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Gamification for pubertal and menstrual health education in adolescent girls: Study protocol

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Abstract:

BACKGROUND: Adolescents' lack of awareness regarding puberty provides the ground for seeking information from unreliable sources, which poses the greatest challenge for adolescents. An educational approach for adolescents and characterized by creativity is gamification. Students' engagement is essential for changes in attitudes and behavior. Therefore, the present study will be conducted with the aim of determining knowledge and practice of puberty and menstrual health in adolescent girls and the effectiveness of gamification for pubertal and menstrual health education in adolescent girls.

MATERIALS AND METHODS: This study has two stages. The first stage is a cross-sectional study with stratified random sampling method to evaluate the knowledge and practice of puberty health among 300 female students (12–13 years old) in Babol. The second stage is an interventional study. At this stage, 90 students who have scored less than 85 from the puberty knowledge, and practice questionnaire will be selected by simple random sampling and then assigned to two groups of gamification and control. Students in the intervention group will receive the necessary education about puberty and menstrual health by gamification method once a week for four weeks. The data will be analyzed by SPSS software version 25. The Chi-square test, repeated measures ANOVA, and ANCOVA test will be used in this study.

CONCLUSION: The gamification method might be effective in improving adolescents' puberty and menstrual health knowledge and practice. The insights derived from this research will be valuable for policymakers in enhancing their planning strategies. As adolescents play a crucial role as the future architects of society, allocating resources and time to their education ensures the well-being and vitality of the community.

Keywords:

Adolescent, education, gamification, health promotion, puberty

Introduction

Puberty is the most important milestone in adolescence.[1-3] The transition period between childhood and adolescence involves developmental changes in social, emotional, cognitive, and biological domains.[1,4-6] Adolescence and puberty are recognized as the key developmental stages for establishing healthy future patterns in adulthood, which offers the opportunity to intervene and positively impact adolescents' health pathways into adulthood.[4,7] Addressing the educational needs of girls at puberty is one of the priorities of healthcare systems.[1,8] According to the World Health Organization, one in five girls is at puberty, with 85% of them living in developing countries.[7] Studies show that 47.9% of adolescents lacked education and information about puberty and 39.9% of them were confused and disgusted about their physical changes in the early stages of puberty;[4,9] and in most

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cases, families were exhausted due to inability to teach puberty.[1,4,10] Evidence indicates that providing education on puberty can lead to heightened understanding and positive attitudes toward the phenomenon of puberty. This, in turn, fosters acceptance of physiological changes, ultimately contributing to the reinforcement of self-esteem and self-confidence.[11] Teaching adolescents about puberty health encourages them to contemplate the correlation between heightened awareness, improved attitudes, and practices, thereby positively impacting their overall health.[12,13]

Addressing puberty-related issues can be effectively achieved through adolescent education. Education acts as a bridge between health information and behavior, emphasizing the interconnection between knowledge, attitude, and practice improvement. In an intervention process, the significance of offering appropriate information and creating learning opportunities for adolescents becomes evident.[14] Nowadays in schools, the main methods of education and health education are lectures[15] In the lecture method, cognitive characteristics are slowly developing and may not be effective in promoting levels of learning beyond knowledge, especially for the development of practical knowledge and behavior change.[16] In structured methods such as lecture, only the speaker is active and learners are passive in the learning process.[17] On the other hand, in modern teaching methods, learners are actively involved in the learning process. One of the new techniques is gamification method.[18] Gamification means the use of mechanisms, techniques, and elements of a game, in contexts other than gaming, that motivates users to achieve specific learning, occupational and health goals, and is also used in the field of mental health.[19]

The use of gamification method means application of the game's elements and components in a way that is measurable. Scoring, ranking, and rewards are among these components.[20] One aspect of gamification is related to learning processes, such as "continuous evaluation," "instructional innovation," and "collaborative learning."[21] Werbach and Hunter (2015) proposed a model in which gamification consists of three elements: dynamics, mechanics, and components. Dynamics form the context of the program. Mechanics is an activity that needs to be completed. Components are signs, rewards, and guides.[19,21] A typical use of mechanics is rewards obtained with components such as badges, points to identify achievements, as well as the use of leaderboards and guides to socialize rewards. Gamification provides an opportunity for students to be engaged, motivated, and enjoy while learning.[22] According to a study conducted in Tanzania on the effectiveness of gamification for adolescents' sex education, gamification had a more positive impact on the achievement and understanding of students' sexual health than traditional education[23] Should the gamification method prove effective in educating adolescent girls, it will be employed to design educational programs aimed at enhancing girls' awareness of issues related to puberty, menstruation, and health behaviors. As a novel approach, gamification can be valuable in enhancing teenagers' learning effectiveness by instilling elements of competition and motivation. This study seeks to assess the knowledge and practices related to puberty and menstrual health among adolescent girls. Additionally, it aims to evaluate the effectiveness of the gamification method in educating adolescent girls about puberty and menstrual health. Specific goals include:

- Determining the mean score of knowledge and practice related to puberty and menstrual health among adolescent girls in Babol City.
- Comparing the variations in the mean scores of knowledge about puberty and menstrual health in two groups, one utilizing gamification and the other serving as a control, immediately and one month after the intervention among adolescent girls in Babol City.
- Comparing the differences in the mean scores of practices related to puberty and menstrual health in two groups, one undergoing gamification and the other acting as a control, immediately and one month after the intervention among adolescent girls in Babol City.

Materials and Methods

Study design and setting

This research includes two parts. The first part is a descriptive-analytical cross-sectional study that examines the knowledge and practice of puberty health in adolescent girls of Babol City.

The second part of the study, according to the nature of the topic, goals, and research questions, is a interventional study, which is designed to evaluate and compare the effectiveness of the gamification method for puberty health education in adolescent girls of Babol City.

Study participants and sampling

Female students aged 12–13 years old in seventh grade meeting the inclusion criteria are invited to participate in this study. Participants will be asked to complete puberty knowledge and practice and socio-demographic questionnaires; those who have obtained average and undesirable scores from the knowledge and practice questionnaire (score 32–85) will be considered to take part in the second phase of the study. In addition to obtaining students' consent, consent forms are also filled out by the parents of the participants. Inclusion criteria for the first stage of the study are as follows: students' willingness to participate in the study, parental consent, acceptance of participation by the school, experiencing

at least three menstrual cycles, female students aged 12–13 years (i.e., seventh-grade students). Seventh-grade female students are selected because routine puberty and hygiene education are provided by midwives at the health center in this grade, and because most students have experienced menstruation at this point.

Inclusion criteria for the second stage of the study are as follows: students' willingness to participate in the study, parental consent, acceptance of participation by the school, female students aged 12–13 years (i.e., seventh-grade elementary students), experiencing at least three menstrual cycles, ability to work with mobile and laptop to perform gamification in the intervention group, obtaining an average and undesirable score from the puberty knowledge and practice questionnaire (score 32-85). Exclusion criteria are failure to answer more than 10% of the questions in the questionnaire,[24] and unwillingness to continue participating in the study.

In the initial stage, to conduct a cross-sectional study aimed at determining the knowledge and practices related to puberty and menstrual health among seventh-grade girls (12–13 years old), the sample size is calculated in alignment with the study objectives. The calculation is based on previous studies and utilizes a sample size formula for estimating an average in the community, considering a scoring range of 0–100 with a mean and standard deviation of 64.2 ± 12.1.[25] Given a 95% confidence level, a standard deviation of 12.1, and an acceptable error of 1.5, the calculated sample size is 251 participants. To account for potential attrition and ensure robustness in the findings, a final sample size of 300 participants has been determined, incorporating a 20% estimate for potential loss.

In the second phase of the study, the sample size was determined for all study objectives, aiming to accommodate the maximum sample size. Based on insights from previous studies,[23] the lowest difference was considered to estimate the maximum sample size for evaluating the impact of gamification intervention on the total score and various scales of puberty health. With an effect size of 0.88, a significance level of 95%, and assuming a bidirectional approach using GPower software version 3, it was estimated that 35 participants per group would be needed. Consequently, a total of 70 participants for both groups were initially calculated. To factor in potential participant loss (estimated at 25%), a final sample size of 90 participants is deemed appropriate (45 in each group).

Data collection tool and technique

The initiation of this research is contingent upon the approval received from the Ethics Committee of Babol University of Medical Sciences and the official permission granted by the Babol Education Department. The research is conducted within the premises of elementary schools for girls in Babol City, encompassing both a cross-sectional phase and an interventional phase.

In the cross-sectional phase, a stratified random sampling method is employed. The primary objective of this phase is to assess the knowledge and practices related to puberty and menstrual health in girls in Babol City, requiring a sample size of 300 participants for comprehensive data collection. To achieve the recruitment of 300 participants, a minimum of four elementary schools in Babol City will be randomly selected from the list of girls' schools, as indicated in Figure 1. Subsequently, the researchers will visit these selected schools to introduce themselves to the school authorities. During these visits, the research objectives will be explained to both the school authorities and seventh-grade female students.

Upon gaining approval and informed consent from eligible participants and their parents, the research team will proceed to administer socio-demographic and puberty knowledge and practice questionnaires to the participants. This comprehensive data collection process will contribute to a thorough understanding of the participants' knowledge and practices related to puberty and menstrual health.

In this study, two tools will be used to collect data:

1. To gather data on demographic and socio-demographic characteristics, a socio-demographic questionnaire will be employed. This questionnaire encompasses inquiries regarding the participant's grade, year of birth, age of parents, parental education, parental occupation, place of residence, number of children in the family, and prior information on puberty and menstrual health. Additionally, it seeks to understand the sources of information on these topics, as well as the participants' preferred sources of information. This comprehensive questionnaire aims to capture a detailed profile of the participants and their background information relevant to the study.
2. The Adolescent Puberty Knowledge and Practice Questionnaire is a validated custom-designed survey. This questionnaire is specifically crafted to assess the knowledge and practices of adolescent girls concerning aspects related to puberty hygiene, puberty, and menstrual health. It serves as a targeted tool to gather valuable insights into the participants' understanding and behaviors in these crucial areas. The questionnaire consists of 34 items; each item has a value between 1 and 4 which is measured on a four-point Likert scale (never to always). The questionnaire consists of two parts: The first part consists of 12 questions related to knowledge and awareness of puberty

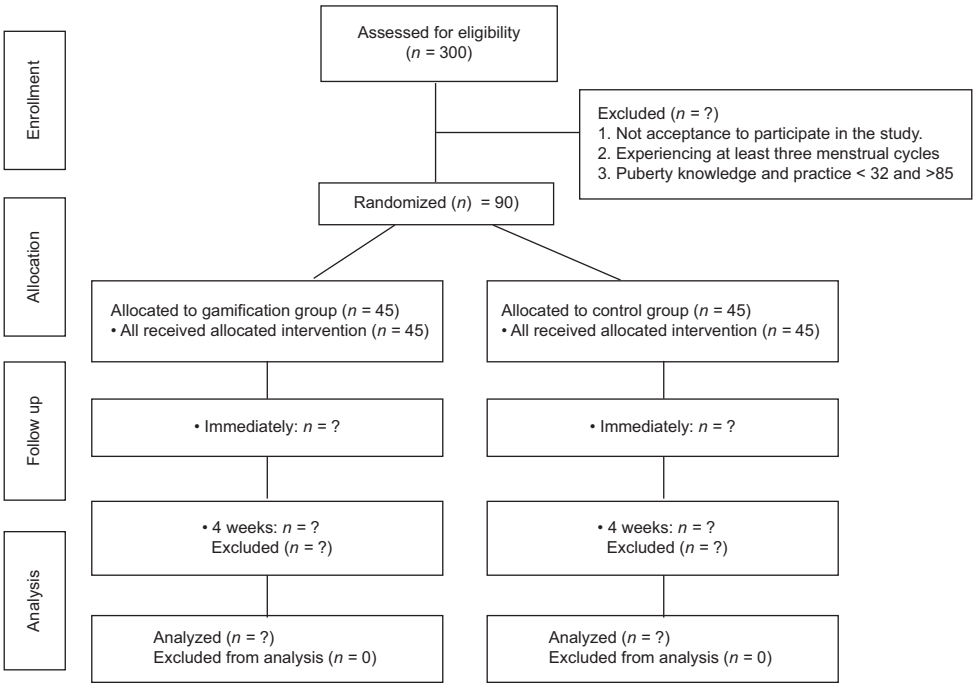

Figure 1: Consort diagram

and menstrual health. The second section consists of 20 questions related to practice of puberty and menstrual health. The minimum and maximum possible scores will be 32 and 128. A score between 32 and 42 indicates that adolescent girls' knowledge and practice about puberty and menstrual health is at an undesirable level. A score between 43 and 85 indicates a relatively good level of knowledge and practice, and a score of 86 and higher indicates a desirable score. The validity and reliability of the questionnaire were confirmed by Mohammad Alizadeh Charandabi *et al*.,(2014); Cronbach's alpha was reported to be over 0.70[26] which is considered acceptable.

Outcome measures

The primary and secondary outcomes of the study involve measuring the mean score of adolescent girls' knowledge and practices related to puberty and menstrual health in both the intervention and control groups.

The content of the educational sessions is tailored based on the Ministry of Health and Medical Education's educational package, which emphasizes various aspects of puberty and menstrual health. Additionally, the sessions incorporate the gamification method to enhance engagement and effectiveness in conveying the educational material. This approach aims to create an interactive and dynamic learning environment for the participants.

Interventions

Education sessions are held once a week over four weeks. The content of each session includes: age of onset of puberty, anatomy, physical signs of puberty, breast development, menstruation and its health, dysmenorrhea, puberty nutrition, and psychological signs of puberty (i.e., PMS, identity, emotional and emotional issues, mental disorders, personality development signs, social, moral, and mental development in different periods of time).

In the intervention group, the essential education about puberty and menstrual health will be delivered through the application of the gamification method [Table 1]. The game elements are designed by the researchers in collaboration with a computing platform called Danoush Company. The link to the gamification training will be provided to parents to check before students' access. The educational platform on puberty and menstrual health is structured based on the principles of gamification, incorporating elements that align with the educational content of puberty and menstrual health and its related dimensions. Accessible through both computers and mobile phones, this platform aims to provide students with information within the framework of gamification, enhancing engagement and interaction in the learning process. Students can use the educational platform at their desired time, place and pace, answer questions, and score points. During an in-person meeting with students, the researcher will inform students about how to access and use the platform. The platform has various stages and sections that are sorted in order and levels;

Table 1: Intervention sessions

Gamification steps	Topic dicussed	Gamification stages
First	*Age of origin signs of puberty	*Presentation of the problem, age, signs of puberty, anatomy of the genital tract
	*Anatomy of the genital tract	*Provide challenges in the field of materials presented to students and earn points related to this stage by them.
Second	*Physical signs of puberty	*Presentation of problems, physical signs of puberty, breast growth, menstruation, and hygiene
	*Breast growth	
	*Menstruation and hygiene	*Provide challenges in the field of materials presented to students and earn points related to this stage by them.
Third	*Proper nutrition during puberty	*Presentation of the problem, proper nutrition during puberty, and psychological signs of puberty
	*Psychological signs of puberty	
		*Provide challenges in the field of materials presented to students and earn points related to this stage by them.
Fourth	*Customs and beliefs related to puberty	**Presentation of the problem, Customs and beliefs related to puberty, sharia rulings related to puberty
	*Sharia law on puberty	*Provide challenges in the field of materials presented to students and earn points related to this stage by them.

students will be provided with clear visual and written instructions on the use of platform and its different stages. The internet safety and online child protection laws will be adhered at all times.

In this study, at least three elements of gamification including points, rankings, and badges are used. Students will receive one point for studying each section, and there is a ranking that determines where each user stands compared to the others. Moreover, the educational platform incorporates additional engaging elements, including starting with a narrative or story and ensuring an engaging ending.

During the first week, topics including age of onset of puberty and anatomy of the female reproductive system are covered in the education platform. After reading the provided material and submitting their homework responses, each student earns scores for this step and can proceed to the next phase of the game. Students have the opportunity to continue playing for the following week. An additional feature allows students to compare their scores at this stage with those of their peers, fostering a sense of competition and camaraderie within the learning environment. If students fail to complete the first week section, it is not possible for them to access other sections or stages in the coming weeks.

The contents of the second week will be on the physical signs of puberty, breast development, menstruation, and health. After studying the materials and presenting the answers to the challenges and quizzes, each student obtains points for this stage and can keep playing the following week. If the second week is not completed, it is not possible for the student to access other stages and levels in the coming weeks. Students can also view their peer scores on the platform after completing the weekly stages and games.

In the third week, content on proper nutrition during puberty and psychological signs of puberty will be covered in the education platform. Upon studying the materials and presenting answers to the designated challenges, each student earns points for this stage and is eligible to continue participating in the game for the subsequent week. Similar to the previous stages, after completing the tasks in the third week, students have the opportunity to compare their scores with their peers. However, access to the materials for the fourth week is contingent upon successfully completing all the tasks assigned in the third week.

During the fourth week, content will cover the following topic: traditions, beliefs, and religious aspects related to puberty and menstrual health. Similar to other stages, students will need to read the required material and complete some quizzes and challenges to earn points and view their peer's total scores.

The control group will not receive any intervention or education from the research team. Both groups will receive a standard puberty and menstrual health education session delivered by a midwife from the city health center. To adhere to ethical standards, following the study completion, the link to the puberty and menstrual health educational platform will be also provided for the students in the control group.

Immediately after the sessions and one month after the sessions, the puberty knowledge and practice questionnaire will be completed by the students in the intervention and control groups.

Data analysis

After collecting data and ensuring the accuracy of data entry, descriptive statistics will be reported using the central mean index, standard deviation dispersion index, number, and percentages. The normality of the data

will be evaluated using Kolmogorov–Smirnov test, and parametric tests are used if normal distribution exists. To investigate the relationship between the sample means from two related groups, paired samples *t*-test will be used, and independent samples *t*-test will be used to compare two independent groups. Depending on the suitability of data, either Chi-square test or Fisher's exact test will be used to investigate the relationship between categorical variables. To compare the means of more than two groups as well as comparing means across one or more variables that are based on repeated observations, one-way ANOVA and repeated measures ANOVA will be used. Furthermore, ANCOVA will be used to compare students' knowledge and practice after the intervention in two groups by considering pre-intervention measures. All analyses will be performed using SPSS version 25. The significance level will be set at $P < 0.05$.

Data collection procedure

To increase the accuracy and validity of the data, pre-existing questionnaires that have been tested in previous studies will be used.

Study duration

The study will start from November 2023, and it is expected to end in October 2024.

Ethical consideration

- This research will commence following approval and clearance from the Ethics Committee of Babol University of Medical Sciences (IR.MUBABOL.REC.1402.026) and authorization from the Education Department of Babol City. The study protocol has been officially registered in the Iran Clinical Trial Registry with the code IRCT20180218038783N4 at 2023-07-30. The research environment includes middle school girls' schools in Babol City.
- To facilitate the research process, an introductory letter will be acquired from the authorities at Babol University of Medical Sciences. Subsequently, by approaching the relevant officials in the research environment and presenting the letter of introduction, necessary permissions for conducting the research will be sought.
- Questionnaires will be completed after obtaining consent from the participants and their parents.
- The research team will provide essential explanations regarding the goals and nature of the research to the study participants.
- The research participants and their parents will be assured of the confidentiality of the information in the questionnaire.
- Participants in the study will be voluntary, and all research participants will be reminded of their right to withdraw from the research at any point during the study.
- Research participants will be provided with the opportunity to ask any questions they may have about the research.
- All materials used in the study will be sourced from reputable scientific sources, and proper citations will be provided to acknowledge the origin of the materials.
- The research participants, their parents, school officials, and the education department will be informed that the results of the research will be made available to them upon request.

Discussion

Adolescents often have limited knowledge regarding puberty. This lack of awareness and knowledge provides the ground for obtaining information from unreliable sources, which poses the biggest challenge and risk for adolescents.[4] It has been shown that education in the field of puberty can improve knowledge, foster positive attitudes toward puberty, and promote acceptance of its physical and physiological changes, thus improving self-esteem and self-confidence in adolescents.[11] In particular, adolescent girls represent a vulnerable group, and insufficient measures to support them through puberty and menstruation can have lasting and irreparable impacts on their health.[27] Girls face various challenges and issues and higher reactivity to interpersonal stressors as they enter adolescence and puberty[11] Mental disorders such as major depression, anxiety disorders, eating disorders, and substance use are common during adolescence.[11,28] Addressing the common problems of puberty in adolescent girls has the potential to minimize the issues as well as ensuring the health of the generation.[1,4] An emerging educational trend for adolescents which focuses on creativity and engaging learners is gamification.[29] This is particularly a beneficial method as students' participation and engagement is essential for potential changes in attitudes and behavior.[23]

Gamification, via incorporating elements of games, such as points, leaderboards, and badges into non-game contexts, provides an opportunity for students to be engaged, motivated, and enjoy the learning experience.[22] One aspect of gamification is related to learning processes, such as "continuous evaluation," "instructional innovation," and "collaborative learning."[21] Gamification has the potential to serve as a sustainable method for achieving the United Nations Sustainable Development Goals related to quality education for adolescents.[30] According to a study conducted in Tanzania on the effectiveness of gamification for adolescent sex education, an innovative educational approach had a more positive impact on the achievement and understanding of students' sexual health than traditional educational

approaches.[23] Another study in the United States determined the effectiveness of gamification on weight loss in overweight and obese adolescents. The results showed that BMI and systolic blood pressure decreased in the intervention group compared to the control group.[31] In a review study examining the effect of gamification method on physical activity in schools, the effectiveness of gamification in increasing physical activity participation has been established.[32] Further studies are recommended to assess the impact of gamification methods on various health-related topics in adolescents. Current studies on adolescent girls' health and puberty education are often descriptive, not utilizing innovative teaching strategies and methods. Therefore, this study aims at addressing the gap in adolescent girls' puberty and menstrual knowledge and practice education by applying a gamification method and evaluating its effectiveness compared to traditional methods of education.

The information gathered from this study can serve as a valuable resource for policymakers, aiding in more informed planning regarding the knowledge and puberty-related behaviors and practice of adolescent girls. Investing time and resources in the education of adolescents, who are the future contributors to society, ensures the overall health and well-being of the community.

Abbreviations

SPSS = Statistical Package for the Social Sciences
ANOVA = Analysis of Variance
ANCOVA = Analysis of Covariance

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Conflicts of interest

There are no conflicts of interest.

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