Multimodal Technologies and Interaction

MDPI

Review

Player–Game Interaction in Mobile Games: A Systematic Review of Human–Computer Interaction Research

Nuri Kara

Department of Digital Game Design, Faculty of Communication, Istanbul Bilgi University, Istanbul 34060, Turkey; nuri.kara@bilgi.edu.tr

Abstract

This systematic review examines methodological patterns and interaction themes in empirical research on player–game interaction in mobile games. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidance, 58 journal articles published between 2015 and July 2025 were reviewed. Articles were retrieved from the Web of Science Core Collection and limited to journals in the 2024 SCImago Human–Computer Interaction category. Structured data extraction, descriptive summaries, and inductive content analysis were used. Methodological quality was assessed using the Mixed Methods Appraisal Tool (MMAT), version 2018. Quantitative approaches predominated. Surveys and questionnaires were the most common data collection methods. Descriptive statistics were the most common analysis method. The five themes were: Interface and Interaction Design, Player Experience and Immersion, Social and Contextual Interaction, Player Psychology and Behavior, and Augmented and Location-Based Interaction. Qualitative studies met all assessed quality criteria. Some studies showed limitations or insufficient reporting concerning sample representativeness, control of confounding, randomization, and the quality of mixed-methods components. The synthesis distinguishes usability, enjoyment, continued play, and problematic engagement. Social connections were described as both supportive and demanding across gameplay contexts. These findings support the evaluation of mobile games in relation to game features, intended player groups, and social and physical settings.

Keywords: mobile game; player–game interaction; systematic review; human–computer interaction

1. Introduction

Time spent on mobile games increased by 7.9%, and the number of gameplay sessions increased by 12% in 2024 compared with 2023 [1]. Mobile gameplay also takes place across different physical and social settings [2]. Understanding player–game interaction therefore requires attention to both game systems and the contexts in which people play. In this review, player–game interaction refers to players' actions and experiences in relation to mobile game interfaces, gameplay mechanics, social features, and gameplay contexts. These interactions can involve touch input, device movement, and location-based features [3].

Studies have investigated player interaction with mobile games from multiple perspectives. Ma and Shao [4] found that bonus delay, bonus size, and payment amount

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influenced preferences for delayed payment bonuses. Shi et al. [5] linked game experience and community interaction to user satisfaction through perceived value. Putra et al. [6] examined relationships between gaming addiction and in-app purchase intention in PUBG Mobile. Their model included loyalty, negative electronic word of mouth, and perceived risk as mediators. Dong et al. [7] found greater accuracy with surface gestures in a mobile augmented reality (AR) game. Their Touch–Move–Release gestures received higher engagement and immersion ratings. Óskarsdóttir et al. [8] found that network features improved churn prediction in a free-to-play mobile game. Jang et al. [9] reported that play frequency and social interaction were positively associated with intentions to purchase virtual items. These studies illustrate the range of interaction processes and outcomes examined in mobile gaming research.

Previous reviews provide important foundations for this work. Caroux et al. [10] synthesized 72 empirical articles published between 2000 and 2013. Their review addressed player experience, interface characteristics, game content, and multiplayer interaction in entertainment games. Serious and educational games were excluded from its scope. Chaichitwanidchakol and Feungchan [3] examined research literature and existing mobile games to classify 14 forms of interaction. Their contribution was a categorization of mobile interaction techniques that could inform game design.

Other reviews have organized the literature around particular gameplay contexts and purposes. Kai et al. [11] reviewed pervasive game research through dimensions of design, technology, user experience, and evaluation. Gonçalves et al. [12] combined deductive and inductive coding to examine social gaming experiences, their outcomes, and the methods used to study them. In educational research, Giannakas et al. [13] reviewed mobile game-based learning literature from 2004 to 2016. They applied a framework that included spatial, social, and pedagogical dimensions. Gao et al. [14] focused on mobile game-based learning in STEM education and examined research methods, instruments, and game features. Alongside these reviews, Li et al. [15] discussed psychosocial issues concerning mobile gaming among K–12 students in a position paper.

These studies examine related aspects of player–game interaction, but focus on different platforms, game types, and purposes. A synthesis focused on mobile games is needed to connect findings across these areas and explain how research methods shape their interpretation. This review also includes more recent empirical studies published up to July 2025. The present review combines an analysis of methodological characteristics with an inductive synthesis of interaction themes across mobile entertainment and serious games. It considers research approaches, data collection and analysis methods, and participant samples. This combined focus clarifies what aspects of mobile interaction have been studied and how the supporting evidence has been produced.

The main aim of this study is to conduct a systematic review of empirical research on player–game interaction in mobile games. The review focuses on selected Human–Computer Interaction journal articles retrieved from the Web of Science Core Collection and published between 2015 and July 2025. This review is guided by the following research questions:

(1) What are the methodological patterns in research on player–game interaction in mobile games?
(2) What themes of player–game interaction are addressed in the literature on mobile games?

Conceptual Background

Player–game interaction has been examined from different perspectives within game studies, human–computer interaction, and player experience research. Sweetser and Wyeth [16] proposed the GameFlow model for evaluating player enjoyment through

elements such as challenge, control, and feedback. Research on game user experience has also addressed interface usability and players' experiences of game systems [17,18]. These perspectives connect players' actions with their cognitive, emotional, and social experiences. Recent research has further examined relationships between different aspects of player experience. For example, Fung and Jackson [19] investigated how positive affect and flow relate over time under different challenge conditions. This distinction supports examining specific experiences separately when studying player–game interaction.

In mobile games, player–game interaction is shaped by the features of mobile devices and the settings in which gameplay occurs. Touch input, device movement, connectivity, and location-based features provide different ways of interacting with mobile game systems [3]. Mobile gameplay also takes place across changing physical and social settings [2]. Recent research on an educational AR game illustrates how physical movement and collaboration can form part of players' experiences [20]. Interaction in mobile games can connect on-screen actions with physical activities and social situations. These connections make gameplay contexts relevant to understanding how players engage with mobile game systems.

Building on the definition introduced above, this review focuses on empirical evidence about players' actions, evaluations, and experiences in mobile games. Relevant evidence concerns game interfaces, gameplay mechanics, social features, or gameplay contexts. Motivation and gameplay-related behaviors are considered in relation to these aspects. The scope includes entertainment games and serious games developed for educational, health, or other purposes. Studies focusing on technical development or hardware implementation without examining player interaction or experience are excluded. Gamified non-game applications are also outside the scope. This conceptualization clarifies the boundaries of the review. The thematic categories were developed inductively from the included studies.

2. Methodology

2.1. Literature Search Strategy

The main goal of this study is to conduct a systematic review to analyze and synthesize empirical findings related to player–game interaction in mobile games. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement was used to provide a transparent and accurate review process [21]. No protocol was prepared or registered for this review. The literature search was conducted in the Web of Science Core Collection on 28 July 2025. Web of Science was selected as the sole database because it covers core and prominent journals in human–computer interaction. The search covered the Social Sciences Citation Index (SSCI), Science Citation Index Expanded (SCI-EXPANDED), and Emerging Sources Citation Index (ESCI). A custom publication date range from 1 January 2015 to 28 July 2025 was applied. The search term mobile game was entered without quotation marks in the Topic field, and the results were restricted to the document type "Article." This initial search yielded 7509 records. The term mobile game was entered in the Topic field to identify a broad range of potentially relevant studies on mobile gaming. No additional search terms were used to restrict the search to specific interaction techniques, player outcomes, or game types. The identified studies were screened to determine whether they examined player–game interaction.

A journal-level eligibility criterion was subsequently applied to delimit the review to research published within the Human–Computer Interaction (HCI) literature. The SCImago Journal & Country Rank (SJR) was used for this purpose. The 2024 ranking was selected because it was the most recent ranking available at the time of the literature search. Within SJR, the "Human-Computer Interaction" subject category and the "Only WoS Journals" option were selected. The journals identified through these criteria were

then individually located using the "Publication Titles" filter within the original WoS search, and the search results were restricted to these journals. This procedure reduced the initial set of 7509 records to 280 records for screening. SJR was therefore not used as an additional bibliographic database to retrieve studies, but as a journal-level eligibility criterion for restricting the records retrieved from WoS. This restriction was applied because the study focuses on the interaction between players and mobile games, which is closely aligned with the scope of Human–Computer Interaction research.

2.2. Study Selection Process

Following the application of the journal-level eligibility criterion, 280 records remained for screening. The eligibility criteria were defined to ensure that the selected studies directly addressed player–game interaction in mobile games. The complete inclusion and exclusion criteria are presented in Table 1.

Table 1. Inclusion and exclusion criteria.

Criterion	Inclusion Criteria	Exclusion Criteria
Study type	Empirical studies reporting original research findings	Theoretical or conceptual papers and review articles without empirical data
Game context	Studies investigating mobile games	Studies investigating non-mobile games, non-game applications, or gamified non-game applications
Research focus	Studies examining player–game interaction	Studies that did not directly address player–game interaction in mobile games
Technical focus	Technical studies in which player interaction or player experience was empirically examined	Studies focusing mainly on technical system development or hardware implementation without examining player interaction or experience
Publication type	Journal articles	Publications other than journal articles
Language	English	Languages other than English
Full-text availability	Full text available	Full text unavailable
Publication period	1 January 2015 to 28 July 2025	Publications outside the specified date range
Journal eligibility	Journals included in the 2024 SJR Human–Computer Interaction category with the "Only WoS Journals" option applied	Journals not meeting the predefined journal-level eligibility criterion

Of the 280 records screened, 14 were excluded because they were not published in English. Full texts were sought for the remaining 266 records, but nine could not be retrieved. The remaining 257 reports were assessed for eligibility. During this assessment, 199 reports were excluded. Of these, 84 were theoretical, conceptual, or review papers without empirical data; 61 focused exclusively on technical or hardware development without addressing player interaction; 50 did not directly examine player–game interaction in a mobile game context; and 4 examined gamified non-game applications rather than mobile games. Consequently, 58 studies were included in the final review. The author conducted the initial title and abstract screening and the full-text eligibility assessment using the criteria in Table 1. Two academics independently reviewed the author's inclusion and exclusion decisions at both stages. Their review examined whether these decisions were consistent with the eligibility criteria. Figure 1 presents an overview of the article selection process.

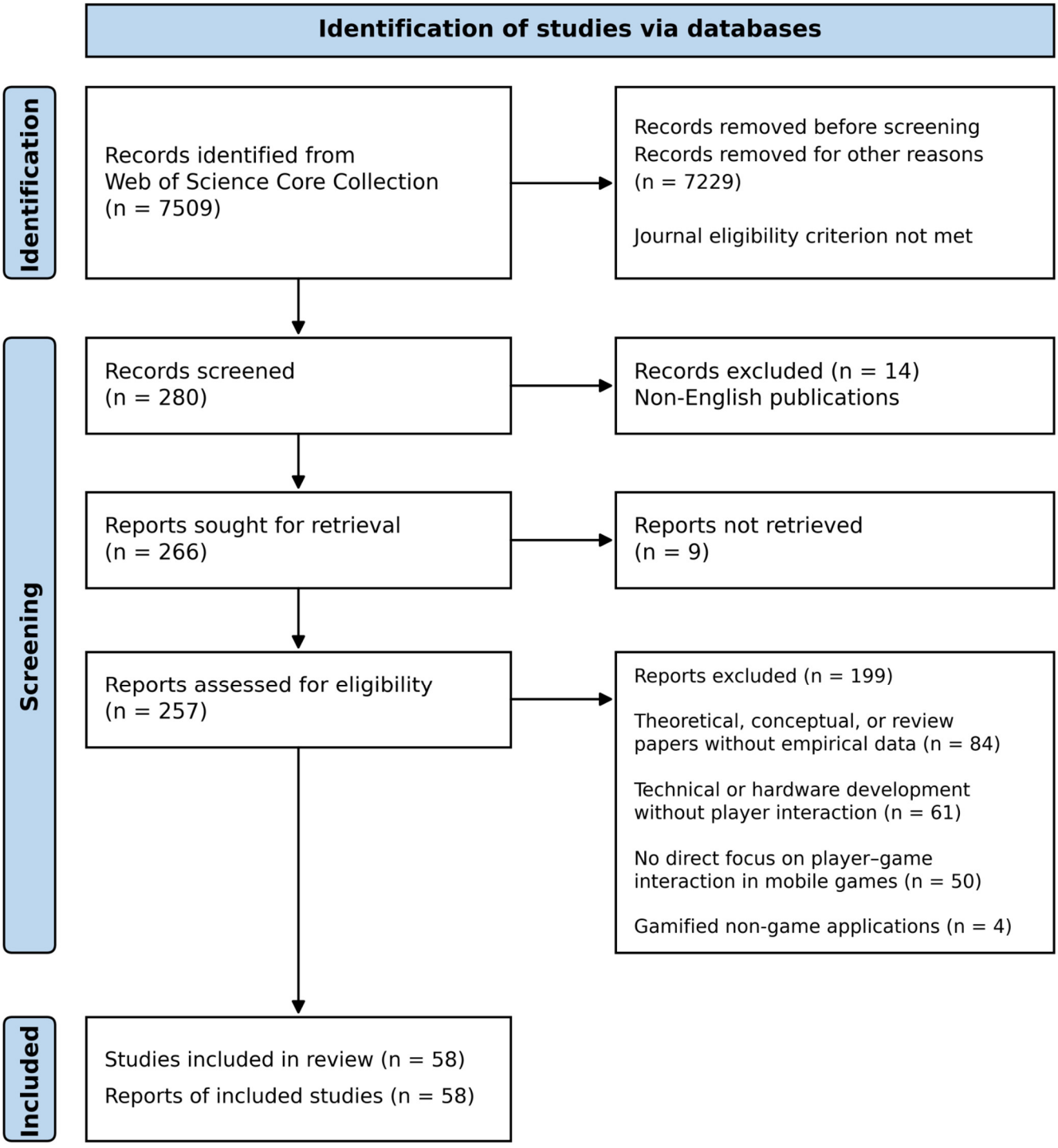

Figure 1. PRISMA 2020 flow diagram of the study selection process. Adapted from Page et al. [21].

2.3. Data Extraction and Analysis

To systematically synthesize the existing literature on player–game interaction in mobile games, a structured data extraction and analysis process was conducted on a final sample of 58 articles. A customized data extraction form was developed to ensure consistency and transparency across all reviewed studies. The data extraction form was developed with the methodological guidance of Büchter et al. [22]. The form included categories, namely subject matter, primary research method, main research question, study goal, main keywords, participant and sample characteristics, main findings, data collection and analysis methods and tools, study domain, publication journal and year, and

examined topics. These categories were selected to capture both the methodological characteristics and the key findings of player–game interaction research.

The review aimed to identify methodological patterns and interaction themes across diverse empirical studies. The included studies differed in their research questions, study designs, gameplay contexts, and outcome measures. A single pooled effect estimate would not address these review questions. Descriptive and thematic synthesis were used instead of meta-analysis. Frequencies and percentages summarized methodological patterns. Inductive content analysis was used to identify interaction themes across studies.

The author performed the data extraction, and the extracted information for each article was manually entered into an Excel spreadsheet using the data extraction form. Methodological patterns were summarized using frequencies and percentages, including research approaches, data collection methods, data analysis methods, sample reporting, and sample size categories. Data collection and data analysis categories were treated as non-mutually exclusive because a single study could employ more than one method or analytical technique. Therefore, the frequencies reported for these categories could exceed the total number of included studies.

An inductive content analysis approach was adopted to identify themes emerging from the reviewed literature. Content analysis is a widely used method in qualitative research for systematically identifying patterns, themes, and categories within textual data [23]. In the context of systematic reviews, content analysis enables the synthesis of diverse empirical findings by categorizing common elements across studies [24]. The author generated initial codes from the extracted research questions, study goals, keywords, findings, and examined topics. Related codes were summarized in a broader category for each study. These categories were reviewed and organized into five final themes. For the thematic frequency counts, each study was assigned to a primary theme based on its main focus of interaction. The main interaction focus was determined from the study's research questions, aims, and main findings. This allowed each study to be counted once when summarizing the distribution of primary interaction topics. The themes could overlap, and studies could address topics relevant to more than one theme. Individual studies could contribute multiple initial codes. The full texts were reviewed to identify secondary themes. A secondary theme was assigned only when it received substantial attention across the article and was supported by detailed findings and discussion. The secondary theme assignments were also checked for consistency with the initial codes. Studies could have more than one secondary theme or none. Supplementary Material S1 presents the initial codes, broader categories, and primary and secondary themes for all 58 included studies. To enhance the trustworthiness of the content analysis, two academics from the Faculty of Communication subsequently reviewed the codes and primary thematic classifications across the included studies to assess whether they were appropriately derived from and consistent with the content of the respective articles. Their feedback was considered by the author and incorporated into the coding and primary thematic classifications where appropriate. As their role involved reviewing the codes and thematic classifications rather than conducting independent parallel coding, inter-rater agreement statistics were not applicable to this review process.

A complete list of the publication journals and the reviewed studies is provided in Appendix A. Appendix B presents the primary thematic classification and methodological characteristics of the reviewed studies.

2.4. Methodological Quality Appraisal

The methodological quality of the 58 included studies was assessed using the Mixed Methods Appraisal Tool (MMAT), version 2018 [25]. This tool was selected because the review included qualitative, quantitative, and mixed-methods studies. Each study was

evaluated using the two screening questions and the criteria appropriate to its research design. Each criterion was rated as "Yes," "No," or "Can't tell." The "Can't tell" response was used when the reported information was insufficient to make a judgment. No overall quality score was calculated, as recommended by the MMAT guidance. The ratings were reported separately for each criterion. The MMAT category and criterion-based ratings for each study are presented in Appendix C.

3. Results

3.1. Methodological Patterns

The majority of studies on player–game interaction in mobile games used quantitative research (n = 35, 60.3%). Mixed-methods (n = 16, 27.6%) and qualitative research (n = 7, 12.1%) were used less often in studies published between 2015 and 2025. Figure 2 presents the data collection methods and sources reported in the included studies. Surveys and questionnaires, including standardized scales and structured rating forms, were the most frequently used methods (n = 48). Interviews and focus groups (n = 15) and observation and walkthroughs (n = 13) were also common. Gameplay logs and performance records were reported in 10 studies, followed by tests and experimental tasks (n = 8) and online reviews and social media content (n = 6). Expert evaluations and feedback (n = 4) and physiological measures and eye-tracking (n = 3) were less common. Two studies used video recordings, and two used documentary sources and update records. Player diaries, participant-created game artifacts, and search trend data were each reported in one study. Each study was counted once within each relevant category. The categories were not mutually exclusive because the included studies could use multiple data collection methods and sources.

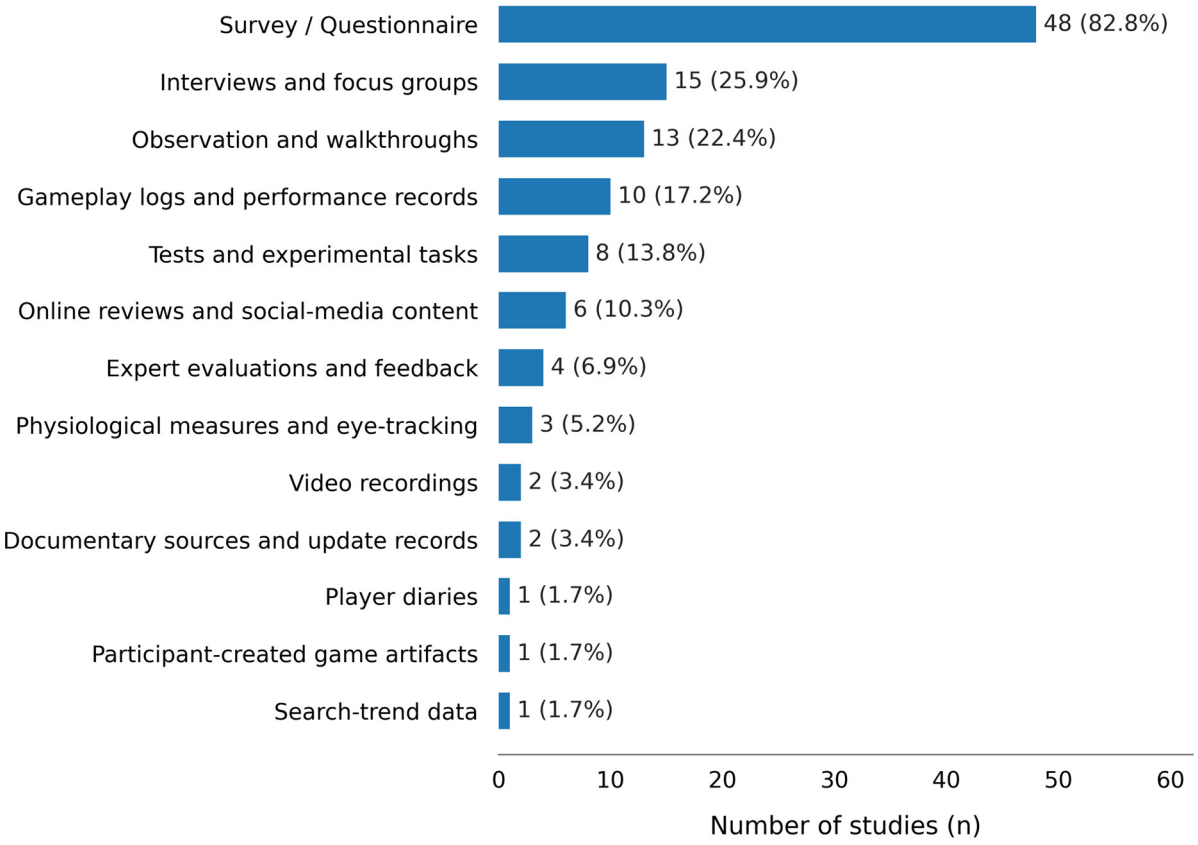

Figure 2. Distribution of data collection methods and sources.

Figure 3 presents the data analysis methods reported in the 58 included studies. Descriptive statistics were the most frequently reported method (n = 36), followed by qualitative coding and interpretation (n = 23). Correlation analysis (n = 19), regression and multilevel models (n = 18), and t-tests (n = 16) were also commonly used. ANOVA and related techniques were reported in 14 studies. Factor analysis (n = 12), structural equation and path modeling (n = 10), and reliability and validity assessment (n = 9) were also reported. Mediation and moderation analysis (n = 8), rank-based nonparametric tests (n = 7), and chi-square tests (n = 6) were less common. Clustering and pattern mining (n = 2) and automated text and sentiment analysis (n = 2) were reported in relatively few studies. Time-series and trend analysis and fuzzy-set qualitative comparative analysis were each reported in one study. The categories were not mutually exclusive because the included studies could use multiple data analysis methods.

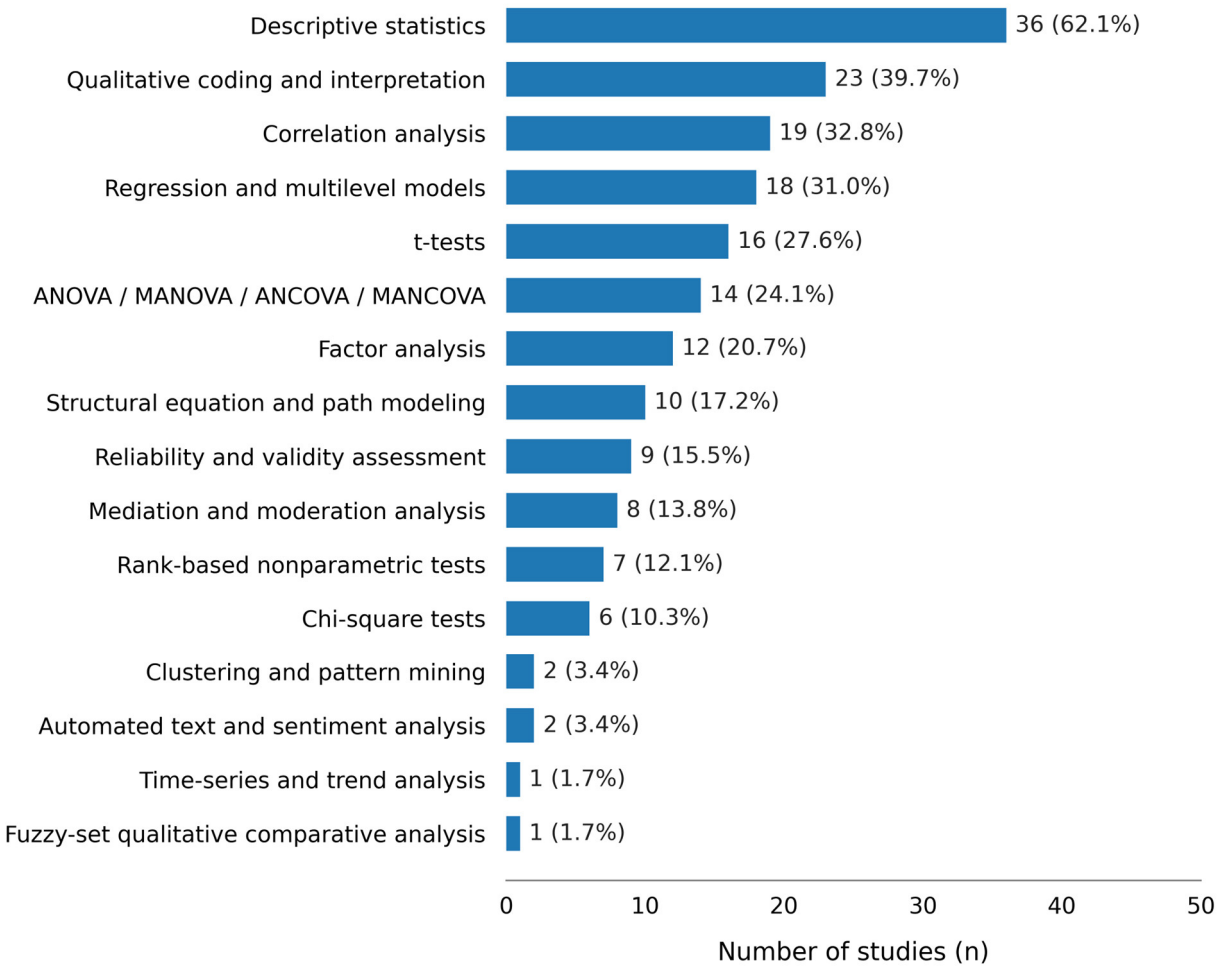

Figure 3. Distribution of data analysis methods.

Figure 4 summarizes the participant samples and sample sizes of the included studies. A single participant sample was identified in 42 of the 58 studies. Ten studies reported multiple participant samples or study phases. Four studies used other record-based samples, and one used player records with a reported user count. Participant counts could not be determined from the extracted information for one study. The sample size distribution in part B of Figure 4 was based on the 42 studies with a single identifiable participant sample. The most common size category was 31–100 participants (n = 10), followed by 301–1000 participants (n = 9). The categories of 101–300 participants and 1001 or more participants each contained eight studies. The 1–30 participant category contained seven

studies. Sample sizes were based on the reported total number of participants or valid questionnaire respondents. Follow-up and analysis subgroups were not added to the total sample size.

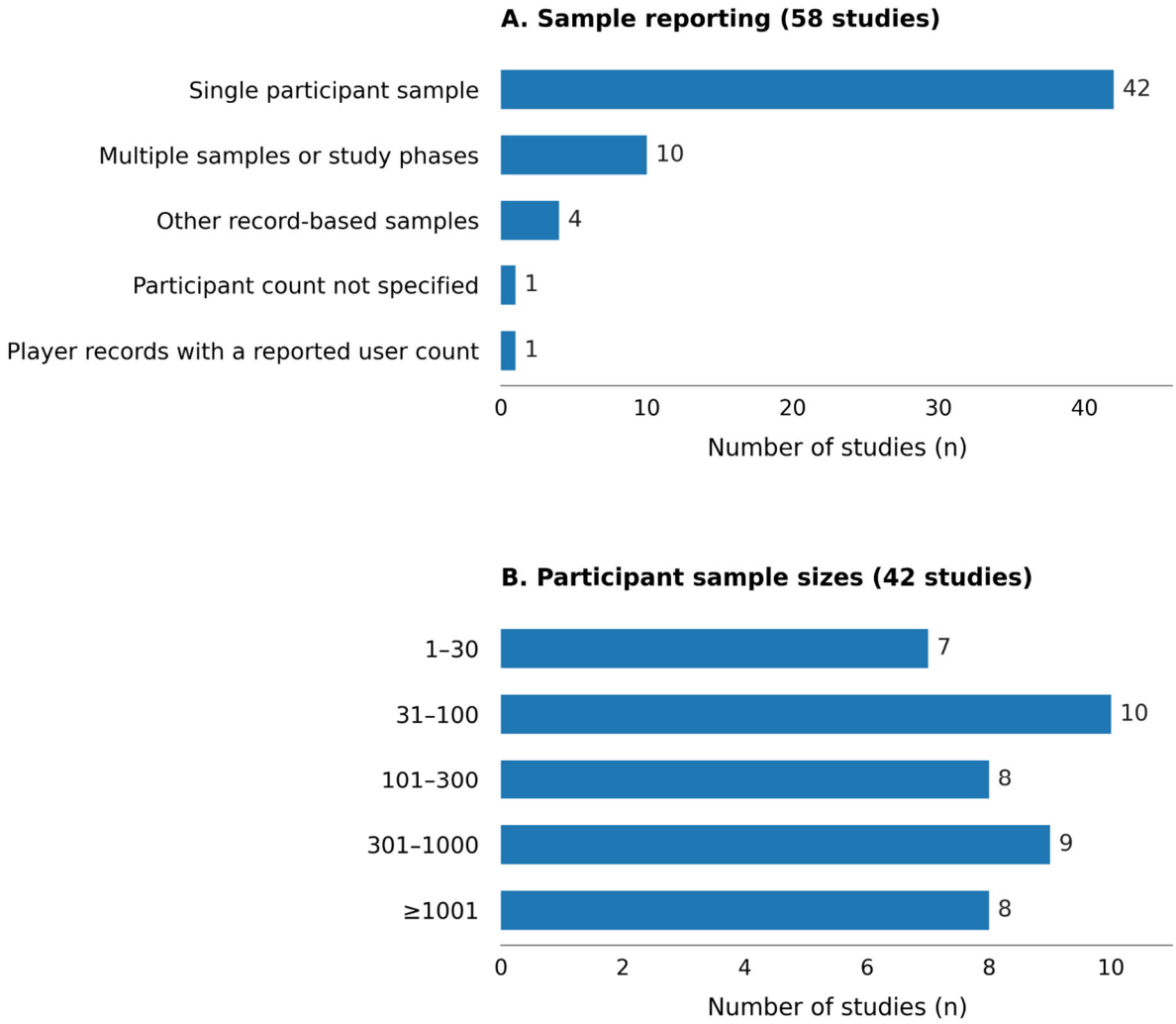

Figure 4. Participant samples and sample sizes.

3.2. Interaction Themes

Five interaction themes were identified. Interface and Interaction Design was the most common primary theme (n = 19, 32.8%). Player Psychology and Behavior followed with 18 studies (31.0%). Augmented and Location-Based Interaction accounted for 9 studies (15.5%). Player Experience and Immersion was identified in 8 studies (13.8%). Social and Contextual Interaction was the least frequently identified primary theme, appearing in 4 studies (6.9%).

Thirty-four studies had one secondary theme, and 11 had two. No secondary theme was assigned to the remaining 13 studies. Table 2 shows the overlaps across all primary and secondary assignments. The diagonal values show the total number of studies assigned to each theme as either primary or secondary. For example, these totals were 29 for Interface and Interaction Design and 31 for Player Experience and Immersion. The most common overlap was between Interface and Interaction Design and Player Experience and Immersion (17 studies). Player Experience and Immersion also overlapped with Player Psychology and Behavior (11 studies) and Augmented and Location-Based Interaction (9 studies).

Table 2. Theme co-occurrence matrix for the 58 reviewed studies.

Theme	T1	T2	T3	T4	T5
T1. Interface and Interaction Design	29	17	3	8	4
T2. Player Experience and Immersion	17	31	4	11	9
T3. Social and Contextual Interaction	3	4	12	6	2
T4. Player Psychology and Behavior	8	11	6	30	3
T5. Augmented and Location-Based Interaction	4	9	2	3	12

3.2.1. Interface and Interaction Design

Studies in this theme examined input and feedback, usability, accessibility, serious-game interfaces, and players' contributions to game design. Experimental comparisons addressed input methods, control schemes, and haptic feedback. Choe and Schumacher [26] found higher ratings of perceived ease of use, usefulness, and concentration with vibration, but no significant difference in enjoyment. Shin and Chung [27] reported higher enjoyment ratings for finger input than for stylus input. Teather et al. [28] found that players preferred touch controls, although combining tilt-based movement with touch-based aiming was also well received. Halloran and Minaeva [29] found that touchscreen evaluations varied with game genre, control implementation, and player background. In a spelling game, simple touch was faster and rated as easier and less effortful than drag-and-drop or point-and-touch [30].

Usability was examined through onboarding experiments, culturally adapted heuristics, and analysis of player reviews. Barnett et al. [31] found that first-time guidance improved perceived information quality, but did not significantly improve overall usability. Muhanna et al. [32] developed heuristics for Arabic mobile games that identified more usability problems, including severe problems, than the two comparison sets. Sim et al. [33] identified different concerns in PC and mobile reviews of Among Us. Mobile reviews indicated chat restrictions, account access problems, network errors, and dissatisfaction with updates.

Two studies focused specifically on design for older adults. Participants in Cota et al. [34] valued opportunities for cognitive exercise and a meaningful game context, while interface problems hindered play. Machado et al. [35] developed age-adapted gameplay heuristics addressing clear goals, feedback, challenge, and visible progress. Accessibility was also examined for players with disabilities. Shohieb et al. [36] recorded longer playing times with adaptive difficulty than with predefined levels among seven children with autism. In the HikePal pilot, street-level pictures helped users with intellectual disabilities navigate, although they often needed reminders to advance the instructions [37].

Interface design was also examined in educational games, hospital preparation, and socio-emotional support. Jamonnak and Cheng [38] reported favorable usability and playability ratings for Little Botany. Pitteri et al. [39] combined visual music representations, contextual information, and questions in a mobile game. Game users obtained higher scores on music questions than participants who listened to the same music without the app. In HospiAvontuur, testing identified difficulties with navigation cues and controls that informed revisions [40]. Participants evaluating the sensor-based story game developed by Tan and Ng [41] generally found it easy to learn and reported interest in its cultural content. In the co-production of ReGoal, young people evaluated its navigation, text, graphics, and interface positively, while also identifying concerns about pacing and level length [42].

Players' contributions to game design were examined through game creation and community feedback. In Gaudl et al. [43], participants modified mobile game mechanics and created playable games through an editable interface. Their evaluations indicated

enjoyment and perceived creativity. Liu and Lai [44] examined how visual, audio, and touch-based interface elements shaped experiences of intimacy in Light and Night. They also documented how player-community feedback informed game updates and interface development.

3.2.2. Player Experience and Immersion

Studies in this theme examined motivation, enjoyment, flow, avatar identification, and experiences with mobile learning games. Motivation and rewards were examined in relation to enjoyment. Baek and Touati [45] found that intrinsic motivation was the only significant predictor of enjoyment among the four factors tested in mobile Minecraft. Enjoyment was also positively associated with performance on the game's construction tasks. Goh et al. [46] compared points, badges, and a non-game version of a mobile crowdsourcing application. Participants gave higher enjoyment ratings to both versions with rewards than to the non-game version. The badge-based version also received higher autonomy and competence ratings than the point-based version.

Flow was examined in relation to player loyalty and intentions to continue playing. In Tower of Saviors, enjoyment and attention focus were positively associated with player loyalty [47]. Both were also linked to human–computer interaction, social interaction, skill, and challenge. Passalacqua et al. [48] found higher perceived flow among non-expert players who received a tutorial. No significant tutorial effect was found among experts or for the physiological indicators of flow. Perceived flow was positively correlated with intention to continue playing.

Game design and playability were linked to enjoyment and avatar identification. Merikivi et al. [49] found that enjoyment predicted intention to continue playing. Ease of use, novelty, design aesthetics, and challenge were positively associated with enjoyment. Li [50] found a positive relationship between playability and avatar identification in mobile role-playing games. Game story was positively associated with perceived similarity, embodied presence, and wishful identification across the three avatar setting groups.

Learning games were examined through gameplay outcomes and participants' evaluations. Paule-Ruiz et al. [51] found higher sound-discrimination scores among preschool children using SAMI than among those using Montessori bells. Interviews highlighted children's interest in the app and preference for the game that allowed free musical composition. Burguera-Bernalte et al. [52] found improved neuroscience knowledge scores in a within-group comparison of NeuroApp users. No significant change was found within the control group. Satisfaction ratings were favorable but came from only eight participants.

3.2.3. Social and Contextual Interaction

Studies in this theme examined group participation, cooperative play, reciprocity, and social connectedness in online and physical settings. Co-located play was examined through device sharing and cooperation. In a museum game, Melero et al. [53] found that students carrying the shared smartphone obtained higher post-test scores than other group members. Questionnaire responses suggested greater attention and participation in four-member groups than in five-member groups. Post-test scores did not differ significantly between these group sizes. Iplikci et al. [54] compared cooperative and solitary versions of a tablet cooking game. Cooperative play involved more positive and neutral conversation. Children also sought and received more help and displayed greater positive affect.

Kim et al. [55] examined group play in Sky: Children of the Light using survey and gameplay data. Greater group play was associated with more reciprocity and higher social capital and social status. In the path model, reciprocity partially mediated the relationship

between group play and social status. Its mediating role was not supported for either bridging or bonding social capital.

Vella et al. [56] examined social connectedness in Pokémon GO through interviews and online forum posts. Players described stronger ties with family and friends and conversations with strangers. They also reported a sense of belonging linked to other players and local places. Outdoor play, integration into everyday routines, and shared passion for the game were identified as facilitators of these connections.

3.2.4. Player Psychology and Behavior

Studies in this theme examined individual differences, continued play, problematic engagement, purchasing decisions, privacy protection, and behavioral patterns. Individual differences were examined through personality traits and epistemic curiosity. Seok and DaCosta [57] found that agreeableness predicted play frequency and duration. However, personality traits explained only a small proportion of variation in gaming behavior. Kim and Lee [58] found that epistemic curiosity was related to perceived switching costs. Continuity and sunk costs were positively associated with intention to continue playing. The association with learning costs was not significant in the overall model.

Problematic play was examined through symptom screening and self-regulation. Seok and DaCosta [59] classified 58 of 1950 players (3%) as showing signs of problematic play under the study's criteria. These players reported more frequent and longer play than nonproblematic players. Chen et al. [60] linked thought suppression to intrusive gaming thoughts and impulsive play. Greater perceived difficulty and lower self-efficacy were associated with less reported reduction in play. Haberlin and Atkin [61] found that Internet addiction scores were positively associated with materialism and negatively associated with social support.

Experimental studies examined challenge and attention. Larche and Dixon [62] found higher flow and urge to play in optimally challenging Candy Crush levels than in easy levels. Stronger escape motives were also associated with more problematic gaming symptoms. Guo et al. [63] used eye tracking with problematic mobile gamers. Participants with high social anxiety fixated sooner on social than non-social game images. Reaction-time measures did not support this bias.

Purchasing decisions involved loyalty, psychological needs, and self-control. Balakrishnan and Griffiths [64] found that gaming addiction scores were positively associated with loyalty and in-game purchase intention. Seo et al. [65] found that favorable attitudes and perceived behavioral control predicted intention to purchase probability-type items. Lower self-control and higher stress were also associated with stronger purchase intention. In Pokémon GO, relatedness and competence were positively associated with play time and spending [66]. Gaming disorder symptoms also correlated with social anxiety and spending.

Monetization and payment design were examined in two further studies. Salehudin and Alpert [67] found that perceived aggressive monetization was associated with a lower likelihood of making in-app purchases. Perceived fairness showed the opposite association. Willingness to spend and play time were positively related to both spending likelihood and spending amount. Ma and Shao [4] found that longer delays reduced preference for delayed payment bonuses. Larger delayed bonuses and higher payment amounts increased this preference.

Design-related pressures were also examined through player accounts. In Empires and Puzzles, Park and Yap [68] linked farming, loot boxes, and raiding to shifts between harmonious and obsessive passion. These shifts were interpreted in relation to waiting periods, cooldowns, and time-limited challenges. Park and Yap [69] linked alliance obligations, randomized rewards, and progressive content releases to frustration of

relatedness, autonomy, and competence. R. Chen et al. [70] identified five dimensions of time investment in players' negative evaluations. These include in-game experience, learning, social interaction, emotional involvement, and economic investment.

Privacy protection formed another aspect of player behavior. H. Chen et al. [71] found that privacy concerns and self-efficacy were positively associated with teenagers' privacy protection practices. Perceived benefits of disclosing information were negatively associated with these practices. Behavioral profiles were identified through survey analysis and gameplay records. Liao et al. [72] identified three profiles among Taiwanese players: competitive gamers, drama gamers, and friends and family gamers. Sequence mining and expert-guided clustering identified eight tactic groups in Bloons TD Battles [73].

3.2.5. Augmented and Location-Based Interaction

Studies in this theme examined AR presentation, learning in physical settings, motivations for location-based play, and the integration of gameplay into everyday life. Sekhavat and Zarei [74] compared three versions of Ladybug. Both AR versions received higher overall immersion ratings than the version using the regular VR camera. Overall immersion did not differ significantly between the two AR versions. Stereoscopic AR scored higher than single AR on the combined emotional involvement and enjoyment measure.

Location-based learning studies examined educational outcomes and practical difficulties. Chang et al. [75] found higher English achievement with rule-based pervasive gameplay than with mobile inquiry-based learning at a cultural site. Cognitive load did not differ significantly between the groups. In EduPARK, students valued outdoor learning, social interaction, and immediate feedback [76]. They also reported difficulties with navigation and finding AR markers. In NoCredit, GameOver!, visiting real-world organizations was positively associated with team performance [77]. Navigation activity showed a negative association with team performance.

Three questionnaire studies examined motivations and gratifications in Pokémon GO. Chen et al. [78] found that serendipity was positively associated with gratification. Gratification was positively associated with stickiness, measured as continued-play intention. The direct path from flow to stickiness was not significant. Hamari et al. [79] found positive associations between continued-play intention and enjoyment, challenge, outdoor activity, nostalgia, and ease of use. Malik et al. [80] found that female respondents reported higher enjoyment and physical-exploration gratification than male respondents. Enjoyment and physical exploration did not differ significantly across age groups.

Other studies examined everyday contexts and changes in game design. Alavesa and Xu [81] analyzed social media images showing Pokémon GO gameplay alongside commuting, shopping, and dog walking. The images also showed creative combinations of virtual Pokémon and physical surroundings. Liu et al. [82] used Google Trends data as a proxy for player activity. Selected feature additions and quality-of-life updates coincided with increases or stabilization in the search-based trend. These patterns informed their proposed "complete game strategy" for Geo-AR games.

3.3. Results of the Methodological Quality Appraisal

The MMAT results are presented in Appendix C. All 58 studies met both screening criteria. The seven qualitative studies met all five criteria for their design. Among the five studies classified as randomized controlled trials, randomization was rated "Can't tell" in all five. Outcome-assessor blinding was rated "No" in one and "Can't tell" in four. Two studies did not meet the criterion for complete outcome data. Among the 27 quantitative non-randomized studies, sample representativeness was rated "No" in four and "Can't tell" in eight. Control of confounding was rated "No" in three and "Can't tell" in eight.

All 27 studies met the criterion for appropriate measurements. Among the three quantitative descriptive studies, sample representativeness was rated "Can't tell" in two, and the risk of nonresponse bias was rated "Can't tell" in two. All three met the criteria for relevant sampling strategies, appropriate measurements, and appropriate statistical analysis. All 16 mixed-methods studies met the criteria concerning the rationale for combining methods, integration, interpretation, and handling of divergent findings. However, the criterion concerning the quality of the individual components was rated "No" in seven studies and "Can't tell" in five. The remaining four studies met this criterion.

4. Discussion

Previous reviews have examined player–video game interaction in entertainment settings [10], classified mobile interaction techniques [3], or focused on pervasive, social, and educational gaming [11–14]. The present review complements this work by synthesizing evidence on mobile entertainment and serious games from the selected HCI journal literature. Its contribution is to interpret the five inductively developed interaction themes alongside the methods used to investigate them. The synthesis distinguishes usability, enjoyment, and continued play as related but different outcomes. It also explains why social and physical settings matter when interpreting these outcomes. Examining the methods used helps distinguish reported experiences and intentions from evidence of actual play.

4.1. Methodological Patterns

Quantitative research was the dominant approach, and surveys and questionnaires were the most common data collection methods. The reviewed studies often relied on players' reported evaluations and intentions. Several studies examined intentions to continue playing or to make purchases across themes of player experience and immersion, player psychology and behavior, and augmented and location-based interaction. Such measures do not establish whether these intentions were followed by actual behavior. Gameplay records offered complementary evidence about group play and player tactics. Similar methodological patterns appeared in earlier research. Caroux et al. [10] found that surveys were commonly used to examine player factors such as engagement and enjoyment. Wiemeyer et al. [83] described subjective, behavioral, and physiological methods for examining player experience. Combining these methods can help distinguish reported experiences from behavioral and physiological responses.

Qualitative research was the least common approach, but mixed-methods studies included qualitative data. Interviews, online observations, and forum posts provided accounts of social support and obligations within game communities. Analysis of social media images showed how location-based play formed part of everyday activities. These findings connect themes of social and contextual interaction, player psychology and behavior, and augmented and location-based interaction. As Engl and Nacke [2] highlighted, mobile player experience is shaped by spatial, temporal, and social influences. Qualitative methods helped explain how players experienced these social relationships and everyday gameplay settings.

In data analysis, descriptive statistics were the most common method. Correlation, regression, and structural equation and path modeling were also used to examine relationships between game evaluations and player outcomes. Understanding these relationships requires attention to what each measure captures. Vanden Abeele et al. [84] developed and validated the Player Experience Inventory to measure functional and psychosocial consequences. They also examined how these dimensions related to enjoyment. This distinction helps separate evaluations of controls and feedback from experiences such as immersion and mastery. Participant characteristics also need to be considered. The

samples included children using educational games, older adults evaluating mobile game interfaces, and experienced players of specific games. Findings should be interpreted in relation to participants' age, gaming experience, and the games studied.

4.2. Interaction Themes

The thematic analysis showed that player–game interaction in mobile games was examined in relation to interface design, player experience, social context, psychological processes, and augmented reality and location-based technologies. These findings suggest that interaction in mobile games involves relationships among players, game systems, and gameplay environments. This interpretation is consistent with the view in game studies and human–computer interaction that player experience emerges from the interplay between system design, user characteristics, and contextual factors. As Nacke and Drachen [18] highlighted, player experience involves cognitive, emotional, and social components arising from interaction between players and game systems. The most frequent overlaps involved player experience. Studies examined input methods alongside enjoyment [27], enjoyment alongside player loyalty [47], and AR presentation alongside immersion [74]. These examples show how questions about game design and technology connect with questions about players' experiences and responses. The secondary themes make these connections visible while preserving each study's main focus.

One important finding from the reviewed studies is that player–game interaction involves both technical usability and subjective experience. The findings suggest that improvements in specific aspects of interaction do not necessarily indicate better overall usability [31]. Broader game research also illustrates this distinction. In a study of older adults, meaningful narrative choices were associated with higher interest and enjoyment ratings without a significant difference in usability [85]. Another key finding from the reviewed studies is that intrinsic motivation and challenge were related to enjoyment, flow, and the urge to play [45,62]. These findings can be interpreted through Self-Determination Theory, which identifies autonomy, competence, and relatedness as basic psychological needs relevant to motivation [86]. However, relationships between experiential outcomes can also vary over time. Fung and Jackson [19] found that positive affect was negatively associated with subsequent flow under optimal challenge conditions. These findings support evaluating usability, enjoyment, and flow as related but distinct outcomes. Positive experiences during play should not be equated with sustained engagement.

Another major finding is that player–game interaction is closely linked to psychological and social processes. The reviewed literature showed relationships between player behavior, motivational needs, emotional engagement, and reward structures. While some studies associated social interaction with belonging, others described social obligations and frustration of psychological needs [56,69]. These findings suggest that social connections can be experienced as both supportive and demanding across different gameplay contexts. Research beyond mobile gaming also highlights the importance of distinguishing forms of engagement. Formosa et al. [87] found contrasting indirect associations between game-based need satisfaction and problematic play among players experiencing stressful life circumstances. The association was negative through harmonious passion and positive through obsessive passion. The findings on problematic engagement can also be interpreted through the I-PACE model. This framework emphasizes interactions between reinforcement, affective and cognitive responses, and self-control in addictive behaviors [88]. The findings on monetization and payment bonuses further suggest that purchasing decisions involve perceived fairness and preferences regarding bonus size and delay [4,67]. These purchasing outcomes should be distinguished from problematic gaming symptoms when interpreting the psychological implications of mobile game design.

Finally, the reviewed studies show that augmented and location-based interaction connects digital gameplay with physical environments. Mobile games can integrate movement, location, and real-world social interaction into gameplay [79,81]. This creates opportunities for immersion and situated learning. However, the reviewed studies also identified difficulties with navigation and locating AR content [76]. These findings suggest that the value of physical settings depends partly on how they are connected to gameplay tasks. As Gee [89] and Plass et al. [90] suggested, games can support learning by presenting information within meaningful contexts of use. Recent research further highlights the practical conditions of these experiences. Pupils' accounts of outdoor AR play described valued opportunities for movement and collaboration alongside difficulties with environmental distractions and shared devices [20]. Reports of map inaccuracies and delayed location updates also highlight the importance of reliable navigation support in location-based games [91]. These findings suggest that physical surroundings and participation arrangements should be considered alongside on-screen interaction when designing mobile games that connect digital and physical activities.

The MMAT appraisal informs the interpretation of these themes (Appendix C). The qualitative studies met all assessed criteria. Some quantitative studies had limitations or uncertainties concerning sample representativeness and control of confounding. Reporting of randomization was insufficient in the studies classified as randomized trials. The quality of individual components was also limited or unclear in several mixed-methods studies. These issues warrant caution when generalizing findings across player groups or attributing outcomes to specific game features. Theme frequencies indicate the distribution of research topics and should not be interpreted as measures of evidence strength.

4.3. Limitations and Future Directions

This study has several limitations. First, the review was restricted to English-language journal articles retrieved from the Web of Science Core Collection. Eligible journals also had to meet the 2024 SJR Human–Computer Interaction criterion. Conference papers and non-English publications were excluded. Relevant studies published in journals outside the eligible set or indexed only in other databases may also have been missed. Second, the search relied on the term mobile game, so studies using different terminology may have been missed. Articles whose full texts could not be obtained were also excluded. The findings represent a selected body of literature up to 28 July 2025. These restrictions may have affected which research methods and interaction themes were represented. The reported frequencies describe the selected studies and should not be generalized to all research on player–game interaction in mobile games. Third, initial screening, data extraction, and coding were conducted by the author. Two academics reviewed the study selection process and the codes and primary thematic classifications. However, data extraction by a single researcher leaves a risk of undetected errors. Independent parallel coding was not performed. It remains uncertain whether other researchers would independently produce the same codes and thematic classifications. Fourth, primary theme counts describe each study's main focus. Secondary themes and the co-occurrence matrix show overlaps, but they do not capture every topic addressed in the articles. Fifth, no protocol was prepared or registered for this review. This may have increased the risk of post hoc methodological decisions. Finally, themes were not compared across publication years.

Future reviews should address these limitations by expanding database coverage and including relevant conference proceedings. Search strategies should incorporate alternative terms for mobile games and specific forms of interaction. Independent screening and coding could strengthen reproducibility. Comparisons across publication periods could also clarify changes in research methods and thematic priorities. Future empirical studies could combine repeated questionnaires, gameplay logs, and interviews to

examine whether enjoyment and flow are followed by continued play. Purchasing intentions and payment preferences should also be examined alongside actual spending and problematic gaming symptoms. Accessibility research could build on existing studies involving older adults and players with disabilities by evaluating designs across different games and settings. Studies could examine how navigation support and device access influence participation and learning for location-based and shared-device play.

4.4. Theoretical and Practical Implications

This review provides several theoretical implications. First, it brings together research on interface design, player experience, social context, psychological processes, and augmented and location-based interaction. The five themes identified in this review provide a structure for examining connections across these areas. The synthesis highlights the need to distinguish usability, enjoyment, continued play, and problematic engagement. It also suggests that explanations of player–game interaction should consider social expectations and physical settings alongside game features and psychological needs. These distinctions may inform future theory-building across human–computer interaction, game studies, psychology, and educational technology.

The review also provides practical implications for designers, developers, and instructors. For game designers and developers, the findings support testing controls, feedback, and navigation with the intended player groups. Usability and enjoyment should be assessed separately when evaluating design alternatives. Accessibility evaluations should also address the difficulties experienced by older adults and players with disabilities. Monetization and social features should be assessed in terms of perceived fairness, spending pressure, and obligations to continue playing. For instructors and serious game designers, the findings highlight the importance of navigation support and device-sharing arrangements in educational AR and location-based mobile games.

5. Conclusions

This study presented a systematic review of 58 empirical studies on player–game interaction in mobile games published between 2015 and 2025. The findings showed that quantitative approaches were the most common in the reviewed literature. Surveys and questionnaires were the most frequently used data collection methods, followed by interviews and focus groups. Descriptive statistics were the most common data analysis method. Qualitative coding and interpretation were also common. The thematic analysis identified five major themes: Interface and Interaction Design, Player Experience and Immersion, Social and Contextual Interaction, Player Psychology and Behavior, and Augmented and Location-Based Interaction. The findings suggest that player–game interaction should be examined in relation to game features, players' experiences, and social and physical settings. The synthesis highlights the importance of distinguishing usability, enjoyment, continued play, and problematic engagement. This review provides a structured overview of these research areas and can inform the evaluation of mobile games across different player groups and gameplay contexts.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/mti10120127/s1, Supplementary Material S1: Initial codes, broader categories, and primary and secondary themes for the 58 included studies. Supplementary Material S2: Completed PRISMA 2020 checklist.

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Data Availability Statement: The reviewed studies and their publication journals are listed in Appendix A. The study characteristics and extracted methodological information are provided in Appendix B. The methodological quality ratings are provided in Appendix C, and the coding framework is provided in Supplementary Material S1.

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Conflicts of Interest: The author declares no conflicts of interest.

Appendix A. Publication Journals of the Reviewed Studies

Table A1. Publication journals of the reviewed studies.

Journal	Number of Studies	Articles (Authors, Year)
Computers in Human Behavior	16	Baek & Touati (2017) [45]; Balakrishnan & Griffiths (2018) [64]; Chen et al. (2018) [78]; Chen et al. (2019) [60]; Cota et al. (2015) [34]; Goh et al. (2017) [46]; Guo et al. (2024) [63]; Haberlin & Atkin (2022) [61]; Huizenga et al. (2019) [77]; Kim & Lee (2017) [58]; Kim et al. (2022) [55]; Larche & Dixon (2021) [62]; Melero et al. (2015) [53]; Merikivi et al. (2017) [49]; Shin & Chung (2017) [27]; Su et al. (2016) [47]
Entertainment Computing	13	Anderson & Falconer (2025) [73]; Barnett et al. (2018) [31]; Burguera-Bernalte et al. (2025) [52]; Gaudl et al. (2018) [43]; Halloran & Minaeva (2019) [29]; Lemmens & Weergang (2023) [66]; Liu et al. (2023) [82]; Ma & Shao (2025) [4]; Pitteri et al. (2021) [39]; Shohieb et al. (2022) [36]; Sim et al. (2025) [33]; Teather et al. (2017) [28]; Torrado et al. (2022) [37]
International Journal of Human–Computer Interaction	8	R. Chen et al. (2024) [70]; Choe & Schumacher (2015) [26]; Hamari et al. (2019) [79]; Holz & Meurers (2021) [30]; Iplikci et al. (2024) [54]; Liao et al. (2025) [72]; Sekhavat & Zarei (2018) [74]; Tan & Ng (2024) [41]
Behaviour & Information Technology	6	Alavesa & Xu (2022) [81]; H. Chen et al. (2024) [71]; Livanou et al. (2025) [42]; Park & Yap (2025) [69]; Paule-Ruiz et al. (2017) [51]; Vrancken et al. (2021) [40]
Games and Culture	4	Liu & Lai (2024) [44]; Seok & DaCosta (2015) [57]; Seok & DaCosta (2018) [59]; Vella et al. (2019) [56]
Universal Access in the Information Society	3	Chang et al. (2017) [75]; Li (2025) [50]; Malik et al. (2020) [80]
International Journal of Computer Games Technology	3	Jamonnak & Cheng (2017) [38]; Machado et al. (2018) [35]; Muhanna et al. (2022) [32]
Electronic Commerce Research	2	Park & Yap (2025) [68]; Salehudin & Alpert (2024) [67]
Multimodal Technologies and Interaction	1	Passalacqua et al. (2020) [48]
Interaction Design and Architecture(s) Journal	1	Pombo et al. (2017) [76]
Interacting with Computers	1	Seo et al. (2019) [65]

Appendix B. Primary Thematic Classification and Methodological Characteristics of the Reviewed Studies

Appendix B.1. Theme 1. Interface and Interaction Design

Table A2. Study characteristics for Theme 1.

Study	Year	Research Approach	Data Collection Methods	Data Analysis Methods	Participants/Sample	Main Focus
Choe & Schumacher [26]	2015	Quantitative	Mobile gameplay experiment; pre/main questionnaire; software-recorded gameplay performance (survival time)	Descriptive statistics; Cronbach's alpha; independent-samples t-test; two-way ANOVA; Tukey HSD post-hoc comparisons	All 70 participants were Chinese smartphone owners aged 18–30 (35 female, 35 male)	Effects of vibration presence, intensity, and length on perceived ease of use, perceived usefulness, perceived enjoyment, cognitive concentration, and gameplay performance
Cota et al. [34]	2015	Mixed methods	Gamebook preference ratings; direct smartphone gameplay; questionnaire; audio-recorded semi-structured interviews	Wilcoxon signed-rank test; Friedman test; Mann–Whitney U test; descriptive analysis and qualitative interpretation of interview responses	Gamebook stage: n = 26 older adults (19 women, 7 men), ages 60–76. Smartphone-game evaluation: n = 10 (5 women, 5 men), ages 60–69.	How game genres and specific design features including cognitive exercise, narrative/context, rewards, difficulty, and usability shape older adults' motivation to play mobile games.
Jamonnak & Cheng [38]	2017	Quantitative	Repeated mobile gameplay over three weeks; usability questionnaire; playability questionnaire	Descriptive analysis of 5-point Likert ratings and mean scores	N = 28 school-aged children (12 female, 16 male)	Usability and playability of Little Botany, including UI layout, navigation, controls, feedback, rewards, challenge, and the integration of real-world location/weather data
Shin & Chung [27]	2017	Mixed methods	Commercial mobile gameplay (Monument Valley) using finger and stylus; immediate closed-ended online questionnaires; four-week delayed closed-ended and open-ended questionnaires	Three-way repeated-measures MANOVA; independent-samples t-test; Bonferroni-adjusted paired t-tests and follow-up univariate tests; Pearson correlations; content analysis of 347 open-ended responses into 44 subordinate and 14 superordinate characteristics	N = 80 undergraduate and graduate students recruited for the immediate evaluation (32 male, 48 female); N = 78 returned after four weeks and were retained for delayed analysis (31 male, 47 female), ages 17–32.	Effects of finger-touch versus stylus input, story-based knowledge, and time on ergonomic quality, hedonic quality, appeal, enjoyment, and remembered gameplay experience

Teather et al. [28]	2017	Quantitative	Instrumented gameplay/performance logs; high-frequency position/orientation/tilt/touch logs; post-experiment 5-point subjective questionnaire	Repeated-measures ANOVA; Bonferroni-Dunn post-hoc comparisons; Friedman tests for subjective ratings; Conover post-hoc comparisons	N = 16 paid regular gamers (13 male), ages 19–34 (mean 22.6, SD 4.1); all reported weekly experience with dual-analog physical or mobile virtual controls.	Performance and user-experience consequences of combining touch and device-tilt input for movement and aiming in a dual-analog mobile shooter
Barnett et al. [31]	2018	Quantitative	Timed gameplay of Super Mario Run and Linia with or without their existing FTUE guidance; adapted 11-item IBM PSSUQ after each game	Descriptive comparisons; retrospective power analysis; Mann–Whitney U tests for overall and usability subscales	N = 20 volunteers of mixed gender; all were unfamiliar with both games.	How first-time-user-experience guidance and information affect overall usability, system use, information quality, and interface quality in mobile games
Gaudl et al. [43]	2018	Mixed methods	90-min rapid game-jam participation with Wevva; paper visual-analogue-scale survey; participant-created/saved game artifacts; participants also played and critiqued each other's games	Descriptive survey analysis; Pearson correlations/significance testing; bottom-up iterative coding/classification of 72 saved games by primary/secondary mechanics and design exploits	Four rapid game jams involved 105 Girlguiding participants overall. Quantitative survey analysis used n = 69 participants from two jams; qualitative artifact analysis examined 72 participant-saved games.	How users interact with editable mobile 'fluidic games' to explore a design space, modify mechanics, create playable games, and experience creativity, enjoyment, and interface familiarity
Machado et al. [35]	2018	Mixed methods	Study 1: direct mobile gameplay and questionnaires; validation with five mobile games by older adults and expert heuristic evaluators. Study 2: demographic questionnaire, Trail Making test, 15-day Labuta Batuta gameplay, player diaries, and semi-structured interviews	Study 1 comparison of older-adult and expert heuristic findings/problem counts; Study 2 Grounded Theory using line-by-line, focused, axial, and theoretical coding with diary/interview triangulation	Study 1 phase 1: n = 30 older adults (18 women, 12 men; mean age 67, range 60–92). Study 1 phase 2: 4 of those older adults plus 4 expert evaluators. Study 2: 10 new participants recruited, 8 completed (6 men, 2 women; mean age 63).	Age-sensitive gameplay heuristics and mobile-game mechanics for older adults, including challenge, feedback, objectives, autonomy, immersion, learning, progression, mobile-device interaction, and enjoyment

Halloran & Minaeva [29]	2019	Quantitative	Gameplay of comparable games across touchscreen, console, and/or PC; pre-test gaming-background/preference questionnaire; post-play ratings of ease of controls, ease of task completion, and satisfaction; participant comments and researcher observations	Repeated-measures ANOVA with pairwise comparisons; paired-samples t-tests where applicable; correlations; linear regression; post-hoc one-way ANOVA across touchscreen genres; interpretation of participant comments	Pilot: n = 5 (ages 20–25). Four subsequent within-subject experiments involved mostly university students. Experiment 1: n = 14; Experiment 2: n = 18 in Methods and 19 in Results; Experiment 3: n = 20; Experiment 4: n = 21 in Methods, although one Results statement reports 20.	How touchscreen controls, platform affordances, porting/design choices, genre, and player background interact to shape ease of control, ease of task completion, and satisfaction
Holz & Meurers [30]	2021	Quantitative	Tablet-based gameplay tasks, questionnaires, preference rankings, recorded writing times, researcher observations, and open-ended feedback.	Descriptive statistics; linear mixed-effects models fitted by REML with pairwise contrasts and interaction tests; Pearson's chi-squared tests; post hoc Wilcoxon rank-sum tests; and residual diagnostics, using R.	N = 25 German children aged 8–11 (14 boys, 11 girls; mean age 9.9, SD = 0.57), including 8 with developmental dyslexia. Some workload and writing-time analyses used n = 24 because of missing data.	How drag-and-drop, point-and-touch, and simple touch affect workload, user experience, preference, and writing performance in a mobile spelling game for children.
Pitteri et al. [39]	2021	Quantitative	Google Forms demographics; five-minute free exploration of the app; a usability questionnaire with 14 five-point items and one yes/no item for the experimental group; mobile serious-game interaction with three music pieces and in-game questions	Descriptive usability statistics; scoring of music-learning questions; Mann–Whitney U test comparing total scores between experimental and control groups	N = 20 volunteers (10 men, 10 women; mean age 33.95, SD = 16.76); 6 had experience playing a musical instrument.	How touchscreen interaction, visual music representations, navigation, feedback, and game-based questioning support usability and learning in a mobile serious game for music

Vrancken et al. [40]	2021	Mixed methods	Open-ended stakeholder interviews; stakeholder brainstorming sessions; prototype and alpha-version gameplay tests; direct observation; semi-structured child interviews; funometer, fun-sorter, and again-again ratings; knowledge questions; observations of controls, usability problems, and bugs	Qualitative categorization of stakeholder interview feedback; descriptive analysis of child ratings and knowledge responses; observational synthesis	Stakeholder interviews: hospitalized children and parents (reported n = 30), other parents (n = 31), hospital staff (n = 56), and teachers (n = 29). Design sessions: n not reported. Game testing: 6 children (prototype) and 22 children (alpha version).	How to design, test, and iteratively refine an age-appropriate mobile serious game that informs children about hospital admission while supporting fun, understandable controls, knowledge transfer, and an immersive preparation experience
Muhanna et al. [32]	2022	Mixed methods	Remote expert focus groups; closed- and open-ended practitioner questionnaire; two follow-up focus groups; heuristic evaluation of Arabian Heroes and Malik Altawseel using one of three heuristic sets	Affinity diagramming of qualitative practitioner feedback; descriptive comparison of the number and severity of usability issues identified across Arabic Mobile Game Heuristics, Nielsen's heuristics, and Game Usability Principles	Heuristic-development stage: 3 domain experts in remote focus groups and 11 practitioners reviewing/rating the proposed heuristics. Validation experiment: n = 18 experienced evaluators (10 male, 8 female)	Development and validation of culturally adapted usability heuristics for Arabic mobile-game interfaces, including layout, language, feedback, consistency, controls, and visual interpretation
Shohieb et al. [36]	2022	Mixed methods	Direct mobile gameplay with Pickstar; automatically logged winning-rate and time-on-task/gameplay data; pre- and post-study caregiver interviews/questionnaires; usability evaluation	Descriptive analysis of gameplay and usability measures; correlation coefficients relating skill level to winning rate; engagement-rate calculations from gameplay logs; qualitative/descriptive analysis of caregiver feedback	Convenience sample of n = 7 children aged 5–10, all diagnosed with ASD (moderate to severe; verbal skills none to low). Their caregivers comprised 2 special instructors and 5 parents aged 21–50.	How dynamic difficulty adjustment, adaptive challenge, multisensory feedback, and interface design affect engagement, independence, usability, and vocabulary-learning interaction for children with ASD

Torrado et al. [37]	2022	Qualitative	Semi-structured expert interviews; multidisciplinary focus group; functional high-fidelity mobile-game field test with three end users; direct observation during play; unstructured post-test interviews with users and caregivers	Inductive qualitative thematic analysis of interview transcripts and observation notes	Requirements stage: semi-structured interviews with five experts; multidisciplinary focus group $n = 6$. Pilot field test: three people with intellectual disabilities used the functional HikePal mobile game with support from two caregivers; users and caregivers were interviewed after play.	How to design an accessible mobile exergame and navigation system that can motivate people with intellectual disabilities to undertake outdoor physical activity
Liu & Lai [44]	2024	Qualitative	Systematic walkthrough of Light and Night's onboarding, menus, settings, characters, visual/audio features, and touch/swipe/tap mechanics; open-ended semi-structured interviews; participant observation of player communities on Sina Weibo and Bilibili	Qualitative interpretive analysis using Jørgensen's game-world-interface framework and a 'design workshop' framing	Snowball sample of 58 Chinese otome-game players aged 20–35, including 32 Light and Night players.	How representational, audio, touch-based, narrative, and intimate interface elements shape player experience in a mobile otome game, and how player-community feedback influences interface updates and iteration
Tan & Ng [41]	2024	Mixed methods	Stakeholder workshops, virtual-tour observation, and qualitative feedback during requirements gathering; gameplay with The Story of Praya Lane; an online questionnaire using adapted UEQ and UES-SF items and an open-ended question on transformative learning.	Descriptive statistics (frequencies, percentages, means, and standard deviations); chi-square tests of independence examining associations with age and gender; deductive thematic analysis of open-ended responses using transformative learning criteria.	Main user study N = 58. The earlier requirements-gathering ethnography involved 42 undergraduates aged 18–23 and should be treated separately from the final app evaluation.	How a mobile sensing and AR-based interactive story game can be designed to support usability, immersion, engagement, cultural learning, and reflection.

Livanou et al. [42]	2025	Mixed methods	Online questionnaires; online focus groups; ReGoal prototype playtesting followed by an online feedback questionnaire.	Descriptive statistics; one-way ANOVA, including Welch-adjusted tests and planned contrasts; linear regression with demographic and parental covariate adjustment; thematic analysis of focus-group data; bivariate Pearson correlations.	Phase 1: n = 122 young people aged 11–16 completed the initial online survey. Phase 2: n = 16 participants from Phase 1 attended three focus groups. Phase 3: n = 72 participants from the earlier phases played and evaluated the latest ReGoal prototype.	How to co-produce, develop, and iteratively refine a mobile serious game for young people with conduct problems while prioritizing an acceptable interface, navigation, content, engagement, and socio-emotional relevance.
Sim et al. [33]	2025	Quantitative	Web-crawled English user reviews from Steam and Google Play	Review preprocessing/filtering; BERTopic with transformer embeddings and clustering; topic representation and similarity-matrix analysis	Collected English reviews: 348,860 from Steam and 1,048,576 from Google Play. Topic modeling used 22,108 filtered negative Steam reviews and 270,442 negative Google Play reviews.	How PC and mobile players differ in UX concerns, especially communication/chat, account and network problems, updates, social interaction, customization, and purchasing preferences

Appendix B.2. Theme 2. Player Experience and Immersion

Table A3. Study characteristics for Theme 2.

Study	Year	Research Approach	Data Collection Methods	Data Analysis Methods	Participants/Sample	Main Focus
Su et al. [47]	2016	Quantitative	Online questionnaire distributed to verified Tower of Saviors players via Facebook and the associated PTT Bulletin Board System forum	Descriptive statistics; Pearson correlations; t tests; multiple linear regression; confirmatory factor analysis; structural equation modeling; fuzzy-set qualitative comparative analysis	456 questionnaires were returned from the Tower of Saviors Facebook fan page and PTT forum; after removing incomplete responses and those without a valid player UID, n = 394 remained (86.4% valid-response rate).	How human–computer interaction, social interaction, player skill, and challenge contribute to flow (perceived enjoyment and attention focus) and subsequently to player loyalty in a mobile game.

Baek & Touati [45]	2017	Quantitative	Mobile Minecraft gameplay; two individual construction tasks with group strategy discussions; peer-rated task achievement; Computer Game Attitude Scale; Enjoyment Test; Learning Style Inventory; Intrinsic Motivation Inventory; Collaboration Attitude Test	Pearson correlations; multiple linear regression models predicting enjoyment, intrinsic motivation, and achievement	N = 164 South Korean students aged 11–12 (97 boys, 67 girls) from two elementary schools.	How learning style, collaboration skills, intrinsic motivation, and game attitude relate to enjoyment, and how enjoyment relates to achievement during sustained mobile Minecraft play
Goh et al. [46]	2017	Quantitative	Outdoor mobile tasks using Track (points), Badge (badges), and Share (non-game control); viewing/creating/rating location-based content; leaderboard/badge/status interaction; 5-point post-condition questionnaires	Principal component factor analysis with varimax rotation; reliability analysis; one-way ANOVA; Tukey post-hoc comparisons	N = 155 university participants (83 male, 72 female; mean age 26.93).	How virtual reward mechanics (points vs. badges) shape affective, cognitive, and behavioral enjoyment, autonomy, competence, relatedness, and perceived output quality in mobile crowdsourcing games
Merikivi et al. [49]	2017	Mixed methods	Online questionnaire posted to mobile-game forums/social networks; open-ended questions about reasons for enjoyment and quitting	Measurement-model assessment and structural equation modeling (SEM); interpretive coding of open-ended responses into pastime/boredom, challenge, and social categories; descriptive frequencies for qualitative categories	549 people visited the online survey; 288 responded. After excluding 81 responses, n = 207 valid mobile game users remained. The open-ended question about enjoyment received 118 responses; the question about reasons for quitting received 88 responses.	How game design and playability attributes shape enjoyment and how enjoyment subsequently drives continued mobile-game use
Paule-Ruiz et al. [51]	2017	Mixed methods	Experimental-group tablet interaction logs; direct classroom observation for the control group; repeated music-learning sessions; child surveys/interviews and teacher interviews/meetings	Independent-samples t tests; Levene's tests; Cohen's d and effect-size r; frequency distributions; Friedman tests across sessions; qualitative interpretation of child/teacher survey and interview data	N = 86 third-year kindergarten children from a public school in northwest Spain	How four touch-based mobile music games support musical-note learning, sound discrimination, motivation, autonomous interaction, and creativity in preschool children compared with Montessori bells

Passalacqua et al. [48]	2020	Quantitative	45-min lab session; Flow Short Scale; continuous-use intention scale; electrodermal activity recorded with Biopac MP-150	Descriptive statistics; regression models for experimental effects; independent-samples t tests; Pearson correlations; post-hoc mediation analysis	N = 40 participants recruited through an institutional research panel and randomized to tutorial vs. no-tutorial conditions; self-reported expertise classified participants as expert or non-expert. Electrodermal analyses retained 30 participants after artefact exclusions.	How tutorial presence and player expertise shape first-time perceived and psychophysiological flow, and how flow relates to continuous-use intention
Li [50]	2025	Quantitative	Online questionnaires; player background and gaming-experience items; 37-item playability scale and 9-item avatar-identification scale	Descriptive statistics; exploratory/factor analysis of the playability scale; Pearson correlations; structural equation modeling with fit indices for each avatar-setting model; one-way ANOVA	N = 736 valid mobile-RPG players in Taiwan (456 male, 280 female).	How game playability and avatar-setting models shape players' identification with their mobile-RPG avatars
Burguera-Bernalte et al. [52]	2025	Quantitative	Pre and post knowledge assessments; recorded game scores; satisfaction and psychological questionnaires; cognitive tests, and cardiovascular measurements.	Descriptive statistics; within-group paired samples t-tests; Pearson correlations; heart rate variability data processing.	Phase 1 recruited n = 42 first-year psychology students and randomly allocated them to experimental and control groups (21 each). Complete pre- and post-test knowledge data were available for 15 participants per group. Phase 2 assessed an 18-person subsample; eight participants completed the satisfaction questionnaire.	Whether using a mobile serious game suite improves neuroscience learning and user satisfaction, and how cognitive and psychophysiological factors relate to learning and academic performance.

Appendix B.3. Theme 3. Social and Contextual Interaction

Table A4. Study characteristics for Theme 3.

Study	Year	Research Approach	Data Collection Methods	Data Analysis Methods	Participants/Sample	Main Focus
Melero et al. [53]	2015	Mixed methods	QuesTInSitu location-based museum gameplay; a questionnaire with 15 Likert items and an open-ended question; a six-item post-test and performance measure; direct observations by two researchers during group play	Descriptive and normalized comparisons; independent two-sample *t* tests allowing unequal variances; qualitative interpretation and triangulation of researcher observations and students' open-ended responses	N = 76 secondary-school students aged 14–16	How carrying versus sharing the mobile device and group size shape attention, participation, engagement, collaboration, and performance during a location-based museum game
Vella et al. [56]	2019	Qualitative	Semi-structured interviews with Pokémon GO players; 880 Reddit r/pokemongo stories posts	Thematic analysis; iterative two-coder coding in NVivo	N = 15 Pokémon GO players aged 17–31 (M = 23.27, SD = 4.18; 60% male, 40% female) plus online forum contributors	How Pokémon GO gameplay produces social connectedness and belonging, including interactions with strangers, strengthened existing ties, sense of place, and the game mechanisms that facilitate those outcomes
Kim et al. [55]	2022	Quantitative	In-game survey and matched, anonymized gameplay and social-interaction logs.	Descriptive statistics; adapted PageRank scoring for social status; factor analysis and Cronbach's alpha; regression-based residualization; path analysis in R 4.0.3 using lavaan; model-fit assessment;	N = 1056 adult *Sky: Children of the Light* players aged 18–62 (M = 23.02, SD = 5.12) who had completed the final realm and were active at least 30 days during the preceding six months.	How group play as an in-game affordance relates to reciprocity, bridging and bonding social capital, and social status in a mobile massively multiplayer online game.
Iplikci et al. [54]	2024	Quantitative	Two tablet-game sessions; video recordings; post-session game evaluations	Correlation analysis; t-test comparing recording durations; multilevel models accounting for children nested within groups; duration-adjusted behavioral indices; models of game preference; exploratory moderation analyses	67 fifth-grade students were recruited; four declined participation in study sessions, leaving *n* = 63 (23 female), ages 10–12 (M = 10.95, SD = 0.50).	Whether cooperative versus solitary mobile gameplay changes children's social interaction, helping behavior, positive affect, and preference during co-located play

Appendix B.4. Theme 4. Player Psychology and Behavior

Table A5. Study characteristics for Theme 4.

Study	Year	Research Approach	Data Collection Methods	Data Analysis Methods	Participants/Sample	Main Focus
Seok & DaCosta [57]	2015	Quantitative	Paper-and-pencil questionnaire combining Big Five Inventory measures with items on mobile-phone ownership, game-play frequency, hours played, years of experience, number of installed games, purchases/spending, and recommendations	Descriptive statistics; categorical regression analyses predicting multiple mobile-game behaviors from Big Five personality traits	N = 1995 South Korean students who played mobile games: 1277 high-school students, 621 undergraduate students, and 97 graduate students.	Whether Big Five personality traits predict the frequency, duration, purchasing, spending, and recommendation patterns of mobile game play
Kim & Lee [58]	2017	Quantitative	Smartphone app-based questionnaire assessing epistemic curiosity, perceived switching costs, and continued-play intention.	Confirmatory factor analysis; Pearson correlations; structural equation modeling; multiple linear regression; ANOVA; mediation and path analysis; multiple-group analysis in AMOS; t-test comparison of path slopes	N = 500 South Korean smartphone users were recruited through a commercial survey panel; *n* = 396 met the authors' definition of mobile gamers, while 104 were non-gamers.	How epistemic curiosity and perceived switching costs explain future play intention, retention, and individual differences in mobile game continuation.
Balakrishnan & Griffiths [64]	2018	Quantitative	28-item questionnaire measuring addiction, game loyalty, purchase intention for mobile in-game features, and six additional socio-demographic questions	Confirmatory factor analysis; structural equation modeling with maximum-likelihood estimation; direct and indirect effect testing; ANOVA/MANOVA and chi-square comparisons	N = 430 completed questionnaires from students at two Indian universities; 470 had been invited. The sample was nearly gender-balanced (217 male, 213 female) and included undergraduate, postgraduate, and doctoral students with varied daily play time and in-app purchase histories.	How mobile game addiction and loyalty relate to intention to purchase in-game features, including the mediating role of loyalty

Seok & DaCosta [59]	2018	Quantitative	Paper-and-pencil 92 item questionnaire; analysis used items on mobile game frequency, demographics, and problematic play symptoms measured on a 5-point Likert scale	SPSS (version 21) classification rules for problematic play; descriptive statistics; Pearson chi-square tests	N = 1950 active mobile game players from four high schools and six universities near Seoul, South Korea (high school *n* = 1241; undergraduate *n* = 612; graduate *n* = 97). Of the sample, 1373 were male and 569 female, with 8 missing gender responses. The largest age group was 18–20 years (*n* = 931).	How prevalent problematic mobile gameplay is and how problematic versus nonproblematic players differ in frequency, duration, preferences, and demographics
Chen et al. [60]	2019	Quantitative	Two-wave online questionnaires assessing self-regulation and reduced smartphone game use	Partial least squares structural equation modelling; confirmatory factor analysis; structural path analysis; moderation analysis; mediation analysis and bootstrapping; Harman single-factor test	N = 381 valid two-wave responses from Chinese smartphone game users who passed addiction and problematic use screening questions; 175 were male and 206 female, and 79.2% (*n* = 302) were aged 25–40.	Why smartphone game users who want to reduce addictive play fail to do so, and how thought suppression, intrusive thoughts, impulsive play, smartphone ubiquity, perceived difficulty, and self-efficacy interact across self-regulation stages
Seo et al. [65]	2019	Quantitative	Online questionnaire assessing psychological factors, gaming motivations, and in-game purchasing behavior and intentions.	Descriptive statistics and correlation analysis; multicollinearity tests; hierarchical multiple regression	N = 534 active Summoners War players recruited from the game's Reddit community; ages 14–49 (M = 24.80, SD = 6.15), 44 female and 13 unspecified gender.	How rational theory of planned behavior factors and non-volitional game-related factors jointly explain intention to purchase probability-type items in a mobile game.
Larche & Dixon [62]	2021	Quantitative	Real Candy Crush Saga gameplay; gameplay video for win/loss coding; self-report scales	Paired-samples t tests; Pearson correlations; hierarchical multiple regression; chi-square test; mixed repeated-measures ANOVAs with simple-effects analyses	N = 60 experienced Candy Crush players (53 female, 7 male), psychology undergraduates aged 17–46.	How optimal challenge and the motive of gaming to escape aversive boredom shape flow, arousal, positive affect, urge, game preference, and problematic smartphone-gaming tendencies

Haberlin & Atkin [61]	2022	Quantitative	An online survey to collect data on mobile gaming habits and measure levels of materialism, social support, and Internet addiction.	Descriptive statistics; exploratory and confirmatory factor analysis; Pearson correlations; multiple regression predicting Internet addiction; PROCESS moderation analysis with 10,000 bootstrap samples	N = 189 U.S. adult mobile game users recruited through Amazon Mechanical Turk. The final sample was 61% female, 80% White, mean age 33	How mobile gaming motivations, materialism, social support, play intensity, and spending relate to problematic use and Internet addiction symptoms
Lemmens & Weergang [66]	2023	Quantitative	A cross-sectional online questionnaire	Descriptive statistics; exploratory factor analysis; correlations; group comparisons; regression models; moderation analyses	N = 1630 core Pokémon GO players, all trainer level 25 or higher (M = 37.74, SD = 3.09); 796 (48.8%) had reached level 40. Participants were recruited internationally through Discord and Facebook communities.	How competence, autonomy, relatedness, gender, social anxiety, and gaming disorder symptoms relate to persistent Pokémon GO play, progression, and microtransaction spending
H. Chen et al. [71]	2024	Quantitative	An online survey measuring privacy protection practices of Chinese teenagers in mobile gaming	Multistage path model in Stata; SEM model-fit assessment with RMSEA/CFI; ordinary least squares regression for moderation analysis	N = 561 valid Chinese high-school students aged 15–19 who regularly played mobile games (mean age = 17.39).	How parental mediation, platform protection, risky encounters, privacy concerns, self-efficacy, perceived disclosure benefits, and optimistic bias shape teenagers' privacy protective behaviors in mobile gaming
R. Chen et al. [70]	2024	Mixed methods	Online player reviews from Bilibili covering six mobile games; an online questionnaire administered through Credamo	Sentiment analysis using SnowNLP; BERTopic topic modelling; manual categorization of topics; descriptive comparison of review and survey results using radar charts; graphical examination of relationships between time investment dimensions and game ratings.	Study 1 collected 182,497 raw Bilibili review entries across six mobile-game types, of which 61,267 negative reviews were analyzed. Study 2 used a questionnaire survey with n = 1028 valid respondents (597 male, 431 female).	How different forms of player time investment relate to extrinsic motivational pressures, negative emotions, and evaluations of mobile games

Guo et al. [63]	2024	Quantitative	Online screening questionnaires; computerized dot-probe tasks using mobile game image stimuli; eye-tracking	Descriptive statistics and scale reliability analysis; independent-samples t-tests; calculation of trial-level bias scores; mixed-design ANOVA.	Experiments 1 and 2 used the same n = 68 problematic mobile gamers (mean age about 19.8). Experiment 3 included 35 problematic mobile gamers, of whom 33 had participated in Experiments 1 and 2 (18 low social anxiety, 17 high social anxiety). Initial online screening involved 496 university students.	Whether problematic mobile gamers, particularly those with high social anxiety, show attention bias toward in-game social information, and how this bias unfolds across the early, middle, and late stages of attention.
Salehudin & Alpert [67]	2024	Quantitative	Expert judgments and respondent interviews for item pretesting; pilot questionnaires; an online survey via Qualtrics	Content-validity assessment; exploratory factor analysis; reliability analysis using coefficient alpha; descriptive statistics; Cragg's hurdle regression	Study 1 pilot sample n = 103. Study 2 main sample n = 1053 adult free-to-play mobile gamers who had played at least 30 min per day in the preceding seven days: US n = 527 and Australia n = 526.	Why many mobile gamers spend nothing on in-app purchases and how perceived aggressive monetization, fairness, willingness to spend, self-control, and play time shape conversion and spending size.
Liao et al. [72]	2025	Quantitative	Online questionnaire administered via SurveyCake, using nominal and ordinal items on demographics, mobile gaming habits, social interaction, mobile payment, and purchasing preferences.	Descriptive statistics; K-means cluster analysis; Apriori algorithm	N = 2326 valid Taiwanese gaming-player questionnaires from 2462 returned responses; 50.75% male and 49.25% female. The largest age group was 21–30 years (43.74%).	What user profiles and behavioral preference patterns characterize Taiwanese mobile gamers across gaming, social media, and mobile payment, and how those patterns can support intentional and behavioral recommendations
Park & Yap [68]	2025	Qualitative	Participatory online observation; collection of forum posts, comments, and visual materials; observational fieldnotes; semi-structured interviews with game developers.	Open, axial, and selective coding to develop first-order concepts, second-order themes, and aggregate dimensions; iterative comparison of textual data, visual data, and fieldnotes	Members of the Empires and Puzzles online community, and game developers who participated in seven interviews. The forum comprised approximately 10,927 posts across nine relevant topics.	How mobile game mechanics and their temporal design contribute to transitions between harmonious and obsessive passion in mobile gaming engagement.

Anderson & Falconer [73]	2025	Mixed methods	Match replay files collected from live game servers over one week in November 2020; developer-team discussions and feedback.	Sequential pattern mining using SPADE; Shannon-entropy scoring; expert-informed manual labeling and selection of action phases; comparison of k-means, DBSCAN, and hierarchical clustering.	3576 unique Bloons TD Battles players aged 18 or older, represented in a reported final dataset of 9665 matches and 19,330 player action sequences.	Whether fine-grained network message data and expert-guided machine learning can identify meaningful player tactics and play-style patterns in a commercial mobile tower defense game
Ma & Shao [4]	2025	Quantitative	Online demographic, gaming-experience, and payment-experience questionnaire; a temporal discounting task; an impulsivity questionnaire	Descriptive statistics; regression analysis; chi-square tests; Mann–Whitney U tests; Cohen's d effect sizes.	The participant total was inconsistently reported: 332 in the text, but 322 across the three experimental groups (112, 103, and 107) and gender counts (124 male, 198 female). Participants had prior mobile-game experience (mean age = 31.1, SD = 8.59).	How temporal discounting and specific payment scheme features influence mobile game users' preference for delayed versus immediate in-game payment bonuses
Park & Yap [69]	2025	Qualitative	Online observation of an official game forum and related social media; collection of forum posts, comments, and visual materials; observational fieldnotes; review of contextual sources such as news articles and business reports.	Visual mapping and narrative strategies; open, axial, and selective coding informed by self-determination theory; iterative comparison of textual and visual data	Approximately 11,246 posts plus visual materials from an official mobile game community	How mobile game design characteristics and mechanics frustrate autonomy, competence, and relatedness, and produce unintended negative psychological consequences for players

Appendix B.5. Theme 5. Augmented and Location-Based Interaction

Table A6. Study characteristics for Theme 5.

Study	Year	Research Approach	Data Collection Methods	Data Analysis Methods	Participants/Sample	Main Focus
Chang et al. [75]	2017	Mixed methods	Pre and post achievement tests; cognitive-load questionnaire; focus group interviews	Descriptive statistics; t tests; ANCOVA; MANCOVA; Bonferroni post-hoc comparisons; qualitative coding and categorization of focus group interview responses	N = 137 second year university students in Taiwan (mean age 21).	How rule-based, location-dependent pervasive gameplay embedded in a real world cultural site affects language learning, cognitive load, and learners' contextual experience
Pombo et al. [76]	2017	Qualitative	Participant observation during outdoor team gameplay; six audio-recorded, structured post-play focus group interviews	Inductive content analysis of observation reports and focus group transcripts; descriptive reporting of enjoyment and ease ratings.	N = 74 students from three classes across two Portuguese school levels (class mean ages = 9.0, 9.0, and 12.9). Six post-play focus groups comprised four groups of 13 and two groups of 11 students.	How students perceive the enjoyment and difficulty of the EduPARK augmented-reality mobile game in an urban park, and how their feedback can guide prototype refinement and the design of outdoor educational games.
Chen et al. [78]	2018	Quantitative	Online questionnaire promoted through Facebook pages and gaming bulletin boards; interviews with 12 players to determine player-grouping criteria.	Descriptive statistics; confirmatory factor analysis; correlation analysis; structural equation modeling and multiple group comparisons	600 Pokémon Go players in Taiwan recruited through convenience sampling: 328 male and 272 female respondents; 335 (55.8%) were aged 21–30. The sample included 492 average players (levels 1–20) and 108 advanced players (above level 20).	How serendipity, network externalities and intrinsic motivation influence gratification, flow, and stickiness in Pokémon Go, and whether relationships differ by player level

Sekhavat & Zarei [74]	2018	Quantitative	Pre-study background questionnaire; a five-minute gameplay session with one of three Ladybug prototypes; a post-play, 16-item immersion questionnaire	Descriptive participant summaries; t-tests for participant background differences; pairwise ANOVA comparisons; correlation analyses	N = 30 students were recruited and divided into three between-subject groups of 10: regular VR camera, single AR camera and stereoscopic AR camera.	How regular VR, single AR and stereoscopic AR presentation affect immersion, focused immersion, control and autonomy, emotional involvement and enjoyment
Hamari et al. [79]	2019	Quantitative	Online questionnaire; seven-point Likert items and five yes/no nostalgia items.	Descriptive statistics; PLS-SEM in SmartPLS 3; covariance-based SEM in AMOS	1190 current or recent Pokémon Go players in an international, self-selected online sample: 698 male and 492 female respondents; 58% were aged 21–30. The largest groups resided in the Philippines (n = 402) and Finland (n = 375).	How gratifications, ease of use, and privacy concerns relate to continued-play and in-app purchase intentions in Pokémon Go
Huizenga et al. [77]	2019	Quantitative	Questionnaires; team game scores; researcher observations used to validate self-reported activities	Factor analysis/reliability checks; paired-samples t tests; multilevel variance-components models; regression analyses	N = 181 secondary school students (66 male, 115 female), ages 15–22, playing in 69 teams of two or three in Oostende, Belgium.	How real world urban and location-based game activities, immersion, and team interaction relate to learning outcomes and team performance in NoCredit, GameOver!
Malik et al. [80]	2020	Quantitative	Web-based questionnaire covering demographics, gaming behavior, reasons for starting Pokémon Go, gaming gratifications, and privacy concerns. Seven-point Likert scales were used for gratification and privacy constructs except nostalgia. Nostalgia was measured using five yes/no items summed into a 0–5 score.	Descriptive statistics; Cronbach's alpha reliability analysis; independent samples t-tests; one-way ANCOVA controlling for time spent playing; Tukey's HSD post-hoc comparisons; correlation analysis; and two-way MANOVA examining the interaction between gender and age.	N = 1190 valid current or recent Pokémon GO players after cleaning 1315 completed responses. Participants were recruited globally through virtual snowball sampling via gaming mailing lists, Twitter, Facebook fan pages, and other online communities.	How Pokémon Go players' motivations, gratifications, and privacy concerns differ across gender and age groups.

Alavesa & Xu [81]	2022	Qualitative	2432 social-media photographs and AR screenshots taken during Pokémon GO gameplay; coding captured subject, AR view, indoor/outdoor and public/private space, use situation, blending of realities, and activity context	Two-observer coding in ImageTagger; Cohen's kappa on 114 images; iterative qualitative categorization following general qualitative coding principles until no new themes emerged	No recruited participant sample. The corpus contained 2432 gameplay-related images from Pokémon GO communities on Twitter, Facebook, and Instagram in eight Nordic cities. The Facebook portion included 712 individual contributors; the total number of contributors across platforms was not reported.	How the physical-digital game world of Pokémon GO blends with players' daily lives across indoor and outdoor, public and private, and AR and non-AR contexts.
Liu et al. [82]	2023	Mixed methods	Extraction of worldwide weekly Google Trends data; collection of official app-store information and update logs, supplemented by Pokémon GO Wiki and PokémonBlog; researcher observation and direct engagement with the game.	Time-series and trendline analysis in MATLAB; in-vivo/open, axial and selective grounded-theory coding	No recruited human participants. The study examined one game, Pokémon GO, using 269 weekly Google Trends observations and game design records; 22 releases were selected for detailed analysis.	How Pokémon Go design updates, interaction structures and quality-of-life changes co-occur with changes in player engagement and what this implies for sustainable Geo AR game design

Appendix C. Methodological Quality Appraisal of the Included Studies

The 58 included studies were appraised using the Mixed Methods Appraisal Tool (MMAT), version 2018 [25]. Ratings are reported for each criterion. No overall numerical score was calculated.

Ratings. Yes; No; Can't tell. "Can't tell" indicates insufficient information to make a judgment.

Screening questions. S1: Are there clear research questions? S2: Do the collected data allow to address the research questions?

Table A7. Qualitative studies (*n* = 7).

Study	S1	S2	1.1	1.2	1.3	1.4	1.5
Liu & Lai (2024) [44]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vella et al. (2019) [56]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alavesa & Xu (2022) [81]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Torrado et al. (2022) [37]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Park & Yap (2025) [68]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Park & Yap (2025) [69]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pombo et al. (2017) [76]	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note. 1.1: Is the qualitative approach appropriate to answer the research question? 1.2: Are the qualitative data collection methods adequate to address the research question? 1.3: Are the findings adequately derived from the data? 1.4: Is the interpretation of results sufficiently substantiated by data? 1.5: Is there coherence between qualitative data sources, collection, analysis and interpretation?

Table A8. Randomized controlled trials (*n* = 5).

Study	S1	S2	2.1	2.2	2.3	2.4	2.5
Holz & Meurers (2021) [30]	Yes	Yes	Can't tell	Can't tell	Yes	No	Yes
Pitteri et al. (2021) [39]	Yes	Yes	Can't tell	Yes	Yes	Can't tell	Yes
Passalacqua et al. (2020) [48]	Yes	Yes	Can't tell	Yes	No	Can't tell	Yes
Burguera-Bernalte et al. (2025) [52]	Yes	Yes	Can't tell	Yes	No	Can't tell	Yes
Ma & Shao (2025) [4]	Yes	Yes	Can't tell	Yes	Yes	Can't tell	Yes

Note. 2.1: Is randomization appropriately performed? 2.2: Are the groups comparable at baseline? 2.3: Are there complete outcome data? 2.4: Are outcome assessors blinded to the intervention provided? 2.5: Did the participants adhere to the assigned intervention?

Table A9. Quantitative non-randomized studies (*n* = 27).

Study	S1	S2	3.1	3.2	3.3	3.4	3.5
Choe & Schumacher (2015) [26]	Yes	Yes	No	Yes	Yes	No	Yes
Teather et al. (2017) [28]	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes
Barnett et al. (2018) [31]	Yes	Yes	Can't tell	Yes	Yes	No	Yes
Halloran & Minaeva (2019) [29]	Yes	Yes	No	Yes	Yes	No	Yes
Su et al. (2016) [47]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baek & Touati (2017) [45]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Goh et al. (2017) [46]	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes
Huizenga et al. (2019) [77]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Larche & Dixon (2021) [62]	Yes	Yes	No	Yes	Yes	Yes	Yes
Li (2025) [50]	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes
Kim et al. (2022) [55]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iplikci et al. (2024) [54]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Seok & DaCosta (2015) [57]	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes

Kim & Lee (2017) [58]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Balakrishnan & Griffiths (2018) [64]	Yes	Yes	Can't tell	Yes	Yes	Can't tell	Yes
Seok & DaCosta (2018) [59]	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes
Chen et al. (2019) [60]	Yes	Yes	Yes	Yes	Can't tell	Yes	Yes
Seo et al. (2019) [65]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Malik et al. (2020) [80]	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes
Haberlin & Atkin (2022) [61]	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes
Lemmens & Weergang (2023) [66]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H. Chen et al. (2024) [71]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Guo et al. (2024) [63]	Yes	Yes	Can't tell	Yes	Yes	Can't tell	Yes
Salehudin & Alpert (2024) [67]	Yes	Yes	Can't tell	Yes	Yes	Can't tell	Yes
Chen et al. (2018) [78]	Yes	Yes	Can't tell	Yes	Yes	Can't tell	Yes
Sekhavat & Zarei (2018) [74]	Yes	Yes	No	Yes	Yes	Yes	Yes
Hamari et al. (2019) [79]	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note. 3.1: Are the participants representative of the target population? 3.2: Are measurements appropriate regarding both the outcome and intervention (or exposure)? 3.3: Are there complete outcome data? 3.4: Are the confounders accounted for in the design and analysis? 3.5: During the study period, is the intervention administered (or exposure occurred) as intended?

Table A10. Quantitative descriptive studies (n = 3).

Study	**S1**	**S2**	**4.1**	**4.2**	**4.3**	**4.4**	**4.5**
Jamonnak & Cheng (2017) [38]	Yes	Yes	Yes	Can't tell	Yes	Can't tell	Yes
Sim et al. (2025) [33]	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes
Liao et al. (2025) [72]	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes

Note. 4.1: Is the sampling strategy relevant to address the research question? 4.2: Is the sample representative of the target population? 4.3: Are the measurements appropriate? 4.4: Is the risk of nonresponse bias low? 4.5: Is the statistical analysis appropriate to answer the research question?

Table A11. Mixed methods studies (n = 16).

Study	**S1**	**S2**	**5.1**	**5.2**	**5.3**	**5.4**	**5.5**
Cota et al. (2015) [34]	Yes	Yes	Yes	Yes	Yes	Yes	No
Shin & Chung (2017) [27]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gaudl et al. (2018) [43]	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell
Machado et al. (2018) [35]	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell
Muhanna et al. (2022) [32]	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell
Shohieb et al. (2022) [36]	Yes	Yes	Yes	Yes	Yes	Yes	No
Chang et al. (2017) [75]	Yes	Yes	Yes	Yes	Yes	Yes	No
Merikivi et al. (2017) [49]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Paule-Ruiz et al. (2017) [51]	Yes	Yes	Yes	Yes	Yes	Yes	No
Melero et al. (2015) [53]	Yes	Yes	Yes	Yes	Yes	Yes	No
Tan & Ng (2024) [41]	Yes	Yes	Yes	Yes	Yes	Yes	No
Vrancken et al. (2021) [40]	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell
R. Chen et al. (2024) [70]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Livanou et al. (2025) [42]	Yes	Yes	Yes	Yes	Yes	Yes	Can't tell
Anderson & Falconer (2025) [73]	Yes	Yes	Yes	Yes	Yes	Yes	No
Liu et al. (2023) [82]	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note. 5.1: Is there an adequate rationale for using a mixed methods design to address the research question? 5.2: Are the different components of the study effectively integrated to answer the research question? 5.3: Are the outputs of the integration of qualitative and quantitative components adequately interpreted? 5.4: Are divergences and inconsistencies between quantitative and

qualitative results adequately addressed? 5.5: Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?

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