

Gamified Learning Application for Students with ADHD in Pakistan: A Learning-Based Experiment

Omar Daraz^{1*}, Muhammad Ali²

¹Lahore Garrison University, Pakistan

²University of Punjab, Pakistan

ABSTRACT

The paper discusses how gamification can be used to enhance the learning performance of students with ADHD in Pakistan. The research promotes the importance of gamification as one of the tools that might be used to assist students who tend to experience challenges in the areas of concentration, motivation, and conventional learning settings. The authors created a prototype of a gamified learning application and went through with it extensively on a group of 146 students, aged 13-17 years. The app was created in a way that promoted participation, the rewarding of progress, and that kept the person engaged in the learning process. The research results revealed that the application was successful in enhancing the focus, interest, and learning results of the students. Students who applied gamified learning app showed high improvement as compared to the control group who did not apply the gamified learning app. The findings have indicated clearly that gamification is a viable strategy that can be used to enhance the learning outcomes of ADHD students. What is more important, the research noted the app was especially effective among the students who had troubles with staying concentrated and motivated in the traditional learning conditions when distraction could diminish their performance. The gamified learning application was also demonstrated to be quite effective among students suffering ADHD with poor basic mathematics and reading abilities and offered them an effective and supportive learning experience. In sum, it is possible to state that the given paper has confirmed that gamification is a useful educational resource in Pakistan. Gamified learning app will help ADHD students to have a better focus, get more motivated and have improved academic results, which makes the process of learning more meaningful and effective.

KEYWORDS:

Gamification, UX Gamification for Learning Disabilities, ADHD, Gamification for ADHD, UX, HCI

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*Corresponding author: omerdaraz459@gmail.com

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INTRODUCTION

Gamification in UX is a process through which the aspects that are traditionally and mostly identified with games, i.e. points, levels, badges, and rewards, among countless other interactive elements are integrated into the different parts of product development, e.g. educational applications, web platforms and other types of digital learning solutions (1, 2). Gamification has already been widely researched in various settings and integrated into a variety of aspects of contemporary digital platforms, its most recognizable instances being popular language learning applications such as Duolingo (Shortt, Tilak, Kuznetcova, Martens, and Akinkuolie, 2023), which is based on gamified learning techniques that encourage language learning in students. Although this is a clear indication of the broad usage of gamification in modern learning settings, the extent to which gamification can be used specifically in helping individuals with learning disability as in the case of a student with medically diagnosed ADHD has not been examined deeply.

What is even more relevant to point out in this context is that as a serious educational tool in cultures that are extremely different to the West, especially in South Asia, gamified learning has never received a due exploration in the research. Although we may come upon some evidence of this concept within academic circles, there is no in-depth study conducted as yet which has actually created a gamified learning prototype in Pakistan and subsequently implemented it



with actual local students who have ADHD as their normal way of life. A somewhat comparable study did establish a gamified prototype to support special children in the Philippines, albeit somewhat similarly, as did the current study, although not in all aspects, as cited by Supangan (2019)(Supangan, Acosta, Amarado, Blancaflor, and Samonte, 2019). But as there exist two glaring troubles with the contents of this study, which we turn point-blank in our own findings. First (A) the assumption that gamified app can assist children with ADHD to learn better in the study is just made true. It does not undergo a preliminary experiment, and it has no substantial references to the related literature. Second (B), even the application developed on that research can only be applicable to very young kids in the Philippines, not considering the learning habits, curriculums, or the drastic variations in the level of special schools that are accessible to ADHD patients in Pakistan.

The objectives of this research are outlined as follows:

- A small yet thorough review of the literature that is already available on the mechanisms of gamification used to support the learning process in various locations worldwide, (B) the absence of research and the extremely apparent gaps in the gamification research specifically applied to learning disabilities in Pakistan, (C) the effect of ADHD on students in Pakistan as it relates to culture, social perception and the stigma that remains to be attached to ADHD and mental illness in Pakistan.
- Designing and thoroughly trying a gamified application with a sample size both of experiment and control group, all of whom are medically diagnosed with ADHD. This will be trying to confirm the true value of gamified learning applications to ADHD students in Pakistan. To obtain associations and determine effectiveness, the obtained data will be processed with the help of the relevant statistical techniques and tools.
- Thematic analysis of qualitative open-ended interviews with students and their parents about their perception of the gamified app, the usability of its features, and the general effectiveness of gamification among young learners with ADHD in Pakistan.

LITERATURE OVERVIEW

ADHD symptoms and impacts in students on students in Pakistan

Attention deficit hyperactivity disorder (ADHD) is a developmental, neurobiological condition defined by the presence of severe and pervasive symptoms of inattention, hyperactivity, and impulsivity (Cortese et al., 2025; Lewis, 1994; Palmieri, 2024; Shafiullah and Dhaneshwar, 2025). Several of these symptoms are displayed in the classroom and impact motivation, concentration, and focus. The nature of modern classrooms, unfortunately, does not accommodate the specific needs that come with ADHD, and is heavily reliant on structure, continuity, and discipline, all of which are attributes students with ADHD may struggle with (Sayal, Prasad, Daley, Ford, and Coghill, 2018; Weiss and Hechtman, 1993). In Pakistan, several children with ADHD go undiagnosed, and even some that are diagnosed do not receive proper care, particularly with regards to learning. This can be attributed to a lack of awareness about the specific sort of teaching styles that can be effective for children with ADHD and to a lack of facilities (Ashraf and Tohid, 2016). During our field research, we found that an app that supports learning for these students can be essential in Pakistan and can have long-lasting outcomes that most other research in this field does not carry with it, especially with regards to dispelling harmful taboos

about mental disorders, encouraging digital learning, and compensating for the current lack of learning facilities for ADHD children in Pakistan.

The link between gamification and motivation & its ties to ADHD

There are several recent studies that indicate how gamified learning in apps does improve concentration and motivation, which validate the initial premise of this study (Alsawaier, 2018; Hassan, Dias, and Hamari, 2019). Secondly, we needed to find data that represents a strong general link between gamified learning and better statistical learning for students with ADHD. Once this was found, then we could test our local prototype for Pakistani students with ADHD and examine if gamification proved to be of value here too. Castro & Huamanchahua developed an e-learning prototype and after testing it, found that it did indeed help students with ADHD learn better, stay motivated, and be more productive (de Castro and Huamanchahua, 2021). Another study validated that students with ADHD performed better and showed more motivation in a controlled setting when being exposed to a gamified learning environment (Su and Cheng, 2015). Ranathunga et al. Developed an initial prototype for gamified learning in primary schools, where they utilized the theory of Vygotsky for validation (Ranathunga et al., 2014).

There are plenty of other studies that show how gamified learning is a useful tool that assists children with learning difficulties, including ADHD, dyslexia, and more (Kariyawasam, Nadeeshani, Hamid, Subasinghe, and Ratnayake, 2019; Khaleghi, Aghaei, and Behnamghader, 2022; Khan, Ahmad, and Malik, 2017; Saputra, 2015; Shaban and Pearson, 2019). The reason why gamification can be a useful mechanism to aid those afflicted with ADHD is because gamified apps create a sense of “structured” fun that encourages progression, growth, and consistency (Putra et al., 2018). Consistency, in particular, is something that students with ADHD struggle with tremendously, but gamified concepts, such as progress trackers, incentives, daily rewards, levels, and immediate positive feedback when a learning outcome is successfully achieved. Moreover, a lot of students with ADHD struggle to focus on one particular task for long periods and feel the need to arbitrarily switch between multiple tasks. This feeling is usually accompanied by a sense of restlessness and edginess, which adds to the lack of focus and motivation (Dvorsky and Langberg, 2019). Gamified apps have created mechanisms to counteract this, and they keep track of how much each task or individual item has been focused on. The reason why they work better than unassisted traditional learning (such as these students reading books or studying lectures on their own, without any digital assistance), is because in an isolated environment, these students generally shift from idea to idea, and task to task, and face immense challenges in reading and focusing on one specific task for prolonged periods (Saleem, Noori, and Ozdamli, 2022).

The need for a gamified learning app prototype for ADHD in Pakistan

Gamified apps do exist that teach children about language and other subjects, but these apps are generally limited in their functionality. For instance, Duolingo does not take into account the learning disparity between normal users and users with ADHD, a variable that has been medically established as true and significant. Secondly, although gamified learning interfaces such as Quizlet and Kahoot! have gained popularity in the first world there exists no popular gamified interface that actually gamifies the process of learning in Pakistan, particularly for local curriculums. Recent studies have shown that users with special needs respond positively to gamified learning (Gooch, Vasalou, Benton, and Khaled, 2016). Thirdly, existing applications do not consider Pakistan’s local curriculum, literacy rate (some children may not be able to read

and may need audio input in the local language, Urdu), and other variables. This is the extent of the application currently. Our eventual goal for the application is to build a full-scale app that has a section where Pakistan's school textbooks are fed into the prototype and are gamified (this will be done collaboratively with multiple stakeholder institutions), and another section for general learning purposes, covering all sorts of generalized topics, such as politics, culture, history, sciences, and more.

However, there are primary gaps in the literature we identified after an extensive review of these papers and 59 other papers on gamification enhanced learning from 2017 to 2023. Most papers are limited to the first world, with almost none focusing on how gamification can develop in developing countries in South Asia and can be utilized to support learning for children with learning disorders. Secondly, most papers are reviews of theoretical concepts surrounding gamification, which albeit extremely important, have little value for gamification and its development and usage for pragmatic purposes in Pakistan.

METHODOLOGY & SUBJECTS

Figure 1 shows the methodology framework that illustrates how this research article was conducted.

Methodology of the Research Experiment

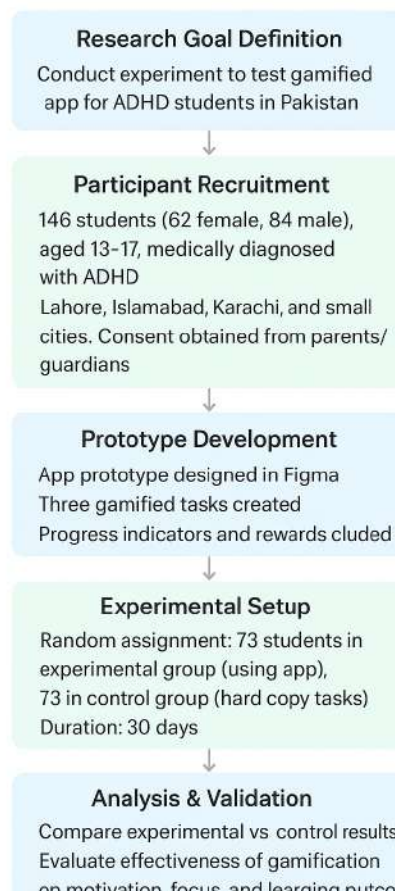


Figure 1: Framework of Methodology

Goal of the research

It was aimed at having a thorough and thought-out research experiment that will be able to in one way or another approximate the depiction of a mobile learning platform and investigate in detail the way in which a mobile learning platform will be able to help the students with ADHD study more efficiently, accomplish their tasks more regularly, and not get disheartened to go on with their studies. The idea behind this experiment was not merely to create and prototype something, but also to investigate in more depth how gamification might be utilized in practice in the context of Pakistan. The prototype of the app under consideration is not yet in any way a finished product, but it currently remains the only available prototype in the academic environment, not to mention the general research in general that may be fed into the app via a database. With the assistance of incorporating the current curriculums of Pakistan into the prototype, it will be possible to make it contextually useful and directly applicable to such children in their regular schooling patterns. The wider aim of this research study, then, is to determine the prototype first and subsequently to make conclusions that would guide, mould and inform a subsequent research which will ultimately lead us to the development and publication of a fully localized and gamified app specifically targeting students with ADHD in Pakistan.

Participants

The respondents in this research included a group of students who were medically diagnosed to have Attention-Deficit/ Hyperactivity Disorder (ADHD) in a selected area of Pakistan. (Sabir, Khan, Imran, Nisa, and Amer, 2024; Woodman et al., 2025) The total number of subjects involved in the study was 146 and gender distribution was 62 female subjects (42.5) and 84 male subjects (57.5). Regional distribution wise, 44 students (30.1%) were located in Lahore, Pakistan, 40 students (27.3%) were located in the city of Islamabad, Pakistan, 36 students (24.6%) were in Karachi, Pakistan and the rest 26 students (18.5%) were found in other smaller cities in the region of Pakistan. These participants were in the age group of between 13 and 17 and this is a critical and significant period of development that ADHD can have a direct impact as far as concentration, motivation and academic achievement. In this study, three standard gamified tests were created according to the sample of participants.

In order to select these participants, we made concerted and continued attempts to reach educational institutes, which specialized on helping and educating students with special needs and disabilities in all major cities of Pakistan. We had very strict and well-defined inclusion criteria, i.e. participants had to be aged between 13 and 17, they had to be a student in an ordinary school or an institution providing special needs as well, they had to also have been medically diagnosed with ADHD by a professional. In order to further guarantee diversity within the sample, a number of different types of schools and institutes have been approached and it was also ensured that both genders are incorporated in the study in order to better represent a more balanced view. Lastly, as a measure of ethics, informed consent was properly obtained and signed by the parents or legal guardians of these children before the study was verified.

Method & Prototype

The design tool (Figma) was used to create an app prototype that was then developed into a working and functional version, the screenshots and detailed descriptions of which are presented in the following parts of this paper (Huang, 2024; Silva, Fabrizio, Jesus, Barra, and Lorenzini, 2024). Basically, the prototype was created based on the initial minimum viable prod-

uct (MVP) of this short paper and at this point three major categories of tasks that students in the experimental group are specifically requested to accomplish within a time span of 30 days are created in the prototype (Essop, Kekana, and Smuts, 2024). The nature of gamification employed in the prototype will also be explained in the figures below and a separate section describing the proposed architecture of the app and methods of gamification will also be explained, which will be developed and refined and released with time.

To achieve a successful test of the prototype and eliminate any kind of bias, we have settled on forming an experimental group out of the entire participant population. To this end, 73 students were randomly chosen with the rest of the students being grouped to the control group. The very experiment would be designed in a manner, in which the students belonging to the experimental group would receive the app prototype to be used regularly during 30 days. This period required them to take the three learning challenges which entailed well designed sets of questions that were put within the application. The control group received the same set of questions, but in the hard copy format so as to be able to provide a sufficient background upon which they can make a proper comparison and be able to gauge the real effects of gamification. They were requested to finish the tasks within the same month of one month.

The results at the end of the period were the comparison of the performances of students belonging to both groups, which were evaluated through the quantitative and qualitative criteria we developed in the given study. The outcomes were afterwards compared to determine whether the gamified experience provided any objective improvements in the concentration, motivation, or learning outcomes as compared to the traditional method. In the initial prototype, we created three primary elements of the app that are well-organized to promote engagement, motivation, and consistency. These are summarized in Table 1.

Table 1: Descriptions of the three types of gamifications included and tested in the prototype

Component Name	Definition
Task A: Task-based game for mathematical equations (progress-based)	A list of 150 mathematical questions were taken from each age bracket's local mathematics books and were added to the prototype. The questions were different for students of each age and were shown after students chose their grade and age from the prototype screens, so that relevant questions would be displayed. The gamification methods applied included badges assigned after a specific number of tasks completed, in-app rewards, visual progress updates (e.g., progress bars), mini-games after every section of questions, and unlockable content.
Task B: Task-based game for mathematical equations (action-based)	A separate set of 150 mathematical questions taken from each age bracket's local mathematics books were added to the prototype. The only difference compared to Task A was the gamification method. Here, a small action game was embedded in the prototype: the "hero" progressed and grew for every set of questions solved and defeated enemies. If students were inconsistent and left questions unanswered, their hero would weaken.
Task C: Local curriculum novels included in the app and gamified	A local English novel, normally assigned to each grade from ages 13–17 in Pakistan, was fed into the prototype in PDF format. Students could check off goals in a fun visual format and collect points after reading each chapter and answering end-of-chapter questions. The control group was only given the PDF of the book without gamification, and asked to complete the reading and exercises independently.

Experiment Validity Metrics

To determine whether the experiment would be considered successful, we needed to establish a clear set of criteria that could be used to validate our initial hypotheses. These hypotheses were that gamification can indeed help students with ADHD in Pakistan learn better, stay motivated, and focus more consistently when completing learning tasks. Without predefined validity metrics, the results would have remained vague and difficult to interpret. Therefore, we decided to incorporate the following validity metrics as an essential part of our experiment to measure both quantitative and qualitative outcomes in a structured way.

The first metric was better task completion percentage. This was measured by looking at the number of questions attempted and the number of chapters finished by each participant. This percentage was separately calculated for each task so that the performance could be compared across the three gamified challenges. Since this involved measurable counts of attempted versus completed items, it produced reliable quantitative data.

The second metric was better performance. This was measured by calculating how many questions were answered correctly out of the total number attempted. In other words, this metric focused on the percentage of correct solutions achieved by each participant, which again generated quantitative data. The comparison between the experimental group using the gamified prototype and the control group using traditional hard copies allowed us to test whether gamification improved accuracy as well as consistency.

The third metric was based on open-ended interviews conducted with the participants' parents after the 30-day period. These interviews were aimed at gathering insights and detailed feedback regarding the learning outcomes of the children. The responses were then subjected to thematic analysis, which allowed us to group and categorize the qualitative data into recurring themes. This ensured that we captured not just statistical performance but also perceptions of effectiveness, motivation, and engagement from the parents' perspectives.

System Screenshots Functionality

The developed prototype that we tested with the experimental group is described in Figure 2. This figure includes app screenshots that illustrate the overall design and represent the three gamified tasks in detail. The screenshots also highlight the progress indicators, which show students how far they have advanced in completing each challenge. Furthermore, the figure includes descriptions of each screen, explaining how students interact with the tasks, how rewards and progress are displayed, and how the gamification elements such as levels, badges, and completion bars are integrated into the learning process.

The inclusion of system screenshots serves not only as visual evidence of the prototype's existence but also as an important way to document its functionality. These visuals demonstrate the difference between the gamified learning approach provided to the experimental group and the conventional, non-gamified approach provided to the control group. Together, they strengthen the overall methodological transparency of the research.

RESULTS & DISCUSSION

Quantitative performance experiment & statistical analysis

For the participant's data we collected and split into two groups (with/without the learning app), Table 2 shows descriptive statistics for each group and each individual success metric we defined. It also contains the results of 6 independent sample t-tests. The six success metrics

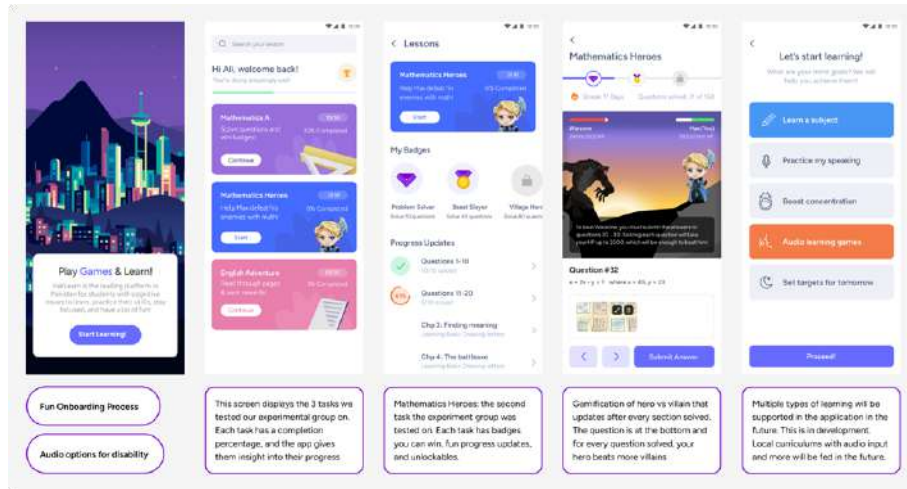


Figure 2: Screenshots of app given to experimental group

(related to the three learning tasks given to the students) are: Task A Success (as, % of questions solved correctly of total attempted), Task B success (bs, % of questions solved correctly of total attempted), Task C Success (cs, % of questions solved correctly of total attempted), whereas ac, bc, & cc were the completion percentages for each task. To understand whether there is a relationship between the presence of the app and the performance of the experimental group (compared to the control group), we conducted independent t-tests keeping app presence as an independent variable and all our performance metrics (as, bs, cs, ac, bc, cc) as dependent variables.

Table 2: Descriptive Statistics and Independent t-tests for App Usage and Performance

Variable Name	Group	N	Mean ± SD	p-value
2*Task A Success (as)	A (app)	73	78.89 ± 13.80	2* \leq 0.01
	B (no app)	73	71.74 ± 9.67	
2*Task B Success (bs)	A (app)	73	76.44 ± 14.17	2*0.009
	B (no app)	73	71.34 ± 8.11	
2*Task C Success (cs)	A (app)	73	76.86 ± 15.78	2*0.020
	B (no app)	73	71.32 ± 12.42	
2*Task A Completion (ac)	A (app)	73	80.88 ± 20.04	2*0.009
	B (no app)	73	74.04 ± 8.77	
2*Task B Completion (bc)	A (app)	73	80.53 ± 19.46	2*0.002
	B (no app)	73	72.49 ± 9.81	
2*Task C Completion (cc)	A (app)	73	81.45 ± 20.97	2*0.007
	B (no app)	73	74.22 ± 8.18	

Very strong associations were found between the presence of the app and an increase in performance, both with regards to task completion (which indicates motivation, discipline, and consistency, which are common pain points for students with ADHD) and with regards to task success. The p-value for all performance variables when testing the experimental group (that used the app to learn and do tasks) is significant, with all values \leq 0.05.

Thematic Analysis with Interview Data

We opted to conduct open-ended interviews with the parents of the 73 experimental group students after the 30-day experiment period. 6 parent groups opted out, so we were left with 67 parent groups whom we interviewed across a 20-day period, analyzed their responses, defined codes, themes, and grouped data together to define the thematic analysis given in Figure 3.

Codes	Theme	Description
<ul style="list-style-type: none"> Amazement at outcomes Belief of +ve influence on learning Hopeful about more additions 	<ul style="list-style-type: none"> • Hopefulness 	Perceived the app as beneficial for children's learning. Belief that the app could make learning easier for their children.
<ul style="list-style-type: none"> Incorrect statements about ADHD Misunderstanding of their child's needs Lack of awareness about mental health 	<ul style="list-style-type: none"> • Misinformation 	Lacked awareness about the special needs of their children and how to facilitate a safe environment for learning at home. Lacked knowledge of mental health importance.
<ul style="list-style-type: none"> Improvements in their child's approach Reportedly better mood, longer attention Received positive comments about app 	<ul style="list-style-type: none"> • Performance 	Parents generally reported seeing their children more motivated, concentration, and focused on studying through the app than they were without it. Also reported

Figure 3: Thematic Analysis of parent's interviews

Secondly, open-ended interviews were also conducted with the 73 experimental group students themselves. None of the children option out, so we conducted 73 interviews across a 20-day period. We conducted a similar thematic analysis and the results are given in Figure 4.

Codes	Theme	Description
<ul style="list-style-type: none"> • Convinced that the app helped them • Gave details of increased motivation/focus • Validation of observed quantitative data 	<ul style="list-style-type: none"> • Empirical Impact 	Narratives about how the app helped them focus, how they found the tasks more enjoyable than traditional study methods, how their ADHD learning needs were catered to.
<ul style="list-style-type: none"> • Questions about how the app was made • Inquiries on when the app will be expanded • Asked if they can contribute to the process 	<ul style="list-style-type: none"> • Inquisitiveness 	Lots of participants were curious about when the app will be expanded to include a lot of local curriculums and about how the research data and idea behind the app were initialized.
<ul style="list-style-type: none"> • Frustrations about the apps limitations • Waiting for more tasks to be added • Want more games and options 	<ul style="list-style-type: none"> • App Limitations 	Parents generally reported seeing their children more motivated, concentration, and focused on studying through the app than they were without it. Also reported a more +ve approach to learning and detailed how their children were learning better.

Figure 4: Thematic Analysis of children (participants') interviews

PROPOSED APP FRAMEWORK, INFORMATION ARCHITECTURE, & USER FLOW

Proposed Framework

The app will have the following sections, broadly speaking, once it is developed fully in the upcoming months:

- **Dashboard:** a learning dashboard that outlines KPIs such as task completion (number of

tasks completed over a specified period), engagement rate, time management, and has sections such as rewards, in-progress tasks, coping techniques (promoting self-care, relaxation, and breaks), and other sections related to progress.

- **Start Learning:** Includes a variety of gamified mechanisms for learning various subjects. Will be divided into two sections, one for generalized learning on a variety of subjects, and one for specifically learning Pakistani curriculums and books that will be gamified and fed to the prototype (progressively, with each app update). Each section will have various games and tasks.
- **Notification Panel:** For updates, progress notifications, updates on any badges and rewards, focus/motivation reminders.
- **Rewards section:** Includes lists of all in-app goals, achieved goals, badges, levels, and more.
- **Settings:** Accessibility options, personalization (colors, avatars, etc), dark mode, audio version, text sizing for people with vision difficulties, and more.
- **Planner & Goal Setter:** In-app module that takes several inputs from users and offers personalized learning plans to users.

All app screens and flows will undergo professional UX heuristic analysis and will be designed and developed with the best UX & HCI guidelines for accessibility kept as the central guiding principles.

Information Architecture (Future Improvements)

Figure 5 represents the planned app information architecture. The next iterations of development will be focused on developing these modules and they will be similarly tested to validate the user flow, the app functionality, and the utility of the content.



Figure 5: Information Architecture for future implementations of the app

CONCLUSION & FUTURE IMPROVEMENTS

There is a necessity of gamified learning application available to Pakistani students with ADHD to learn local curriculums, and this necessity has been raised in multiple educational and clinical settings in which conventional approaches have proven to be insufficient. There

is minimal research and zero prototype in Pakistan other than ours which can assist students with ADHD to adjust to local curriculum in an efficient manner making our research not only unique but also the first move towards this vital gap. Our experiment and statistical analysis confirmed the elevation of performance of a prototype such as ours to the learning outcomes of these students since there was a constant improvement in the performance of the experimental group compared to the control group in the measurement of concentration and motivation. The thematic analysis has provided a positive attitude towards the app and the presence of stigma and lack of awareness on the part of the parents of ADHD in the country, which indicates that although the technological interventions are effective, they have to be encompassed by more comprehensive awareness campaigns. Such can also be modified in the app to assist with these matters like addition of tips, information and blogs on mental health and ADHD which would enable parents and guardians to be more educated and positive towards the learning processes of their children. On the part of the students, the findings support the idea that it is true that gamified learning can benefit these stakeholders by making them engaged, motivated and less frustrated by the traditional teaching process.

The application architecture that was specified in Section 2.5 will be extended and supplemented in subsequent versions to enable it to become more comprehensive and scaled. Additional gamification techniques will be introduced, i.e. featuring more serious games and the appearance of new gamified patterns that have already been tried by other countries but have not been tailored to Pakistan. The app will have local curricular 1-10 that will be offered freely to students of all ages and will be inclusive making it useable in both city and rural school systems. Students with no ADHD will also have the opportunity to use the app freely and apply it as a gamified way of learning, as Pakistan has no local app that could potentially apply gamification and achieve fun and learning and retain the quality of education. Our greatest weakness now is the fact that there are not many gamified activities on the app, which limits its possible impact, but this fact will be mitigated by increasing the content library. In future studies, we will carry out more experiments using bigger pools, curriculums and bigger app architecture to further prove our original hypothesis and make gamification a sustainable learning tool among different learners in Pakistan.

CREDIT AUTHOR STATEMENT

Omar Daraz: Conceptualization, Methodology, Data curation, Writing- Original draft preparation. **Muhammad Ali** Visualization, Investigation, Validation, Writing- Reviewing and Editing.

CONFLICT OF INTEREST:

The author declares that there are no conflicts of interest regarding the publication of this paper.

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