning. *Taylor & Francis*, *50*(4), 258–283. https://doi.org/10.1080/00461520.2015.1122533
14. Prensky, M. (2003a). Digital game-based learning. *Computers in Entertainment*, *1*(1), 21–21. https://doi.org/10.1145/950566.950596
15. Prensky, M. (2003b). Digital game-based learning. *Computers in Entertainment*, *1*(1), 21–21. https://doi.org/10.1145/950566.950596
16. Singh, V., Marcel, R. ·, Durgesh, W., Mishra, K., Amit, ·, Shikha, J., & Editors, M. (n.d.). Multimedia cloud for higher education establishments: a reflection. *Springer*. Retrieved September 10, 2022, from https://link.springer.com/chapter/10.1007/978-981-13-2285-3_81
17. Tobias, S., Fletcher, J. D., & Wind, A. P. (2014a). Game-based learning. *Handbook of Research on Educational Communications and Technology: Fourth Edition*, 485–503. https://doi.org/10.1007/978-1-4614-3185-5_38
18. Tobias, S., Fletcher, J. D., & Wind, A. P. (2014b). Game-based learning. *Handbook of Research on Educational Communications and Technology: Fourth Edition*, 485–503. https://doi.org/10.1007/978-1-4614-3185-5_38
19. Valerio, K. (2012). Intrinsic motivation in the classroom Intrinsic motivation in the classroom. *Journal of Student Engagement: Education Matters*, *2*(1), 30–35. https://ro.uow.edu.au/jseemAvailableat:https://ro.uow.edu.au/jseem/vol2/iss1/6