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Development of a mnemonic card game for sustainability literacy in Master of Business Administration programmes

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Orientation: The Sustainable Development Goals (SDGs) are critical global targets that management education must integrate to prepare future business leaders for sustainability challenges.

Research purpose: This study aims to develop and evaluate a mnemonic card game designed to enhance Master of Business Administration (MBA) students' understanding and retention of the SDGs.

Motivation for the study: Traditional teaching methods often fail to engage students with the complexity of the SDGs, limiting retention and comprehensive understanding. A mnemonic card game offers an innovative, engaging alternative.

Research design, approach and method: Following a Design Science Research (DSR) approach, the study involved MBA students playing the SDG card game. Pre- and post-game quizzes, surveys and facilitator observations were used to assess the game's effectiveness in improving SDG knowledge.

Main findings: The game significantly improved students' understanding, with average quiz scores increasing by 2.41 points post-game. Qualitative feedback indicated high levels of engagement and enjoyment.

Practical and/or managerial implications: The card game can be incorporated into business school curricula to enhance sustainability education, providing a scalable, cost-effective and engaging learning tool. It fosters critical thinking and ethical decision-making, aligning with the Principles for Responsible Management Education (PRME).

Contribution and/or value-add: This study provides an innovative tool that enhances sustainability literacy among MBA students, demonstrating the potential for broader application in management education.

Keywords: Sustainable Development Goals; game-based learning; mnemonics; management education; responsible management; sustainability literacy.

Introduction

Background

The Sustainable Development Goals (SDGs) are a set of 17 comprehensive, universal and inclusive global goals adopted by all United Nations (UN) Member States in 2015 as part of the 2030 Agenda for Sustainable Development. These goals aim to address the world's most pressing challenges, including poverty, inequality, climate change and environmental degradation (Abidi & Jamil 2023; Wadhwani & Malpani 2023). The SDGs replaced the Millennium Development Goals (MDGs) and emphasise human rights and good governance, aiming to ensure well-being for present and future generations through sustainable consumption and the protection of natural endowments (Abidi & Jamil 2023; Wadhwani & Malpani 2023).

Integrating the SDGs into management education is essential to prepare future business leaders for the challenges of sustainability (Tufaner 2024). However, traditional teaching methods often fall short in conveying the complexity and importance of the SDGs, highlighting the need for innovative educational tools (Mandrikas 2020). The Principles for Responsible Management Education (PRME), supported by the UN, provide a framework for integrating sustainability into

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business school curricula, emphasising the development of future leaders who can balance economic and sustainability goals (Tufaner 2024). Despite these frameworks, the pace of integrating SDGs into business school operations has been slow, indicating a need for additional efforts and systematic sustainability-reporting protocols (Talwar et al. 2023).

Problem statement

Traditional methods of teaching the SDGs in management education often fail to engage students and ensure long-term retention of the complex, interconnected nature of these goals. The problem is that conventional approaches typically emphasise environmental aspects while neglecting critical social, economic and governance dimensions, leading to an incomplete understanding of sustainability.

Research objectives

This study aims to develop and evaluate a mnemonic card game designed to enhance MBA students' understanding and retention of the SDGs. The research objectives are:

- To design an engaging mnemonic card game that facilitates the understanding and retention of the 17 SDGs among MBA students by incorporating mnemonic techniques and Game-Based Learning (GBL) principles.
- To align the game with the PRME framework, ensuring it fosters critical thinking, collaboration and ethical decision-making in students.
- To evaluate the effectiveness of the game in comparison to traditional teaching methods, focussing on engagement, knowledge retention and the ability to apply SDG principles in business contexts.
- To explore the practical implications of integrating the game into management education curricula and assess its adaptability to different educational contexts and learning objectives.

In the following sections, this paper will discuss the literature review, detailing the background and theoretical foundations of the SDGs and GBL. The methodology section will outline the design and development of the game, followed by the results and findings, which will present the effectiveness of the game. Finally, the discussion and conclusion sections will explore the implications of the findings and suggest future research directions.

Literature review

Background of the sustainable development goals

The SDGs are a set of 17 interconnected goals and 169 targets established by the UN in 2015 aimed at addressing the world's most pressing challenges, including poverty, inequality, climate change and environmental degradation, with the objective of achieving them by 2030 (Abidi & Jamil 2023; Wadhwani & Malpani 2023). These goals replaced the MDGs and expanded the development agenda to ensure that no one is left behind, emphasising the balance between economic, social and environmental sustainability (Perkins, Kurtiş & Velazquez 2022; Phillips 2023). The SDGs are celebrated as a major achievement representing a comprehensive plan to tackle worldwide social and environmental crises, although they face challenges such as potential trade-offs between goals and the reliance on economic growth which may undermine their success (Samašonok & Išoraitė 2023).

The SDGs provide a framework for action, enabling governments, businesses, civil society and individuals to collaborate towards a more sustainable future, with local action being crucial for their achievement (Bandari et al. 2023). The implementation of the SDGs has been evaluated through various models and scenarios, with the 'Smarter' scenario showing the best potential outcomes for global sustainability (Phillips 2023). Research highlights the importance of local knowledge and the role of poverty in sustainability efforts, particularly in the Global South where local perspectives are essential for more emancipatory and just living (Adiyoso 2022).

Communication plays a significant role in promoting and practising the SDGs as it helps shape public opinion, policy agendas and mobilise resources, fostering intercultural sensitivity and constructive dialogues among various disciplines (Bandari et al. 2023). Bibliometric analysis of SDG-related research indicates a concentration of efforts in developed countries with significant contributions from the United States of America (USA), China and the United Kingdom (UK), and highlights core topics such as climate change, poverty and food security (Asriani 2024).

Public education, personal awareness and the involvement of younger generations are crucial for the successful implementation of the SDGs, as evidenced by research showing higher engagement among younger individuals in sustainable practices (Perkins et al. 2022). The SDGs aim to ensure well-being for present and future generations through sustainable consumption and the protection of natural endowments, establishing a balance between economic growth, environmental protection and social well-being (Abidi & Jamil 2023; Wadhwani & Malpani 2023). Overall, the SDGs represent a shared vision for a sustainable, equitable and prosperous world, requiring significant investments, innovative solutions and a collective effort to transform humanity's relationship with the environment and achieve long-term global sustainability (Adiyoso 2022; Samašonok & Išoraitė 2023).

Game-based learning as a pedagogical strategy

Game-based learning is an educational approach that integrates game elements and principles into learning environments to enhance student engagement, motivation and learning outcomes. Unlike traditional learning methods, which often rely on linear, lecture-based instruction, GBL leverages the interactive and immersive nature of games to create a more dynamic and participatory learning experience.

This approach is grounded in the concept of playfulness, which is an integral part of human learning, especially among young learners, and can effectively remove the predictability and monotony of conventional classroom settings (Balaskas et al. 2023).

Key principles of GBL include the use of narrative, goals, rewards and feedback, which are essential in creating an engaging and motivating learning environment (David & Weinstein 2023). These elements help in contextualising learning, making it more relevant and enjoyable for students. For instance, digital games have been shown to significantly improve language learning outcomes by enhancing vocabulary acquisition, oral communication skills and grammar learning compared to traditional methods (Eltahir et al. 2021; Ghelichli, Seyyedrezaei & Seyyedrezaei 2022). Game-Based Learning is also versatile, applicable across various educational stages, from kindergarten to tertiary education, and can be tailored to different subjects and learning objectives (Chen, Lu & Lien 2019).

In primary and secondary education, GBL has been found to enhance students' understanding of complex concepts and foster real-world application of knowledge (Mohd Ramli et al. 2022). In higher education, it can improve professional skills and knowledge retention, as evidenced by studies on digital marketing and business management programmes (Camacho-Sánchez, Rillo-Albert & Lavega-Burgués 2022). The use of platforms like Kahoot! has demonstrated increased student engagement and motivation, making GBL a valid strategy for classroom instruction (Balaskas et al. 2023). Additionally, the integration of emerging technologies such as augmented reality (AR) and generative artificial intelligence (AI) into GBL platforms shows promise in further enhancing digital and technology literacy skills, although challenges like technical limitations and the need for comprehensive research on efficacy remain (Kazanidis & Pellas 2024).

Game-based learning offers a structured, yet flexible approach to learning, incorporating elements of fun and competition that can significantly improve intrinsic and extrinsic motivation, thereby redefining contemporary pedagogies and enhancing the overall learning experience (David & Weinstein 2023).

Theoretical foundations of game-based learning

Game-based learning is underpinned by several theoretical models, notably constructivist learning theories and experiential learning theories, which provide a robust framework for understanding and enhancing the learning process. Constructivist learning theory posits that learners construct their own understanding and knowledge of the world through experiences and reflecting on those experiences. This theory emphasises active engagement, where learners build new knowledge by connecting it to their existing cognitive structures (Shidiq et al. 2024). In the context of GBL, this means that games can serve as dynamic environments where learners actively participate, experiment and solve problems, thereby constructing knowledge in a meaningful way. The constructivist approach is also evident in the use of digital technologies, which facilitate lifelong learning by providing platforms for continuous engagement and interaction, such as personal learning environments (PLEs) and personal learning networks (PLNs) (Miller & Brown 2015).

Experiential Learning Theory (ELT), developed by David Kolb, complements constructivist theories by emphasising the role of experience in the learning process. Experiential Learning Theory is a cyclical model that involves concrete experience, reflective observation, abstract conceptualisation and active experimentation (Burke 2020). In GBL, this translates to learners engaging in game scenarios (concrete experience), reflecting on their actions and outcomes (reflective observation), forming strategies or hypotheses (abstract conceptualisation) and testing these strategies within the game (active experimentation). This cyclical process not only enhances knowledge retention but also fosters critical thinking and problem-solving skills. Moreover, ELT's holistic approach, which integrates inter- and intrapersonal interactions, aligns well with the collaborative and interactive nature of many educational games (Makewa 2019).

The integration of these theories into GBL is further supported by the need for creative thinking and expression, particularly in fields like science and medicine. A constructivist-designed learning environment can stimulate intellectual structures, support intellectual balance and promote creativity and creative scientific expression, which are crucial for effectively communicating complex information (Komany & Chaijaroen 2020). Additionally, the decolonisation of global health education through experiential learning highlights the importance of engaging students with diverse communities and local knowledge, thereby fostering intercultural competence and critical self-reflection (Hawks, Hawks & Sullivan 2023). This approach is consistent with the principles of both constructivist and experiential learning theories, which advocate for learning through active participation and real-world experiences.

Synergy between game-based learning and mnemonics

Mnemonic techniques are cognitive strategies designed to enhance memory retention by leveraging the brain's natural encoding processes, such as visual imagery, organisation and detailed encoding. These techniques facilitate the storage and retrieval of complex and extensive information in long-term memory, making them invaluable tools in educational settings. Mnemonics can be broadly categorised into several types, each with unique mechanisms and applications. Acronyms and acrostics, also known as first-letter mnemonics, are among the simplest and most widely used forms. They involve creating a word or phrase from the initial letters of the items to be remembered, aiding in chunking and organising material for easier recall (Anosova & Agafonov 2024; Khmara & Khmara 2022).

Visual mnemonics utilise imagery to create associations between new information and familiar concepts. This method can include symbolic representations, pictographic mnemonics and visualisations that help in forming strong mental images, thereby enhancing memory retention (Gadzhula et al. 2023; Hidayah, Sabarun & Widiastuty 2023). The method of loci (MoL), or memory palace technique, is a spatial mnemonic that involves imagining a familiar place and assigning specific items to various locations within this mental space. This technique capitalises on the brain's spatial memory and constructive imagination, making it highly effective for remembering ordered information (Robins 2023). Other mnemonic strategies include the peg word method, which links new information to a pre-memorised list of words that rhyme with numbers, and the keyword method, which connects new vocabulary to familiar words through similar sounds or meanings (Siagian et al. 2023).

The effectiveness of mnemonic techniques has been demonstrated across various educational contexts, from improving vocabulary retention in language learning to enhancing understanding and recall in subjects like pharmacology and human anatomy (Manshur et al. 2023; Myrzabaev et al. 2022; Safi et al. 2018). For instance, the use of mnemonics in teaching the male reproductive system significantly increased student learning outcomes and retention rates (Atimi, Ningsih& Lestari 2023). Similarly, mnemonic devices have been shown to aid in the mastery of vocabulary among junior high school students, with the keyword method proving particularly effective (Gadzhula et al. 2023).

Despite their benefits, mnemonics are not a replacement for traditional teaching methods but rather a complementary tool that, when integrated with other strategies, can significantly improve educational outcomes. The ongoing development and refinement of mnemonic techniques continue to offer promising avenues for enhancing memory retention and learning efficiency in diverse educational settings (Gadzhula et al. 2023; Myrzabaev et al. 2022).

Educational tools and games that successfully integrate mnemonics with GBL have shown significant promise in enhancing student engagement and retention of information. One notable example is the development of a Serious Game (SG) aimed at helping second-language learners memorise vocabulary through visuospatial bootstrapping, which leverages virtual reality (VR) to create an immersive learning environment. This game uses a modified version of Kalmpourtzis' AMSTP game design model, incorporating aesthetics, mechanics, story, technology and pedagogy along with user expertise to provide a comprehensive learning experience (Costuchen, Cunningham & Tordera Yllescas 2022). Another innovative tool is the mobile application 'Mnemorizer', designed to help international students learn English vocabulary for standardised tests. This app combines mnemonics and gamification, showing that mnemonics in the native tongue are more effective than those in English, thus tailoring the learning experience to the cultural and linguistic background of the users (Safi et al. 2018).

Additionally, a mnemonic tool for learning historical dynasties uses magnetic blocks to represent dynasty names and events, allowing students to engage in a game-like activity that enhances their memorisation through physical interaction and sequencing tasks (Wang et al. 2012). In the realm of biology education, the use of mnemonic techniques has been shown to significantly improve student learning outcomes and retention, as evidenced by a study on the male reproductive system, where students' average scores increased markedly after employing mnemonic strategies (Atimi et al. 2023). Similarly, in the field of pharmacy education, mnemonics have been used to help students assimilate complex information more effectively, with visual aids such as tables and pictures enhancing the learning process (Anosova & Agafonov 2024).

The integration of mnemonics in teaching human anatomy has also been explored, with techniques like rhyming, alliteration and visual schemes aiding in the encoding, storage and retrieval of anatomical information, thus improving students' understanding and retention of the subject matter (Khmara & Khmara 2022). Furthermore, mnemonic strategies have been applied in therapeutic dentistry education, where verbal, visual and linguistic mnemonics help foreign students master vast amounts of information, leading to improved knowledge, skills and abilities (Gadzhula et al. 2023).

The effectiveness of mnemonics in educational settings is well-documented, with various studies highlighting their role in improving memory by leveraging natural processes such as visual imagery and organisation (Hidayah et al. 2023). The historical roots of mnemonics dating back to ancient Egypt underscore their enduring relevance and effectiveness in modern education, where they continue to be a valuable tool for enhancing cognitive skills and academic performance (Manshur et al. 2023).

The integration of mnemonics with GBL in these educational tools and games demonstrates a powerful synergy that can significantly enhance learning outcomes across diverse subjects and student populations. By combining the engaging and interactive elements of GBL with the cognitive benefits of mnemonics, educators can create a more effective and enjoyable learning experience that promotes long-term retention and understanding of complex information (Costuchen et al. 2022; Safi et al. 2018).

Evaluating the impact of combined approaches

Assessing the impact of combined GBL and mnemonic approaches on student learning outcomes requires a multifaceted approach that integrates various research methodologies and analytical techniques. One effective method is the use of a pre-test–post-test experimental design, which allows for the measurement of student performance before and after the intervention. This design was successfully employed in studies examining the mnemonic learning model's impact on arts and crafts learning outcomes, where significant improvements were observed in post-test scores compared to pre-test scores (Cayati, Yuspida & Sabillah 2024).

Similarly, the use of classroom action research with cycles of intervention and assessment can provide insights into the effectiveness of mnemonic techniques on specific subject matter, such as the male reproductive system, where notable increases in student achievement and retention were recorded (Atimi et al. 2023). Another robust method is the quasi-experimental design, which can compare the learning outcomes and retention rates between experimental and control groups, as demonstrated in the study integrating the PQ4R learning model with mnemonic-based modules (Muhibbuddin & Safrida 2021). This approach allows for the control of extraneous variables and provides a clearer picture of the intervention's impact.

Additionally, employing statistical tests such as Analysis of Covariance (ANCOVA) can help in examining the significance of differences in learning outcomes between groups, further validating the effectiveness of the combined approaches (Muhibbuddin & Safrida 2021). The use of closed-ended questionnaires to assess mnemonic effectiveness, as seen in the study with nursing students, can also be adapted to include GBL elements, providing quantitative data on student memory and learning improvements (Sharma & Tanwar 2022).

Furthermore, the application of non-parametric statistical hypothesis testing, as used in the study comparing lecture methods with mnemonic methods for memorising physics formulas, can offer insights into the relative effectiveness of different teaching strategies (Jusriana, Anggereni & Budiman 2022). Blended learning approaches, which combine traditional and innovative teaching methods, can also be assessed using pre-test–post-test designs and t-tests to measure significant differences in student performance, as demonstrated in studies on educational measurement and evaluation capabilities (Fongkanta, Buakanok & Inai 2023).

Finally, large-scale studies involving multiple semesters and large sample sizes, such as those investigating the use of mnemonics in statistics courses, can provide comprehensive data on the long-term impact of combined GBL and mnemonic approaches on student learning outcomes and anxiety reduction (Mocko et al. 2017). By integrating these diverse methodologies, researchers can obtain a holistic understanding of how combined GBL and mnemonic approaches influence student learning outcomes, retention, and overall educational experience.

Research methodology

Research approach and design

The research methodology for this study follows a Design Science Research (DSR) approach. The DSR is a systematic process used to create and evaluate artefacts intended to solve identified problems. This approach is particularly suited for developing innovative educational tools, as it involves iterative design, implementation and evaluation phases. The primary artefact in this study is a mnemonic SDG card game designed to enhance MBA students' understanding and retention of the SDGs.

Conceptual foundation

The foundation of the game is rooted in the principles of GBL, which has been shown to significantly enhance student engagement and learning outcomes (Tufaner 2024). The design draws on research indicating that interactive and mnemonic-based educational tools can greatly improve students' ability to recall and apply complex information (Anosova & Agafonov 2024). Recognising the challenges associated with traditional methods of teaching the SDGs, the game seeks to provide an alternative that is both enjoyable and educational.

Mnemonic phrase

Central to the game is the mnemonic phrase: 'No Zebras Go Quietly; Giraffes Can't Always Dance. Instead, Rhinos Choose Rocks; Cool Leopards Play Justly Together'. This phrase was meticulously crafted to provide an easy-to-remember association for each of the 17 SDGs. Each word in the phrase corresponds to the first letter of each SDG, facilitating quicker recall and deeper cognitive engagement. The use of mnemonic devices is well-supported by educational psychology, which highlights their effectiveness in improving memory retention (Siagian et al. 2023).

A depiction of the mnemonic can be observed in Figure 1. Each SDG is represented with a specific colour and icon,

FIGURE 1: Mnemonic depiction for the 17 sustainable development goals.

corresponding to the mnemonic phrase designed to facilitate recall and engagement. For example, 'No' represents SDG 1: No Poverty, and is visually paired with the corresponding SDG icon and colour.

Card types and design

Sustainable development goal cards

Each SDG card represents one of the 17 goals, featuring the mnemonic word, a brief description of the goal and key points. The design of these cards incorporates SDG-specific colours and icons to aid visual learning and ensure consistency with the official SDG branding. The aesthetic appeal and clarity of the cards are intended to enhance readability and engagement, crucial factors in educational game design (Tekinbas & Zimmerman 2003).

Challenge cards

These cards are divided into three categories: questions, activities and discussions. Question cards prompt players to answer queries related to the SDGs, activity cards involve quick tasks that reinforce the goals, and discussion cards encourage players to explore the application of SDGs in real-world business contexts. This variety ensures that the game remains dynamic and caters to different learning styles, which is essential for maintaining student interest and motivation (Mandrikas 2020).

Both SDG cards and challenge cards feature mnemonic symbols paired with SDG images, enhancing visual and cognitive associations as can be seen in Figure 2.

Data collection techniques

The study employed a combination of quantitative and qualitative data collection techniques to evaluate the effectiveness of the game.

- To measure students' understanding and retention of the SDGs before and after playing the game, multiple-choice and short-answer quizzes were administered. These quizzes assessed key points related to each SDG.
- Game facilitators carefully observed gameplay, noting concerns, confusions and innovative alternative suggestions. These observations provided insights into the game's dynamics and areas for improvement.
- Qualitative feedback was collected from students to gather their perspectives on the game's effectiveness, engagement and suggestions for enhancement. This feedback was crucial for refining the game's design and implementation.

Sample and sample size

The study involved MBA students from NWU Business School who had completed at least one semester of their programme with exposure to sustainability concepts integrated into the curriculum. A total of 120 students participated in the game, with 70 students completing both the pre- and post-game quizzes. The selection criteria ensured that participants had a baseline understanding of sustainability, making them suitable candidates for evaluating the educational tool.

Implementation process

The game is designed to be played in a classroom setting with groups of four to six MBA students. The implementation process begins with a brief introduction to the SDGs and the objectives of the game. Students are then divided into groups and provided with a set of SDG and Challenge Cards. Each group member takes turns drawing a challenge card, responding to the prompt, and earning points based on the accuracy and completeness of their answers. A typical game session lasts approximately 30 min, making it suitable for integration into standard class periods. The session concludes with a wrap-up discussion, where key takeaways are summarised and the importance of the SDGs in business practices is reinforced. This structured yet flexible approach ensures that the game can be seamlessly incorporated into various educational contexts.

FIGURE 2: (a) Sustainable development goal card; and (b) challenge cards for sustainable development goal 4: quality education.

Figure 3 showcases the setup of the SDG card game, including the SDG and Challenge Cards, along with the mnemonic symbols and instructions.

Evaluation

To assess the effectiveness of the game, students complete pre- and post-game quizzes designed to measure their understanding and retention of the SDGs. Additionally, a feedback survey was administered to gather insights into the students' perceptions of the game's impact on their learning and engagement. The evaluation process is integral to refining the game and ensuring its alignment with educational objectives.

Aesthetic and structural considerations

The design of the mnemonic SDG card game emphasises simplicity and clarity. The SDG cards are crafted with a clean layout that highlights the mnemonic word and key points, using bold, sans-serif fonts for readability. The Challenge Cards are colour-coded to differentiate between questions, activities and discussions, with small icons representing each category to aid quick recognition. The use of high-quality, durable card stock and potential lamination ensures the game's longevity and usability in multiple sessions. The visual elements are carefully chosen to avoid cognitive overload, balancing informative content with engaging design (Tekinbas & Zimmerman 2003).

FIGURE 3: Sustainable development goal card game setup.

Ethical considerations

In this study, ethical approval has been obtained from the North-West University Faculty of Economic and Management Sciences Research Ethics Committee (EMS-REC) (Ref no.: NWU-01827-24-A4). The study strictly adheres to the ethical guidelines for research involving human participants. All participants will provide informed consent, and their data were anonymised and treated with confidentiality throughout the study.

Results and findings

A total of 120 MBA students participated in the study, with 70 completing both the pre- and post-game quizzes. The demographic details of the participants included:

- **Gender:** 40% female, 60% male.
- **Age range:** 24–35 years.
- **Education level:** All participants had completed at least one semester of their MBA programme.

Comparative analysis

The pre- and post-game quizzes were used to measure the students' understanding and retention of the SDGs. The descriptive statistics for the pre- and post-game quiz scores are as summarised in Table 1.

Statistical analysis

To further analyse the effectiveness of the game, an analysis of variance (ANOVA) was performed to compare the quiz scores across different groups based on gender and age. The ANOVA results showed no significant differences in score improvements between genders ($F[1, 68] = 0.45$, $p = 0.51$) and age groups ($F[2, 67] = 1.23$, $p = 0.30$). This indicates that the game's effectiveness was consistent across these demographics.

Major findings

The study's major findings demonstrate the effectiveness of the game in enhancing MBA students' understanding and retention of the SDGs:

- The mean score improvement of 2.41 points indicates a substantial increase in SDG knowledge post-game.
- Feedback surveys revealed that students found the game engaging and enjoyable, which contributed to their increased understanding of the SDGs.
- The consistent effectiveness across different demographic groups suggests that the game can be broadly applied in diverse educational settings.

TABLE 1: Descriptive statistics for pre- and post-game quiz scores.

Statistic	Pre-game	Post-game	Improvement
Mean	5.69	8.10	+2.41
Median	6.15	9.00	+2.85
Mode	6.92	9.00	+2.08
Range	6.15	8.00	+1.85
Variance	2.52	3.29	+0.77
Standard deviation	1.59	1.81	+0.22

The study's findings align with existing literature on GBL and mnemonic techniques. As highlighted by Balaskas et al. (2023), GBL creates an engaging and interactive learning environment that enhances student motivation and learning outcomes. The mnemonic techniques used in the game, such as acronyms and visual mnemonics, have been proven effective in improving memory retention (Hidayah et al. 2023; Khmara & Khmara 2022).

The increase in students' understanding and retention of the SDGs supports the view that innovative educational tools are necessary for effective sustainability education (Tufaner 2024). The game's alignment with the PRME framework also underscores its potential to foster critical thinking, collaboration and ethical decision-making, as advocated by Bishri (2024).

Overall, this study contributes to the growing body of research on GBL and mnemonics by providing a practical, effective tool for teaching the SDGs in management education. The positive outcomes observed suggest that such approaches can significantly enhance sustainability literacy among future business leaders.

Managerial implications

Practical implications

The results of this study demonstrate that the game is an effective educational tool for enhancing MBA students' understanding and retention of the SDGs. This has several practical implications for business schools and organisations:

Enhanced curriculum integration

Business schools can incorporate the game into their management education curricula to improve the teaching and learning of sustainability concepts. This can be particularly beneficial in courses focused on corporate social responsibility, sustainability, and ethical management.

Improved student engagement

The game's interactive and engaging format can increase student motivation and participation, leading to better learning outcomes. This can help educators address the challenge of keeping students engaged with complex and abstract topics like the SDGs.

Development of critical skills

By aligning with the PRME, the game fosters critical thinking, collaboration and ethical decision-making among students. These skills are essential for future business leaders who will need to navigate the complexities of sustainability in the corporate world.

Scalability and adaptability

The game's design allows it to be easily adapted to different educational contexts and learning objectives.

Business schools can customise the game to align with specific course requirements or regional sustainability priorities.

Cost-effective educational tool

As a cost-effective and easy-to-implement tool, the game can be widely adopted without significant financial investment. This makes it accessible to a broad range of educational institutions, including those with limited resources.

Recommendations

Business schools should consider integrating the game into core management courses, such as organisational behaviour, strategy and operations management. This can ensure that all students are exposed to sustainability concepts early in their education.

To maximise the effectiveness of the game, business schools should provide training for educators on how to facilitate and integrate the game into their teaching. This can include workshops, instructional materials and best practice guides.

Regular feedback from students and educators should be collected to continuously refine and improve the game. This iterative process can help address any challenges and enhance the game's educational value.

Business schools can collaborate with industry partners to use the game as part of executive education and corporate training programmes. This can help bridge the gap between academia and industry, promoting the practical application of sustainability principles in the corporate world.

Ongoing research should be conducted to evaluate the long-term impact of the game on students' knowledge retention and application of SDG principles in their careers. This can provide valuable insights into the effectiveness of GBL and inform future educational strategies.

Strategic implications

By incorporating the game into their curricula, business schools can play a crucial role in shaping responsible leaders who are equipped to tackle global sustainability challenges. This can enhance the reputation of the institution and attract students who are passionate about making a positive impact.

The integration of the SDGs into management education aligns with global efforts to promote sustainable development. Business schools that adopt such innovative educational tools demonstrate their commitment to these goals, potentially attracting partnerships and funding opportunities from organisations dedicated to sustainability.

Institutions that effectively integrate innovative teaching methods like GBL can differentiate themselves in a competitive educational landscape. This can enhance their appeal to prospective students and employers looking for graduates with advanced sustainability competencies.

In conclusion, the game offers a practical and effective solution for enhancing sustainability education in MBA programmes. By adopting and integrating this tool, business schools can significantly improve their students' understanding of the SDGs and prepare them to become responsible and effective leaders in a sustainable future.

Conclusions, limitations and future research

Conclusions

This study aimed to develop and evaluate a mnemonic SDG card game to enhance MBA students' understanding and retention of the SDGs. The game was designed using principles of GBL and mnemonic techniques, aligning with the PRME framework. The main findings demonstrate significant improvements in students' SDG knowledge, with mean quiz scores increasing by 2.41 points post-game. These results indicate that the game is an effective educational tool, enhancing student engagement, motivation and knowledge retention.

Compared to previous research on GBL and mnemonics, this study confirms the effectiveness of combining these approaches to improve learning outcomes. Balaskas et al. (2023) highlighted the benefits of GBL in creating engaging learning environments, while Khmara & Khmara (2022) demonstrated the efficacy of mnemonic techniques in enhancing memory retention. The findings of this study are consistent with these insights, underscoring the potential of innovative educational tools in management education.

The theoretical contribution of this study lies in integrating GBL and mnemonics to enhance sustainability education. Practically, the study provides a scalable, cost-effective tool that can be easily adapted to different educational contexts, promoting responsible management education and sustainability literacy.

Limitations

Despite the promising results, this study has several limitations:

- The study was conducted with a relatively small sample size of MBA students from a single business school, which may limit the generalisability of the findings. Future studies should include larger, more diverse samples across multiple institutions.
- The study focussed on short-term improvements in SDG knowledge. Long-term retention and the practical application of the knowledge gained were not assessed. Future research should explore the long-term impact of the game on students' understanding and behaviour.
- The feedback surveys relied on self-reported data, which may be subject to biases such as social desirability bias. Objective measures should be incorporated in future studies to validate the findings.

Future research

Building on the findings of this study, future research can explore several areas:

Longitudinal studies

Conduct longitudinal studies to assess the long-term retention of SDG knowledge and the practical application of the concepts learned through the game.

Cross-cultural validation

Investigate the effectiveness of the game in different cultural and educational contexts to determine its global applicability.

Comparative studies

Compare the game with other innovative teaching methods to evaluate its relative effectiveness and identify best practices for sustainability education.

Integration with technology

Explore the integration of emerging technologies such as AR and VR to enhance the game's immersive experience and educational impact.

Impact on behaviour

Study the impact of the game on students' attitudes and behaviours towards sustainability, assessing how well they apply SDG principles in real-world scenarios.

In conclusion, the game represents a significant advancement in management education, effectively enhancing students' understanding and retention of the SDGs. By addressing the limitations and exploring future research directions, educators can further refine and optimise this innovative educational tool, contributing to the development of responsible and knowledgeable future business leaders.

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Competing interests

The author declares that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

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Data availability

The data that support the findings of this study are available from the corresponding author M.J.G., upon reasonable request. Because of the nature of this research, participants' consent was not obtained for public data sharing, and thus data are not publicly available.

Disclaimer

The views and opinions expressed in this article are those of the author and are the product of professional research. The article does not necessarily reflect the official policy or position of any affiliated institution, funder, agency or that of the publisher. The author is responsible for this article's results, findings and content.

AI Declaration

The author would like to declare that AI-assisted tools, including natural language processing and grammar-checking software, were used in the copy-editing process of this paper to ensure clarity, coherence and adherence to academic standards.

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