

Impact of Ashiyan Board Game on Iranian Students' Understanding of Native Vertebrates

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Abstract: Contemporary pedagogical research emphasizes active learning strategies to enhance cognitive engagement in primary education. This study investigates the pedagogical efficacy of “Ashiyan” (whose English equivalent is “Nest”), an interdisciplinary board game developed, modified, and tested during a graduate course on educational games to bridge Iran’s fourth-grade Science (ecology) and Social Sciences (geography) curricula. The main goal of the game is to familiarize students with the five main groups of vertebrates and their characteristics. This familiarization is achieved through native vertebrate specimens so that students not only repeat and practice what they have learned but also become familiar with Iran’s native vertebrates. The research method employed a mixed-methods design. The first part adopted a quantitative quasi-experimental approach with a pre-test/post-test design and an experimental group and a control group. In a quasi-experimental design, participants are not randomly selected, but they are randomly assigned to the experimental and control groups after selection. This method ensures that the assignment to groups is not biased, even though the initial selection of participants was not random. In this study, 120 participants were selected from six Iranian primary schools, and they were randomly assigned to two groups using stratified randomization to balance demographic variables. Following the intervention, learning and retention assessments were administered to both groups, and results were analyzed using inferential statistics to determine and compare the effects and results. In the qualitative phase, the data, gained from thematic analysis of interviews with 10 teachers and class observations, helped the researcher identify recurring patterns in the educational outcomes. A 28% improvement in accuracy ($p < 0.01$) of species identification was found for the experimental group participants compared to those of the control group, as measured by standardized assessments. Furthermore, a 35% higher retention of ecological relationships after a 4-week period was observed in the experimental group participants compared to those of the control group, as measured by standardized assessments. Qualitative data from 10 teacher interviews and classroom observations highlighted enhanced motivation, with 80% of students voluntarily engaging in post-game conservation activities. Thematic analysis identified three key drivers for this engagement: “Gamified rewards”, “Supportive peer interactions”, and “Real-world ecological storytelling” embedded in the game design. “Ashiyan” presents an adaptable framework for converting rigid academic material into culturally responsive, interactive programs, fostering students’ development as proactive environmental guardians. Researchers can adapt its mechanics, dynamics, and narrative for other ecosystems and compare cross-contextual outcomes. Additionally, the study bridges traditionally separate domains, advancing educational sustainability science.

Keywords: Educational board games, Interdisciplinary learning, Ecological literacy, Primary education, Culturally responsive pedagogy

1. Introduction

Despite the critical role of science and social studies in shaping students’ scientific thinking and environmental responsibility, Iran’s primary education system still faces challenges such as traditional teaching methods, lack of connection between curriculum content and students' lived experiences, and declining learning motivation (Shayestehnia et al., 2024; Taherian, 2024). In many classrooms, scientific and environmental concepts—such as species identification, habitats, and ecological relationships—are delivered abstractly and theoretically, with little connection to real-life contexts. This disconnect reduces cognitive engagement and prevents meaningful internalization of content (Ardoin, Bowers, & Gaillard, 2020).

To address these challenges, educational researchers have increasingly turned to active and interdisciplinary learning strategies, particularly the use of educational games, which promote experiential, competitive, and interactive learning (Lin & Hou, 2016; Tsai et al., 2019; Garcia & Miralles, 2022; Hashim et al., 2023). However, most existing educational games either lack alignment with formal curriculum objectives or focus on general, non-local ecosystems (Javidi-Kalateh-Jaferabadi & Jahangard, 2018).

In this context, the board game “Ashiyan” was developed to help students understand the characteristics of five major vertebrate groups native to Iran—fish, amphibians, reptiles, birds, and mammals—through active gameplay. These characteristics include breathing, reproduction, body covering, dietary patterns, and habitats. The game aligns with content from Grade 3 Science and Grade 4 Social Studies textbooks and presents

ecological learning in an engaging, narrative-based, and culturally relevant format. Players aim to earn the highest score by correctly identifying features of animals, turning content mastery into a strategic, motivating experience.

Considering the utility of the game described above, the current paper aims to adopt a mixed-methods approach, combining a quasi-experimental pre-test/post-test design with a control group and qualitative data from classroom observations and teacher interviews. Quantitative findings from the present study reveal that students who played “Ashiyan” demonstrated 28% greater accuracy in species identification and 35% higher retention of ecological relationships compared to that by control group. These promising results raise a central research question that this study seeks to answer: Can the educational board game “Ashiyan” enhance primary students’ understanding of the five main vertebrate groups in the context of native vertebrate animals of Iran?

Beyond their entertainment value, educational board games have shown significant potential to promote conceptual understanding, collaborative learning, and problem-solving skills across various subjects (Plass, Homer, & Kinzer, 2015). In the context of science education, gamified approaches—especially those involving tactile and visual components—have been linked to increased motivation, deeper engagement, and enhanced long-term retention of knowledge (Alsawaier, 2018; Martindale & Weiss, 2019; Ardoin Bowers, & Gaillard, 2020). Moreover, board games provide structured opportunities for students to practice decision-making, receive immediate feedback, and apply learned concepts in simulated, low-risk environments (Noda, Shiotsuki & Nakao, 2019). When designed with local contexts in mind, such tools also contribute to culturally responsive pedagogy, helping students form meaningful connections between scientific content and their sociocultural environment (Gay, 2018; Ladson-Billings, 1995). This is particularly relevant for ecological education, where fostering a sense of place and environmental stewardship has been shown to depend on localized, experience-based learning (Liefländer et al., 2013; Hammady & Arnab, 2022). By incorporating native species, real habitats, and region-specific storytelling, “Ashiyan” aligns with these principles while offering a curriculum-linked alternative to more abstract instructional methods.

2. Methodology

The current paper employed a mixed-methods design. In the quantitative phase, a quasi-experimental design, featuring a pre-test, a post-test, a retention test, an experimental group, and a control group, was used. In this quasi-experimental approach, participants were not randomly selected; however, they were randomly assigned to either the experimental or control group. A total of 120 students were selected from six Iranian primary schools and randomly assigned to experimental and control groups using stratified randomization to ensure demographic balance. Both groups took a pre-test before the intervention. The experimental group then received the instructional program, while the control group followed the regular curriculum. After the intervention, a post-test was administered, followed by a retention test four weeks later to assess long-term effects. A standard teacher-made test was used to measure learning, with face validity confirmed by experts and acceptable internal consistency. Prior to applying repeated measures ANOVA, assumptions including normality (Shapiro–Wilk), homogeneity of variances (Levene’s), equality of covariance matrices (Box’s M), and sphericity (Mauchly’s) were tested and all met ($p > 0.05$).

In order to probe the educational aspects of the Ashiyan game, the current research conducted semi-structured interviews with 10 teachers and attended class. This section aimed to reveal differences in the motivation and the social interaction as well as environmental attitudes in between before and after the game experience of all students.

The interview questions dealt with: how much they had been actively involved, signs of motivation, acts of support in the environment, their interest in the environment and any transfer of learning to action. Interviews were recorded and transcribed verbatim and analysed using Thematic Analysis. This analysis occurred in three stages: Basic Themes, Organizing Themes and Overarching Themes.

3. Findings

3.1 Quantitative Findings

Table 1: Means and Standard Deviations of Learning and Retention Scores in Experimental and Control Groups

Test	Group	Mean Score	Standard Deviation
Pre-test	Experimental	12.3	2.1
Pre-test	Control	12.1	2.3
Post-test	Experimental	15.7	2.0
Post-test	Control	13.0	2.2
Retention Test	Experimental	17.0	1.8
Retention Test	Control	13.3	2.1

As shown in Table 1, while pre-test scores were similar between the experimental and control groups, the post-test and retention test scores of the experimental group were considerably higher. The experimental group showed a 28% increase in results of learning and a 35% increase in results of the retention test compared to those of the control group. These differences were statistically significant, with a p-value of < 0.01, indicating that the results are not due to chance and demonstrate a strong effect of the intervention.

3.2 Qualitative Findings

Qualitative analysis resulted in the recognition of 3 Overarching themes the entire coding process is included in Table 2. These themes are:

3.2.1 Gamified rewards

The motivational factors in this Ashiyani game is added to by the competition and visual point rewards included in the application that directly enhanced a student's intrinsic motivation.

“Even after the game is complete, students wanted to go through more cards and guess the characteristics of other animals.” (Teacher 3)

3.2.2 Supportive peer interactions

While the game had an individual focus, the game period did witness an increase in friendly exchanges and banter between students.

Teacher 7 described, “In the game, the students exchanged their opinions for the animal's features voluntarily, and a friendly class climate was formed.”

3.2.3 Real-world ecological storytelling

The use of real stories that tackle Iran's ecosystems resulted in enhanced positive environmental attitudes among students.

“One of the students said, ‘I wish we could save the endangered animals of Iran.’” (Teacher 5)

Table 2 illustrates the coding process for Basic Themes, Organizing Themes and Overarching Themes and the logic involved in the data.

Table 2: The Process of Qualitative Data Coding

Basic Themes	Organizing Themes	Overarching Themes
Desire for more points, enthusiasm for healthy competition, enjoyment of mental challenges, effort for personal progress, eagerness for positive competition, insistence on participating in subsequent rounds of the game	Increased intrinsic motivation	Gamified Rewards
Informal consultation about animal characteristics, friendly exchanges of opinions, mutual support, encouragement of classmates after correct guesses	Supportive Peer Interactions	Supportive Peer Interactions
Reduction in boredom in class, active participation in class discussions, expressed satisfaction with the game process, excitement about	Increased class engagement	

<i>Basic Themes</i>	<i>Organizing Themes</i>	<i>Overarching Themes</i>
discovering animal characteristics, increased scientific questioning during the game		
Curiosity about specific animal traits, attention to living conditions, expressed concern about the protection of endangered species, suggestions for forming animal protection groups, expressing interest in wildlife	Growth of environmental attitude	Real-world Ecological Storytelling
Ongoing discussions about animals, asking questions beyond the game, researching native habitats, reading zoology books, expressing interest in visiting natural habitats, designing crafts	Stimulating self-driven learning	
Studying supplementary resources, voluntary participation in environmental activities, creating volunteer groups at school, involvement in environmental science festivals, encouraging friends to care for nature, following environmental news, raising self-awareness about the importance of species conservation	Development of sustainable learning	

Classroom Observations

Observations in the classroom in the current study indicated the following:

- There was a notable increase in the degree of active engagement by students. Not only were students physically active during game play, but motivation to engage and perform also spilled over into post-game behavior. Such voluntary actions included environmental drawings, recommended areas to visit natural habitats, and even establishment of parent-foster volunteer group for scientific and environmental events.
- Some students initiated researching videos and articles about indigenous animal species and proposed a visit to a forest and other natural places. In sum, behaviors such as the informal chatting soup group activities and reinforcing group relations within the game have been seen, pointing to a pattern of supportive peer interactions occurring in the classroom.
- Analysis of interviews and observations indicated that about 80% of the students were willing to engage in environmental activities after playing the game. Examples of supporting quotes and observational evidence from students are included in Table 3.

Table 3: Samples of Quotes and Observational Data from Students

<i>Basic Themes</i>	<i>Organizing Themes</i>	<i>Overarching Themes</i>	<i>Quotes/ Observational Data</i>
Desire for more points, enthusiasm for healthy competition, enjoyment of mental challenges, effort for personal progress, eagerness for positive competition, insistence on participating in subsequent rounds of the game	Increased intrinsic motivation	Gamified Rewards	"I always wanted to get more points because I really wanted to win and beat the others."
Informal consultation about animal characteristics, friendly exchanges of opinions, mutual support, encouragement of classmates after correct guesses	Supportive Peer Interactions	Supportive Peer Interactions	"After I guessed correctly, I told the other students how to guess and helped them."
Reduction in boredom in class, active participation in class discussions, expressed satisfaction with the game process, excitement about discovering animal characteristics, increased scientific questioning during the game	Increased class engagement		"When the teacher asked us to name the characteristics of vertebrate animals, everyone raised their hands to answer. We were so happy that we could help."
Curiosity about specific animal traits, attention to living conditions, expressed concern about the protection of endangered species, suggestions for forming animal protection groups, expressing interest in wildlife	Growth of environmental attitude	Real-world Ecological Storytelling	"My dad told me we're going to the forest. I'm really excited to see more animals up close."
Ongoing discussions about animals, asking questions beyond the game, researching native habitats, reading zoology books, expressing interest in visiting natural habitats, designing crafts	Stimulating self-driven learning		"Every day I read with my dad about endangered animals and how we can save them."

Basic Themes	Organizing Themes	Overarching Themes	Quotes/ Observational Data
Studying supplementary resources, voluntary participation in environmental activities, creating volunteer groups at school, involvement in environmental science festivals, encouraging friends to care for nature, following environmental news, raising self-awareness about the importance of species conservation	Development of sustainable learning		"We formed a group at school with the guidance teacher to learn more about protecting endangered animals. We want to do activities like gathering information and making a bulletin board for the school festival."

4. Discussion and Conclusion

The current paper evaluated the effectiveness of a board game called “Ashiyan” as a novel educational approach for learning and retention of educational knowledge in the field of environmental concepts and native vertebrate identification in Iran. The findings suggested that this game was effective in improving students' species recognition skills and ecological comprehension. In terms of quantitative results, students who played “Ashiyan” demonstrated a 28% increase in accuracy in identifying species compared to the control group and a 35% increase in holding ecological relationships to memory after a four-week lapse. These statistically significant improvements ($p < 0.01$, as reported in the findings) highlight the game's strong impact on concrete learning outcomes. The substantial gains suggest that the interactive engagement with “Ashiyan” translated into a measurable enhancement of students' ability to accurately identify species and recall complex ecological relationships over time, directly addressing the study's primary research question regarding the game's efficacy. Serving as a powerful tool for teaching and consolidation of the knowledge of science, the game is supported by the research results. It is especially useful in the field of ecology and biodiversity. This is shown in “The Game of the Sea” (Arboleya-García and Miralles, 2022). This study demonstrates the effectiveness of board games in teaching ecological concepts. Similarly, in the current study, the use of board games was highly effective in enhancing the understanding of ecological concepts. Like in “The Game of the Sea”, that employs board games for instruction of ecosystem and marine life, the game “Ashiyan” deals with native species and both marine and terrestrial ecosystems of Iran, showing the game-based instruction as effective in transferring complicated scientific knowledge.

In the qualitative part, drawing upon interviews with teachers and classroom observations, three emerged as the major themes, all of which focused on the beneficial effects of the game on the learning and interaction of students. Additionally, analysis indicated that approximately 80% of students voluntarily engaged in post-game environmental activities, supporting the effectiveness of the intervention beyond the classroom.

The first quality theme was “Gamified Rewards”. The teachers confirmed that “Ashiyan” had enhanced students’ motivation as well as the game players earned scores for the correct guess and each position of their pieces in each round. This reward system increased their motivation to learn and advance, so that they could feel a sense of achievement. This heightened motivation and active participation, driven by the game's reward system, likely contributed to the increased effort and focus during learning activities, which in turn could explain the significant gains in species identification accuracy and knowledge retention shown in the quantitative results. This pattern echoes the results of “The Design of an Ecosystem-Education Board Game Integrating Role-Play and Peer-Learning Mechanism and Its Evaluation of Learning Effectiveness and Flow” (Lin & Hou, 2016), which emphasize the role of a reward mechanism in promoting student's engagement. Lin & Hou (2016) also employed a similar rewarding scheme and found that game rewards had potential to enhance student learning motivation and engagement. This approach being used in “Ashiyan” also promotes learning environment as it involves the students themselves to take part in the learning and handling of environmental concepts.

The second theme, retrieved from analysis of the interviews, was “Supportive Peer Interactions”. Irrespective of the fact that “Ashiyan” is an individual game, teachers claimed it benefits positive interactions among students. After all, these interactions resulted in a deeper understanding of scientific issues and more engagement during lessons. This deeper understanding and increased engagement, fostered by supportive peer interactions, are plausible contributors to the enhanced learning outcomes evidenced by the 28% greater accuracy in species identification and 35% higher retention of ecological relationships observed in the experimental group. These results are consistent with the study “Using Board Games To Teach Socioscientific Issues On Biological Conservation And Economic Development In Taiwan” (Tsai et al., 2019) that highlights the role of the interactions in groups in the learning process. Though being an individual game, “Ashiyan” deepens

the classroom interactions, helping students better align themselves with concepts and enhancing their motivation. Tsai et al. (2019) also emphasized role of the interactions among the students that the interactions could help students to learn about complex social and environmental issues.

The third theme was “Real-world Ecological Storytelling”. Teachers observed that through this game, students not only acquired knowledge of ecology but also learned about actual environmental problems in nature. The fables of these natural inhabitants of Iran had helped us understand many of the ecological concepts and make us feel responsible towards our environment. This connection to real-world contexts and the emotional engagement fostered by storytelling likely enhanced the meaningfulness of the scientific content, thereby facilitating the deeper comprehension and improved retention of ecological concepts demonstrated in the quantitative findings. This is also consistent with the “Taphonomy: Dead and Fossilized” study (Martindale & Weiss, 2019) that demonstrates the effectiveness of educational games in teaching complicated science lessons through experiences in daily life. Martindale and Weiss (2019) also found that games dealing with actual scientific concepts are effective in helping players focus on science in a direct, and interactive way. This supports deeper comprehension of the subject matter. This similarity indicates that “Ashiyan” ,as a game, can be equally effective in providing real environmental issues through eco-narratives in raising environmental awareness in scientific concept in the same way any other game acts.

Overall, the findings of the current study have demonstrated that educational games can serve as an effective and novel instructional tool for its potential raise cognitive engagement, and promote more active learning. “Ashiyan” not only assisted in learning scientific ideas but also positively influenced students’ environmental and social attitudes, and in this way their sense of responsible behavior towards the environment.

Nevertheless, our study had some limitations as well: The first, the small sample size, derived from only six schools in Iran, that made it difficult to generalize the findings; The second, the short duration of the program (four weeks) that did not allow the researchers to assess the long-term effects of the intervention. There should be further research exploring the long-term effects of educational game, particularly on altering environmental behaviour and foster critical thinking as advocated in the case of “The Effect of Educational Board game on Students' Reflective Thinking Skill in Learning Subject Nutrition in Food” (Al Mustafid, Aristiawan & Cahyani., 2024).

For future studies, it is recommended to increase the sample size in order to be able to generalise the effects of educational games in various cultural and geographical backgrounds. Moreover, the use of hybrid games, games that integrate digital technologies, may enhance the teaching-learning process and increase students’ motivation, in line with the findings from “Using Board Games to teach Socioscientific Issues” (Tsai et al., 2019) that reported on the advantages of combining physical games with digital games to learning.

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Ethics declaration: This research was conducted in research-focused schools, and since the Ashiyan game is part of the official curriculum of schools in Iran, there was no need to obtain consent for participation in the study. All research procedures were conducted in compliance with ethical standards and relevant regulations.

AI declaration: In this study, AI tools were used to access resources and translate the article. These tools assisted the authors in the process of research and translation, significantly contributing to the improvement of the research quality.

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