

INTERNATIONAL CONFERENCES PROCEEDINGS

▶▶ 2026

7 - 9 March • Zagreb, CROATIA

# MOBILE LEARNING

+

# ICEduTech

Edited by

Inmaculada Arnedillo Sánchez  
Piet Kommers  
Tomayess Issa  
Pedro Isaías



**INTERNATIONAL CONFERENCES**  
**ON**  
**MOBILE LEARNING 2026**  
**AND**  
**EDUCATIONAL TECHNOLOGIES 2026**



**PROCEEDINGS OF THE  
INTERNATIONAL CONFERENCES**

**on**

**MOBILE LEARNING 2026**

**AND**

**EDUCATIONAL TECHNOLOGIES 2026**

**7 - 9 MARCH, 2026**

**ZAGREB, CROATIA**

Organised by



international association for development of the information society

Copyright 2026

IADIS Press

All rights reserved

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Permission for use must always be obtained from IADIS Press. Please contact [secretariat@iadis.org](mailto:secretariat@iadis.org).

As a member of Crossref (a non-profit membership organization for scholarly publishing working with the purpose to make content easy to find, link, cite and assess) each published paper in this book of proceedings will be allocated a DOI (Digital Object Identifier) number for its fast and easy citation and indexation.

Edited by Inmaculada Arnedillo Sánchez, Piet Kommers, Tomayess Issa  
and Pedro Isaías

Associate Editor: Luís Rodrigues

ISBN: 978-989-8704-76-4

# TABLE OF CONTENTS

FOREWORD	ix
PROGRAM COMMITTEE	xiii
KEYNOTE LECTURE	xvii

## FULL PAPERS

### *Mobile Learning*

EDU4HEALTH: A TECHNOLOGY-ENHANCED HEALTH EDUCATION THROUGH AUGMENTED REALITY AND GAMIFICATION <i>Lúcia Pombo, Margarida M. Marques and João Ferreira-Santos</i>	3
ANALYSIS OF THE PERCEIVED COMPLEXITY OF USE CASES IN DIGITAL EDUCATIONAL SPACES <i>Tobias Moebert, Alexander Schröter, Ralf Krebs and Ulrike Lucke</i>	11
A MULTI-MOBILITY FRAMEWORK FOR INSTITUTIONAL MOBILE LEARNING: INSIGHTS FROM FORMAL AND INFORMAL DATA <i>Daniela Olea-Ibarra and María Teresa Nicolás-Gavilán</i>	22
EVALUATING INTER-RATER CONSISTENCY OF GENERATIVE AI SYSTEMS IN RANKING MOBILE EDUCATION APPS: A NON-PARAMETRIC EXTENSION <i>Victor K. Y. Chan</i>	31
MODEL ASSISTED STATISTICS WITH MOBILE WEB USAGE <i>Ioannis Leftheris, Theodoros Xanthopoulos and Kyriaki Tsilika</i>	39
MRGEN: A CONCEPTUAL FRAMEWORK FOR LLM-POWERED MIXED REALITY AUTHORIZING TOOLS FOR EDUCATION <i>Mohammed Oussama Seddini, Mohamed Ez-Zaouia, Ngoc Luyen Le and Iza Marfisi-Schottman</i>	49
COMPARING HYBRID MOBILE QR-SCANNING AND NARRATIVE DESKTOP EDUCATIONAL ESCAPE GAMES <i>Hana Ulrichová, Magdaléna Závodná, Kateřina Kostolányová, Michaela Mrázová and Otto Suchánek</i>	57
SPART-ME M: DESIGN, IMPLEMENTATION AND EXPERIMENTAL EVALUATION OF A MOBILE ALTERNATIVE TO INTERACTIVE TABLETOPS IN EDUCATION <i>Sebastian Simon, Mia Čarapina, Silvio Plehati and Iza Marfisi-Schottman</i>	65

## ***Educational Technologies***

- THE RESPONSIVENESS AND MINIMAL DETECTABLE CHANGE OF THE DISCIPLINARY TECO IN OCCUPATIONAL THERAPY STUDENTS OF SAPIENZA UNIVERSITY OF ROME: A CROSS-SECTIONAL STUDY  
*Francescaroberta Panuccio, Iaria Ruotolo, Anna Berardi, Giovanni Galeoto, Andrea Marini Padovani and Giovanni Sellitto* 73
- EXPLAINABLE AI FOR COMPUTER SCIENCE INSTRUCTORS: ENHANCING TEACHING AND PROFESSIONAL PRACTICE  
*Mahmoud Mohanna* 80
- TECO-T TRANSVERSAL COMPETENCIES IN MEDICINE: CROSS-SECTIONAL ANALYSIS OF TECO SURVEY AT SAPIENZA UNIVERSITY OF ROME  
*Andrea Marini Padovani, Giovanni Sellitto, Iaria Ruotolo, Anna Berardi, Francescaroberta Panuccio and Giovanni Galeoto* 88
- NAVIGATING THE AI REVOLUTION: A SIMULATION-BASED FRAMEWORK FOR STRATEGIC TECHNOLOGY ADOPTION IN EDUCATION  
*Albert Schram* 96
- A DIGITAL SIMULATION APPROACH TO ADMISSION TEST PREPARATION FOR HEALTH PROFESSIONS PROGRAMS: DEVELOPMENT AND EARLY DATA FROM ITALIAN STUDENTS  
*Giovanni Galeoto, Donatella Valente, Iaria Ruotolo, Giovanni Sellitto and Luisa Romano* 103
- WHAT MAKES STUDENT-BUILT METAVERSE WORLDS “GOOD” IN DIFFERENT WAYS? A THEMATIC COMPARISON USING VISITOR REFLECTIONS  
*Hiroko Kanoh* 111
- AN IMPROVEMENT OF PHRASE FILL-IN-BLANK PROBLEM FOR JAVA TEST CODE READING STUDY  
*Xiqin Lu and Khaing Hsu Wai* 120
- EXPLORING STUDENTS' LEARNING MANAGEMENT SYSTEM SATISFACTION AT A UNIVERSITY OF TECHNOLOGY IN SOUTH AFRICA  
*Sibongile Simelane-Mnisi and Johnny Mafika Mthimunye* 127
- INTERNAL CONSISTENCY AND DISCRIMINANT VALIDITY OF THE TECO-D IN SPEECH AND LANGUAGE THERAPY AT THE “SAPIENZA” UNIVERSITY OF ROME: A CROSS-SECTIONAL STUDY  
*Iaria Ruotolo, Giovanni Sellitto, Anna Berardi, Giovanni Galeoto, Francescaroberta Panuccio and Andrea Marini Padovani* 139
- A STUDY ON ENHANCING DIGITAL LITERACY AMONG RURAL TEACHERS BASED ON STUDENT DEVELOPMENT NEEDS  
*Yue Zhao and Jiachao Wei* 146
- THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE EMOTIONAL WELL-BEING AND SOCIO-EMOTIONAL SKILLS OF MIDDLE SCHOOL STUDENTS: AN EXPLORATORY STUDY  
*Btissam Guennoun and Omar Akrasi* 153

PROSPECTIVE TEACHER PERCEPTIONS OF MINECRAFT AS A PEDAGOGICAL TOOL FOR FOUNDATIONAL MATHEMATICS AND COMPUTER SCIENCE INSTRUCTION 161  
*Ana Mirković Moguš, Nenad Šuvak and Željko Gregorović*

DEVELOPING SPATIAL NARRATIVE STRATEGIES FOR PANORAMIC VR CULTURAL HERITAGE CONTENT THROUGH PROJECT-BASED LEARNING 169  
*Xuefang Zhang and Yiran Cheng*

## SHORT PAPERS

### *Mobile Learning*

MICRO-LEARNING WITH TIKTOK VS. CLASSROOM INSTRUCTION: DANCE ACQUISITION AMONG PHYSICAL EDUCATION STUDENTS 179  
*Noa Choresh, Avner Caspi and Levi Bar-Gil*

A DESIGN-CENTERED EVALUATION FRAMEWORK FOR KOREAN AS A SECOND LANGUAGE (KSL) MOBILE LEARNING 183  
*Milena Morais de Abreu Elias and Keol Lim*

ANALYTICS-INFORMED MOBILE LEARNING DESIGN-BASED APPROACHES FOR PROFESSIONAL LEARNING 187  
*Bertil P. Marques and Rosa M. Reis*

### *Educational Technologies*

NURTURING DIGITAL LITERACY MOTIVATION: A HUMAN-CENTRED PERSPECTIVE ON TECHNOLOGY AND LEARNING IN MOROCCO 192  
*Karima Slamti*

COMPARING EXPERT AND AI-BASED ASSESSMENTS IN EVALUATING LEARNER KNOWLEDGE 197  
*Mohamad Al Assaad and Houssam Kanso*

AI-POWERED TEACHER ASSISTANCE FOR INCLUSIVE EDUCATION 201  
*Rita Nohra and Mohamad Al Assaad*

UNIVERSITY TRAINING FOR FUTURE SCHOOL TEACHERS AND SENSE OF BELONGING: THE INFLUENCE OF SCHOOL PLACEMENT EXPERIENCE AND RELATIONAL EXPECTATIONS 205  
*Valérie Theric, Hélène Cheneval-Armand and Jenny Rinallo*

RESEARCH ON THE DEVELOPMENT OF A VIRTUAL LECTURE CONTENT RECORDING SYSTEM USING FULL-BODY AND FACIAL EXPRESSION TRACKING WITH MONOCULAR CAMERAS 210  
*Takumi Matsumoto and Shigeru Sasaki*

THE VALUE, PREDICAMENTS AND PATHS OF DIGITAL TRANSFORMATION OF BASIC EDUCATION IN UNDERDEVELOPED COUNTIES FROM THE PERSPECTIVE OF URBAN-RURAL INTEGRATION 215  
*Zhiqi Miao*

## REFLECTION PAPERS

### *Mobile Learning*

- ADAPTATION IN TECHNOLOGY-SUPPORTED LEARNING: REFLECTION  
ON MOBILE LEARNING 223  
*Mia Čarapina and Sebastian Simon*

### *Educational Technologies*

- USING CANVAS DISCUSSION BOARDS TO PROMOTE CLASS  
ENGAGEMENT AND COMMUNITY IN A REMEDIAL COURSE 227  
*Aruna Ullal and Gautam Ullal*

## DOCTORAL CONSORTIA

### *Mobile Learning*

- TOWARD AN INTEGRATED PEDAGOGICAL-ACCESSIBILITY DESIGN  
FRAMEWORK FOR SMARTPHONE-BASED AUGMENTED REALITY  
SIMULATIONS IN PHYSICS MLEARNING: A DOCTORAL RESEARCH  
TRAJECTORY 233  
*Sabine Jamaledine, Bill Kapralos, Asim Butt and Adam Dubrowski*
- EXAMINING AUDIO-BASED PSEUDO-HAPTICS FOR ENHANCING MID-AIR  
INTERACTIONS IN VR 239  
*Nour Halabi, Bill Kapralos, Eva Peisachovich, Pejman Mirza-Babaei and Adam Dubrowski*

## AUTHOR INDEX

# EDU4HEALTH: A TECHNOLOGY-ENHANCED HEALTH EDUCATION THROUGH AUGMENTED REALITY AND GAMIFICATION

Lúcia Pombo, Margarida M. Marques and João Ferreira-Santos  
*CIDTFF—Research Centre on Didactics and Technology in the Education of Trainers  
Department of Education and Psychology, University of Aveiro, 3810-193 Aveiro, Portugal*

## ABSTRACT

The increasing prevalence of mental health challenges among adolescents, such as anxiety, depression, stress, and low self-esteem, has become an urgent educational and public health concern that benefits from multiple stakeholder perspectives. In parallel, digital technologies have reshaped young people's daily lives, influencing how they learn, socialise, and perceive themselves. To address these challenges, a technology-enhanced intervention for schools, based on Augmented Reality (AR) and gamification, was proposed under the Edu4Health project to foster physical, mental, and social well-being among students aged 13–16. Building on the success of the EduPARK and EduCITY projects, Edu4Health aims to co-design digital tools, including an AR-based mobile application (App4Health) and an interactive pedagogical guidebook for teachers. Using a design-based research (DBR) methodology, the project integrates educational innovation, technological development, and community engagement. Preliminary insights were gathered from an exploratory questionnaire (N = 48) administered during the European Researchers' Night 2025 in Aveiro. Preliminary findings show positive public perceptions of mobile applications and gamification in promoting health and well-being, confirming the project's potential to align digital engagement with sustainable Health Education. The results support the development of Edu4Health as a scalable model for technology-supported health promotion and digital literacy in schools.

## KEYWORDS

Mobile Learning, Augmented Reality and Gamification, Health Education, Exploratory Study, Design-Based Research

## 1. INTRODUCTION

In recent years, mental health has become one of the most pressing global challenges affecting adolescents. According to the World Health Organization (WHO, 2021), one in seven adolescents experiences a mental health disorder, with anxiety and depression accounting for more than half of these cases. This growing crisis is closely associated with an increasingly digitalized environment that reshapes young people's communication patterns, self-perception, and learning behaviours (Twenge, 2020). Although digital technologies are often perceived as contributing factors to these problems, they can also serve as transformative tools for learning and behavioural change, when integrated through thoughtful pedagogical design.

Evidence indicates that mobile technologies, when appropriately integrated, can enhance learning motivation, engagement, and self-regulation (Traxler, 2018). In the field of Health Education, digital tools, particularly mobile applications, Augmented Reality (AR), and gamified learning environments, can bridge the gap between health literacy and behavioural change (Goossens et al., 2023). However, school-based approaches often remain outdated, emphasizing content transmission rather than promoting active participation or behavioural transformation. As a result, many adolescents lack the personal and social competences necessary to make informed decisions about their health and well-being.

The success of previous initiatives in exploring outdoor and contextualized learning through mobile AR games, namely the EduPARK (Pombo & Marques, 2020) and EduCITY (Marques et al., 2025) projects, provides a solid foundation for expanding these approaches into the field of Health Education. Building on these experiences, the Edu4Health research and development project seeks to create a technology-enhanced intervention that integrates AR, gamification to promote well-being among adolescents aged 13 to 16. The project's central research question is: How does Edu4Health, a technology-enhanced intervention applied in

schools, based on mobile AR and gamification, promote the development of personal and social competences, active participation, and health-related behaviours in physical, mental, and social dimensions? To address this question, Edu4Health adopts a Design-Based Research (DBR) approach (Plomp & Nieveen (2013) which combines iterative design, empirical testing, and participatory collaboration with educators and students. As part of the initial exploration phase required by DBR, an exploratory study was conducted during the European Researchers' Night 2025, in a Portuguese coastal city. The objective was to collect exploratory data on public perceptions of mobile health applications and expectations regarding the Edu4Health project, providing early design inputs for the app's conceptual and visual development. Accordingly, the study was guided by the following research question: How do participants perceive the potential of mobile applications that integrate AR and gamification in promoting adolescents' health literacy, well-being, and healthy behaviours?

This exploratory work contributes to the foundational phase of the Edu4Health project, helping to validate the conceptual relevance and social acceptance of the technological and pedagogical approach that will be developed. A questionnaire was administered to capture early perceptions and expectations from the public. The findings provide valuable evidence to inform the design principles of the Edu4Health intervention, ensuring that it is pedagogically meaningful, contextually grounded, and responsive to the needs of its target users. In doing so, this paper positions Edu4Health at the intersection of educational technology, health promotion, and youth empowerment, contributing to the advancement of the emerging field of technology-enhanced health and well-being education.

In what follows, the article presents a theoretical framework situating the study within research on digital Health Education, gamification, and AR-based learning. It then outlines the methodological procedures of the exploratory study and discusses the results, highlighting participants' perceptions of digital health applications, expectations regarding the Edu4Health app, and colour associations with health and well-being. The paper concludes by addressing implications for the design of the Edu4Health intervention and directions for future research within the ongoing DBR process.

## **2. THEORETICAL AND EDUCATIONAL FRAMEWORK**

In the modern world, digital technologies have transformed the ways in which young people learn, work, play, and socialise. These lifestyle changes have coincided with a steady rise in mental health problems among adolescents (Zubair, 2023). The digital world provides psychologically vulnerable adolescents with opportunities for social connection and support, as well as a distraction from their mental health problems. Research has shown a strong correlation between social network use and the development of anxiety and other psychological problems, including depression, insomnia, stress, and eating disorders as well as non-suicidal self-injury (Zubair, 2023). Further evidence (Zubair, 2023; Vidhya et al., 2021) suggests that excessive engagement with technology and social networks may contribute to the development of these illnesses. Online social networks have the potential to increase social interactions, but they may also reduce face-to-face communication, which can lead to mental health problems (Zubair, 2023; Vidhya et al., 2021).

Recognition of these potential mental disorders is often passive and in the hands of caregivers, such as parents or educators. However, as there are few significant physical risk factors, patients do not actively seek medical or psychological services. This underscores the urgent need to strengthen mental health awareness and care provision. Prevailing Health Education frameworks used in schools are largely outdated, and there are few available health partners to provide adequate support. Consequently, schools face growing difficulties in addressing the alarming rise of health-related issues prevalent in modern society (Young, et al. 2013).

UNESCO (2023) advocates for improved health and educational outcomes for all learners by fostering school systems that actively promote both physical and mental well-being (Kmic, 2019). Despite the well-documented health benefits of outdoor recreation, young people today are spending significantly less time outdoors (Mann, 2022). To address this concerning trend, technology offers promising opportunities to make outdoor activities more engaging and accessible (Kmic, 2019). For instance, mobile applications developed in previous projects, such as EduPARK (Pombo & Marques, 2020) and EduCITY (Marques et al., 2025), integrate mobile AR technologies with outdoor gaming strategies to encourage physical activity in natural settings. Moreover, urban games featuring outdoor hotspots and AR-based content have demonstrated innovative potential in Health Education, particularly for adolescents (dos Santos et al., 2023). Growing evidence indicates

that strengthening children's connection with natural environments can yield substantial benefits for both their physical and mental health (Mann, 2022).

Building upon these perspectives, the pedagogical design of the Edu4Health project is grounded in constructivist and socio-interactionist learning theories, which highlight the importance of active participation, contextualised learning, and collaborative knowledge construction (Vygotsky, 1978). From this standpoint, learning is viewed not as a passive process of information acquisition but as an active engagement with real-world contexts and social interactions that stimulate reflection and transformation. Within Health Education, this approach encourages learners to interpret, question, and apply health concepts in authentic environments, thereby fostering deeper understanding and sustainable behavioural change (Rowlands et al., 2023).

Edu4Health also draws upon the Self-Determination Theory (Deci & Ryan, 2000), which emphasises the fulfilment of three basic psychological needs (autonomy, competence, and relatedness) as essential for intrinsic motivation and well-being. By incorporating gamification and technology-enhanced learning elements that provide meaningful choices, clear feedback, and opportunities for collaboration, the project seeks to nurture students' self-efficacy and personal agency in adopting healthy lifestyles.

Mobile learning (m-learning) further supports these principles by extending learning beyond the classroom and enabling situated, experiential engagement. AR technologies, in particular, have been shown to enhance students' motivation, conceptual understanding, and retention by embedding abstract content in tangible, interactive contexts (Akçayır & Akçayır, 2023). In Health Education, AR can support the visualisation of physiological processes, simulate health-related scenarios, and cultivate empathy by linking digital information to real-world situations. Recent studies indicate that AR-based interventions can improve adolescents' health literacy, empathy, and decision-making skills (Lampropoulos et al., 2025).

Similarly, gamification, understood as the use of game-design principles in non-game contexts, has demonstrated effectiveness in fostering motivation, behavioural change, and engagement (Gkintoni et al. 2024). Evidence suggests that gamified health interventions can promote physical activity, increase mental health awareness, and support healthy lifestyle choices among young people (dos Santos et al., 2023). For instance, integrating challenge-reward systems and peer collaboration has been found to improve adolescents' emotional well-being and resilience while sustaining participation in health-promoting activities (Ávila et al., 2023).

By synthesising these frameworks (constructivism, self-determination, m-learning, AR, and gamification) Edu4Health proposes an action-oriented pedagogy for Health Education that transcends traditional content-driven models. Through a design-based research methodology, the project iteratively refines its strategies in collaboration with students, teachers, and community stakeholders. This cyclical process ensures that educational interventions remain relevant, context-sensitive, and evidence-informed. Ultimately, Edu4Health aims to empower learners as active co-creators of their health knowledge, bridging the digital and physical worlds to foster both cognitive and emotional dimensions of well-being. Its design-based research methodology ensures iterative refinement based on feedback from students, teachers, and community stakeholders.

### 3. METHODOLOGY

This chapter outlines the methodological procedures that will guide the Edu4Health project, and then presents the procedures conducted in this exploratory study. It includes the research design, context and participants, as well as data collection and analysis.

#### 3.1 Research Design

The methodological framework of Edu4Health is grounded in the principles of DBR, which integrates educational innovation, empirical inquiry and iterative refinement in authentic learning contexts. This approach is particularly suited to projects that seek to bridge theory and practice through successive cycles of design, implementation, evaluation and reflection (Reeves & McKenney, 2021).

The project will evolve through four interconnected phases. The **analysis and exploration** phase will involve reviewing the scientific literature and national and international health and education directives, and

collecting contextual data through field observation in schools and community settings. Key inputs will include stakeholder consultations with teachers, school leaders, health professionals and local partners, as well as focus groups and questionnaires with students and families to capture initial attitudes and expectations. The main input will be a Pedagogical Guidebook to support educators with AR-based activities adaptable to classroom and outdoor learning.

The **design and development** phase will draw on these inputs to co-design the technological and pedagogical components with educators, health specialists and students. This phase will include the development of the *App4Health*, a mobile app that integrates AR content, daily challenges and a virtual “health companion”, a friendly rabbit named *Bravo*, designed to promote healthy behaviours, such as balanced nutrition, regular physical activity, mindfulness, and adequate sleep.

The **implementation and evaluation** phase will pilot the app and related materials in authentic school contexts to assess usability, engagement and educational relevance. Finally, the **reflection and refinement** phase will involve analysing empirical evidence and stakeholder feedback to revise both the theoretical framework and the practical artefacts, informing subsequent DBR cycles. Additionally, an Interactive Action Programme for Schools will be designed to encourage the long-term integration of Health Education within school curricula.

This structured, iterative approach ensures coherence between pedagogical innovation and technological development, supporting the creation of meaningful, evidence-informed and sustainable mLearning experiences for health education.

## 3.2 Context and Participants

In September 2025, the Edu4Health team participated in the European Researchers’ Night event hosted at *Fábrica Centro Ciência Viva de Aveiro*, aiming to engage the public through an interactive experience entitled “The Wheel of Fortune.” The stand showcased activities from the EduPARK, EduCITY and Edu4Health projects, designed to blend entertainment and education. Visitors explored AR markers, played short mobile games, took part in physical challenges, and discussed the role of mobile apps in health promotion.

Participation exceeded expectations, with continuous public interaction throughout the three-hour event. The activity illustrated the project’s broader goal of democratising science through play, encouraging citizens of all ages to reflect on health, well-being, and the constructive use of digital tools. From the stand visitors, 48 participated in this exploratory study, providing preliminary stakeholder perceptions rather than data from the adolescent (13–16) target group. This was a self-selected convenience sample in a public outreach setting, and demographic detail was limited; therefore, representativeness cannot be assumed.

## 3.3 Data Collection Instruments and Procedures

To gather preliminary insights into public attitudes towards digital Health Education, an exploratory questionnaire was administered to 48 voluntary respondents during the event. The instrument captured perceptions of mobile technologies for health promotion and feedback relevant to the future development of the Edu4Health app. It included two sections: Block A (Apps for Health and Well-being) and Block B (Edu4Health App), using a four-point Likert scale (1= strongly disagree; 4= strongly agree).

Data were collected anonymously, in person and then submitted to quantitative and qualitative analysis. Participation was voluntary. Respondents were informed about the study purpose, the anonymous nature of data collection, and their right to decline or stop at any time; informed consent was obtained prior to completion. Minors completed the questionnaire only when accompanied by a parent or legal guardian, who provided consent.

## 3.4 Data Analysis

Survey responses were analysed using descriptive statistics to summarise respondents’ demographic characteristics and levels of agreement with each item. Frequencies, percentages, means and standard deviations were calculated for the Likert-scale items, providing an overview of respondents’ perceptions of health-related mobile applications and expectations for the Edu4Health app. In addition to the closed questions, the questionnaire included one open-ended item asking respondents to indicate the colour they most associated

with health and well-being. These qualitative data were examined through simple categorisation of the responses, identifying the most frequently mentioned colours and their relative frequencies. The analysis aimed to capture intuitive associations between colour and health, which will inform future decisions about the app's visual identity and user-interface design.

All analyses were performed using standard spreadsheet and statistical software, and data were handled anonymously in accordance with ethical research principles. Given the convenience sampling and exploratory purpose, results are reported descriptively and interpreted as indicative rather than generalizable. Accordingly, no learning outcomes are assessed in this exploratory phase.

## 4. RESULTS AND DISCUSSION

This chapter presents and discusses the preliminary results of the exploratory study conducted during the European Researchers' Night. The purpose of this analysis is to examine public perceptions of digital health applications and expectations regarding the future *App4Health* tool.

### 4.1 Perceptions of Digital Health Applications

As shown in Figure 1, participants demonstrated generally positive attitudes towards digital applications related to health and well-being. Mean values for positive items were above 3.0 (A1, A3) on a four-point Likert scale and below 2.0 for negative items (A2, A4), indicating agreement with statements that emphasise the educational and motivational potential of digital tools (A1, A3) and disagreement with those suggesting they are purely recreational or unconcerned with users' well-being (A2, A4). A3 was most endorsed ( $M = 3.71$ ,  $SD = 0.46$ ; 100% agree/strongly agree) and A1 was also high ( $M = 3.27$ ,  $SD = 0.68$ ; 91.67% agree/strongly agree), while A2 ( $M = 1.35$ ,  $SD = 0.60$ ; 97.92% disagree/strongly disagree) and A4 ( $M = 1.67$ ,  $SD = 0.69$ ; 87.50% disagree/strongly disagree) were largely rejected.

The results suggest that, overall, participants recognise the capacity of mobile technologies to support learning about health-related topics and to promote the development of healthy physical and psychological habits. This finding points to a broader public awareness of the constructive role of digital tools in fostering health literacy and behavioural reflection. These outcomes align with the growing literature indicating that mobile learning (mLearning) extends educational opportunities beyond formal contexts, facilitating more situated and personalised engagement with knowledge (Traxler, 2018). Likewise, the perception of motivational value supports findings by Gkintoni et al. (2024), who demonstrate that gamified digital environments can enhance adolescents' engagement, well-being and health-related behaviours.

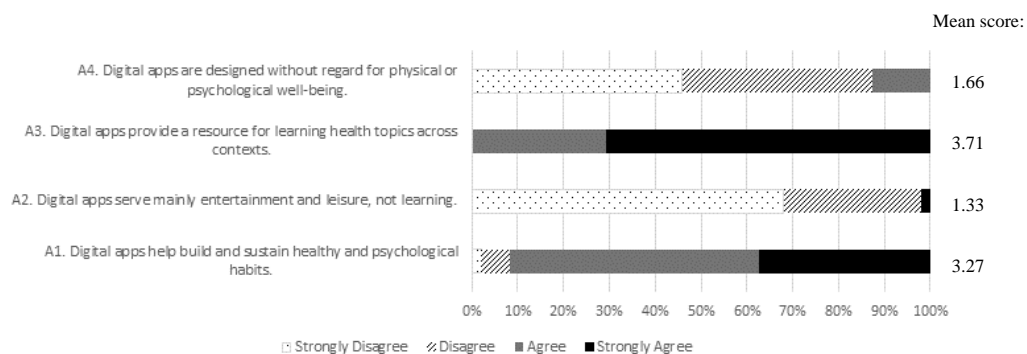


Figure 1. Distribution of agreement responses for statements on digital applications and health promotion (A1–A4)

### 4.2 Expectations Regarding the Edu4Health App

The second part of the questionnaire focused on participants' expectations regarding the proposed App4Health application. Overall, the results revealed consistently positive perceptions, with mean scores above 3.0 (B1 and

B3) on a four-point Likert scale for items formulated positively, and below 2.0 (B2 and B4) for items formulated negatively. Respondents agreed that Edu4Health could support balance and school health literacy (B1, B3) and disagreed that it is merely recreational or ineffective for healthy lifestyles (B2, B4). In descriptive terms, B1 and B3 showed strong endorsement ( $M = 3.50$  and  $3.42$ ; 100.00% and 97.92% agree/strongly agree), whereas B2 and B4 were predominantly rejected ( $M = 1.54$  and  $1.75$ ; 97.92% and 87.50% disagree/strongly disagree). As shown in Figure 2, participants therefore perceived Edu4Health as educationally relevant and supportive of reflection and informed decision-making in everyday learning contexts.

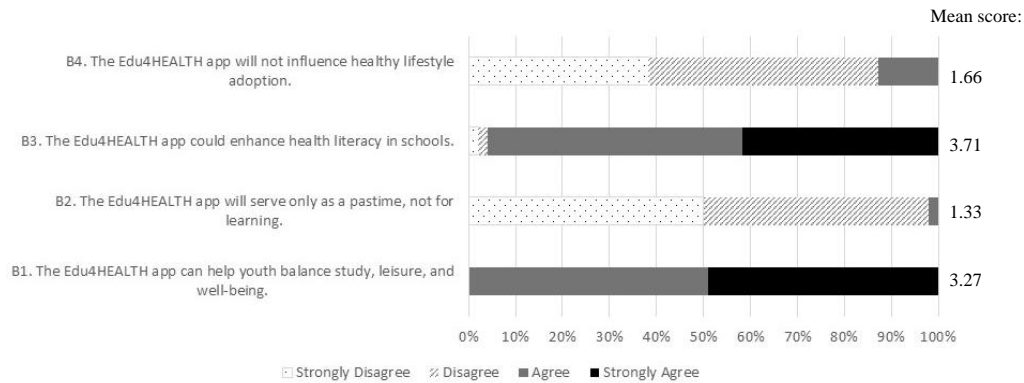


Figure 2. Mean agreement scores for statements on expectations regarding the Edu4Health app (B1–B4)

These findings validate the conceptual direction of the Edu4Health intervention and its emphasis on combining AR, gamification and behavioural feedback to promote well-being. They are consistent with previous research showing that interactive and playful digital environments can foster motivation and behavioural awareness among young learners (Gkintoni et al., 2024). The coherence between the perceptions expressed in Figures 1 and 2 further confirms that most participants view mobile technologies as credible and motivating resources for health education, supporting the project's design-based research (DBR) approach and its iterative, evidence-informed development process.

### 4.3 Colour Associations with Health and Well-Being

The open-ended question on colour associations offered further insight into how participants symbolically link visual elements to health and well-being. Most associated these concepts with green (20 mentions), followed by blue (11), while red (7) and yellow (3) appeared less frequently, and a few respondents suggested softer or pastel combinations. The predominance of green reflects its cultural and psychological association with vitality, balance and nature, whereas blue is commonly linked to calmness, trust and emotional stability. Occasional references to red and yellow may indicate associations with energy, alertness and optimism.

These findings provide clear guidance for the visual identity of Edu4Health, supporting a colour palette that conveys both vitality and emotional balance. They align with established research in colour psychology and health communication, which highlights the role of colour in shaping affective responses and engagement with wellness-related content (Kaya & Epps, 2004), and reinforce the project's aim to create a trustworthy and motivating aesthetic across the app interface and communication materials.

### 4.4 Implications and Future Work

At this stage, the empirical evidence is limited to descriptive analyses of self-reported perceptions and expectations from a non-target convenience sample and does not demonstrate learning outcomes. Nevertheless, the results provide valuable empirical input for the forthcoming design and development stages of the Edu4Health project and offer transferable insights for other educational intervention initiatives. The positive perceptions identified reinforce the project's core premise that mobile, gamified learning environments can effectively support health education and well-being promotion in schools, in line with global priorities for adolescent health literacy emphasised by the World Health Organization (WHO, 2021).

The association of health with colours such as green and blue will inform the visual identity of the App4Health interface, aligning aesthetic choices with users' perceptions of vitality, balance and trust (Kaya & Epps, 2004). In the next phase of the design-based research (DBR) process, these findings will guide the refinement of technological and pedagogical components. The App4Health prototype will be developed and tested with students aged 13–16 to evaluate user experience, engagement and learning outcomes, while feedback from educators and health specialists will inform revisions to the teacher guidebook and school action programme. Future work will incorporate user engagement and usability data to substantiate the intervention's educational efficacy.

## 5. CONCLUSIONS AND FORTHCOMING STAGES

The preliminary findings offer encouraging evidence of public readiness to embrace digital and playful approaches to health and well-being education. Participants demonstrated an understanding that digital applications can have meaningful educational and social impact. This aligns with contemporary literature emphasising the benefits of blended health literacy interventions that merge cognitive learning with behavioural reinforcement (Rowlands et al., 2023; Park et al., 2024). By incorporating AR and gamification, Edu4Health contributes to an emergent trend in which immersive technologies support social learning, motivation and emotional development (Bower et al., 2023).

Moreover, the engagement achieved during the European Researchers' Night illustrates the project's capacity for community-based science communication, which not only disseminates research outcomes but also co-creates knowledge with the public. Such participatory outreach aligns with UNESCO's (2030) Agenda, particularly the goals of Quality Education (SDG 4) and Good Health and Well-being (SDG 3), underscoring the project's social relevance and contribution to sustainable development.

Exploratory studies, such as this, play a crucial role in informing design decisions and methodological planning, as it was demonstrated within the Edu4Health project. By identifying public perceptions, expectations and symbolic associations, the research provides a robust empirical basis for defining priorities in app development, pedagogical content and visual communication strategies. While the small sample ( $n = 48$ ) limits the generalisability of the findings, these exploratory results serve as a valuable baseline for subsequent development and testing. They confirm that the integration of AR and gamified tools resonates with contemporary expectations for experiential, meaningful and socially relevant education. These exploratory perceptions and design implications inform the next DBR cycle.

The Edu4Health project represents a transformative educational innovation that merges pedagogy, digital technology and public health. By employing AR and gamification, it aims to nurture digital literacy, emotional awareness and self-regulated learning while promoting healthier lifestyles among adolescents aged 13–16. The positive attitudes observed among the general public reinforce the relevance of this interdisciplinary initiative, positioning Edu4Health as a prototype for integrating Health Education into school systems through experiential, technology-supported learning. Through iterative cycles of design, testing and reflection, the project is expected to contribute a validated framework for One Health Education, aligning cognitive, behavioural and social dimensions of well-being.

In its forthcoming stages, Edu4Health will focus on co-designing and testing the App4Health prototype in collaboration with teachers and students from partner lower secondary schools, developing AR-enhanced learning experiences addressing key health topics such as nutrition, physical activity, stress management and emotional literacy, and implementing classroom and outdoor pilot studies to evaluate usability, engagement and behavioural impact. Subsequent phases will assess long-term learning gains through mixed-method research and expand dissemination via teacher training and community outreach. Ultimately, the project aspires to establish a sustainable, evidence-based model for digital Health Education that can be adapted nationally and internationally, bridging science, technology and human well-being.

## ACKNOWLEDGEMENT

This work was funded by FEDER - Fundo Europeu de Desenvolvimento Regional funds through the COMPETE 2030 in the framework of the project COMPETE2030-FEDER-00771400.

## REFERENCES

- Akçayır, M. and Akçayır, G. (2023). Augmented reality in education: A meta-analysis, In *Educational Research Review*, Vol. 39, pp. 100512.
- Ávila, M. A., Lopes, F. M. and Barbosa, R. A. (2023). Gamified physical activity interventions and adolescent well-being: A systematic review, In *International Journal of Environmental Research and Public Health*, Vol. 20, No. 3, pp. 1849.
- Bower, M., DeWitt, D. and Lai, J. (2023). Immersive learning technologies and student engagement: Implications for education and well-being, In *Computers & Education*, Vol. 197, pp. 104703.
- Deci, E. L. and Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behaviour, In *Psychological Inquiry*, Vol. 11, No. 4, pp. 227–268.
- dos Santos, T. T., Ríos, M. P., de Medeiros, G. C. B. S., Mata, A. N. S., Silva Júnior, D. N., Guillen, D. M. et al. (2023). Extended reality as a health education strategy for adolescents at school: Protocol for a systematic review and meta-analysis, In *PLOS ONE*, Vol. 18, No. 11.
- Goossens, J., Lamote, S., Byl2, S., & Vyncke, V. (2023). Educational game “GUIDE in Health and Healthcare” to improve health literacy. *International Journal of Integrated Care*.
- Gkintoni, E., Drosos, N. and Anagnostopoulou, V. (2024). Gamification for health promotion: Empowering youth engagement through playful digital learning, In *International Journal of Emerging Technologies in Learning*, Vol. 19, No. 3, pp. 112–123.
- Kaya, N. and Epps, H. H. (2004). Relationship between color and emotion: A study of college students, In *College Student Journal*, Vol. 38, No. 3, pp. 396–405.
- Kimic, K. et al. (2019). The application of new technologies in promoting a healthy lifestyle, In *Baltic Journal of Health and Physical Activity*, Vol. 11, No. 1, pp. 56–67.
- Lampropoulos, G., Fernández-Arias, P., del Bosque, A. and Vergara, D. (2025). Augmented reality in health education: Transforming nursing, healthcare, and medical training, In *Nursing Reports*, Vol. 15, No. 8, pp. 289–302.
- Mann, J. et al. (2022). Getting out of the classroom and into nature: Augmented reality learning for health and well-being, In *Frontiers in Public Health*, Vol. 10, pp. 877058.
- Marques, M. M., Ferreira-Santos, J., Rodrigues, R. and Pombo, L. (2025). Mobile augmented reality games towards smart learning city environments: Learning about sustainability, In *Computers*, Vol. 14, No. 7, pp. 267.
- Nielsen, J., Andersen, T. and Klastrup, L. (2020). Co-designing digital health interventions with adolescents: Lessons from participatory design practice, In *Journal of Adolescent Health*, Vol. 67, No. 5, pp. 678–685.
- Park, E., Lee, S. and Kim, H. (2024). Integrating gamification and behavioural theory for digital health literacy: A systematic review, In *Frontiers in Public Health*, Vol. 12, pp. 145–158.
- Plomp, T. and Nieveen, N. (Eds.). (2013). *Educational Design Research – Part A: An Introduction*, SLO – Netherlands Institute for Curriculum Development, Enschede, The Netherlands.
- Pombo, L. and Marques, M. M. (2020). The potential educational value of mobile augmented reality games: The case of EduPARK app, In *Education Sciences*, Vol. 10, No. 10, pp. 287.
- Reeves, T. C. and McKenney, S. (2021). *Educational Design Research: Principles and Practice*, Routledge, London, UK.
- Rowlands, G., Protheroe, J. and Okan, O. (2023). Health literacy and learning: A global framework for behavioural change, In *Health Education Journal*, Vol. 82, No. 1, pp. 56–70.
- Traxler, J. (2018). Learning with mobiles in the digital age: The changing landscape of mobile learning, In *Interactive Technology and Smart Education*, Vol. 15, No. 3, pp. 255–270.
- Twenge, J. M. (2020). *iGen: Why Today’s Super-Connected Kids Are Growing Up Less Happy and More Lonely*, Simon & Schuster, New York, USA.
- UNESCO. (2023). *Global Report on Teachers Addressing Teacher Shortages*, UNESCO Publishing, Paris, France.
- Vidhya, R. et al. (2021). A comprehensive study on mental health problems caused by online social networks, In *EAI Endorsed Transactions on Pervasive Health and Technology*, Vol. 7, No. 6.
- Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*, Harvard University Press, Cambridge, USA.
- World Health Organization (WHO). (2021). *Global Standards for Health Promoting Schools*, WHO Press, Geneva, Switzerland.
- Young, I. et al. (2013). Health-promoting schools: Working in partnership to address global needs – a collaboration leading to the production of practical tools for practitioners, In *Global Health Promotion*, Vol. 20, No. 4, pp. 35–42.
- Zubair, U. et al. (2023). Link between excessive social media use and psychiatric disorders, In *Medicine Spectrum*, Vol. 5, No. 2, pp. 112–118.