Use of gaming as an occupation in adults with upper limb impairment: A scoping review

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Purpose:
Gaming is a meaningful occupation for 3.3 billion people worldwide and is also used for upper limb rehabilitation. Yet, little is known regarding the use of gaming as a meaningful occupation for people with upper limb impairment. This scoping review thus explored the use of gaming through an occupational lens.
Materials/Methods:
This scoping review was conducted using the Arksey and O'Malley framework and Joanna Briggs Institute scoping review methodology and protocol template. Medline, CINAHL, IEEE Xplore and Embase were searched for studies that included gaming as an intervention for people with upper limb impairment. Studies exploring occupation, occupational engagement, activity or participation were included.
Results:
Of the 282 studies included, only 10 explored occupational engagement. Gaming was used predominantly for stroke populations (n=237) and conducted in a hospital setting (n=149). Across the studies, 146 systems were used, ranging from dedicated rehabilitation robots to commercial gaming systems, and 85 different activity and participation outcome measures were reported. Qualitative studies reported themes of peer socialisation and perceived upper limb improvement that fostered gaming use.
Conclusion:
This review identified limited representation of gaming being utilised as a meaningful occupation for people with upper limb impairment. Given the importance of participating in meaningful occupations for people with upper limb disability, further research exploring the potential of gaming to promote occupational engagement is warranted.

Keywords:
Occupation, occupational engagement, gaming, upper limb impairment

Word Count: 4795

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Occupation is defined as “an activity or group of activities that engages a person in everyday life, has personal meaning and provides structure to time. Occupations are seen by the individual as part of his/her identity” (Creek, 2006, p. 4). Its significance and individual meaning are shaped by cultural, familial, and social contexts (Hasselkus & Dickie, 2024). Engagement in occupation is complex, multifaceted, and influenced by individual experiences that affect motivation and future participation (Roberts & Bannigan, 2018). Meaningful occupation contributes to personal and sociocultural identity, a sense of fulfilment and restoration, psychological well-being, and social connection (Roberts & Bannigan, 2018) and is considered essential to overall health and well-being (Bar & Jarus, 2015). In literature and practice, the term 'occupation' is often used interchangeably with 'activity' or 'function' (Roley et al., 2008). Activity or function typically refers to the performance of daily tasks such as self-care, cooking, and leisure (World Health Organisation., 2001) and can be objectively observed.

Occupational engagement refers to “the extent to which a person has a balanced rhythm of activity and rest, a variety and range of meaningful occupations and routine, and the ability to move around in society and interact socially” (Bejerholm & Eklund, 2007, p. 21). Occupational engagement is used interchangeably with ‘participation’ (Cruz et al., 2023); however, these are also distinctive concepts. ‘Participation’ refers to a person’s ability to perform activities within essential roles and relationships, e.g. mother or friend, that occur in life situations and environments in the home or community (World Health Organisation., 2001). Occupational engagement is a complex, individualised, and multi-dimensional concept (Morris & Cox, 2017) that extends beyond merely performing and participating in occupations. It encompasses the broader cognitive and emotional aspects associated with occupations (Almomani et al., 2019; Black et al., 2019; Markus, 2022), fosters health and well-being and is influenced by motivation, personal interest, and meaning (Black et al., 2019). Occupation may be understood as an overarching concept encompassing activity and participation, shaped by the individual experience of performing an activity (Pierce, 2001). In contrast, occupational engagement encompasses subjective meaning (Hammell, 2004) attributed to an occupation that cannot be directly observed. While these terms are used interchangeably, they are distinct, yet closely related concepts.

Upper limb impairment can hinder participation in meaningful occupations integral to personal identity, leading to feelings of burden, competence and value, impacting psychological and emotional well-being (Meads et al., 2020; Poltawski et al., 2016) and occupational engagement. Applying a broader occupational lens allows for a deeper understanding and recognising the significance of personally meaningful occupations, the role of subjective meaning, and person-specific factors that influence occupational engagement and quality of life (Maritz et al., 2018) for people with upper limb impairment.
Gaming is commonly associated with leisure and entertainment and is described as a structured and valued activity that influences emotional regulation, mood, and stress management (Lorentz et al., 2015). For this review, gaming refers to playing a game using electronic devices such as a computer, mobile phone or other mediums (Wright., 2022). Gaming devices include commercial consoles (e.g. Nintendo Wii), commercial rehabilitation systems (e.g. Armeo Spring), custom-built devices and virtual reality platforms. Worldwide, 3.3 billion people are actively engaging in gaming (Gill., 2025) for stress relief, relaxation, fun, and to pass the time (Entertainment Software Association., 2023). Additional benefits of

gaming include learning, creativity, and social connection by nurturing and maintaining friendships across genders, age groups and geographical locations. Contrary to the ‘lone gamer’ stereotype, research highlights the potential of gaming for collaborative engagement, competition, and shared goal achievement (De Grove, 2014; Rogers et al., 2017). Collectively, the evidence emphasises the benefits of gaming as a meaningful occupation, extending its value beyond leisure and entertainment purposes.

Gaming has gained traction in upper limb rehabilitation, improving hand-eye coordination, reflexes, and reaction times (Finke et al., 2018). Gamification strategies targeting motivation and engagement promote behaviour change through increased repetition and recovery (Koivisto & Malik, 2021), and improve satisfaction with devices and use in rehabilitation (Baptista & Oliveira, 2019). These benefits highlight the potential of gaming as both an avenue to support health and well-being and a meaningful occupation for individuals with upper limb impairment. However, there is limited evidence of the value of gaming devices for people undergoing rehabilitation from an occupational perspective. Despite the growing popularity of gaming and its potential to foster occupational engagement, its significance as a meaningful occupation for individuals with upper limb impairment remains underexplored. This gap limits rehabilitation professionals from leveraging gaming for holistic outcomes, such as improved participation, social connection and quality of life beyond motor recovery. Therefore, the primary aim of this scoping review is to map the current literature and explore the use of gaming devices in rehabilitation by people with upper limb impairment through an occupational lens.

Research Questions

The primary question was: How are gaming devices used as an occupation with adults with upper limb impairment? Additional questions include: 1) What type of devices are being used? 2) Where are the devices being used (e.g. home, rehabilitation service)?; 3) Who are the cohorts of people using gaming devices?; and 4) How is occupational engagement explored when gaming is employed in rehabilitation?

Methods

This scoping review was conducted using the Arksey and O’Malley framework and Joanna Briggs Institute scoping review methodology and protocol template and reported according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. A scoping review was selected due to the evolving nature of gaming devices used for upper limb impairment to comprehensively map this broad and emerging topic, to identify and clarify current evidence, and to explore key characteristics and knowledge gaps (Arksey & O'Malley, 2005; Munn et al., 2018). A scoping review approach offers a broader perspective compared to a critical appraisal of its effectiveness, without the structured and restrictive focus of a systematic review. This scoping review aims to provide a foundational understanding of how gaming is integrated into upper limb rehabilitation and highlight opportunities for further research, particularly from an occupational perspective. A critical appraisal of individual studies was not performed; consistent with our scoping review objectives, the aim was to map the nature of gaming interventions and their evaluation methods rather than to assess methodological quality. This review focuses on the first three questions outlined in the registered protocol. Full details are available in the protocol registered in Open Science Framework (Registration DOI: https://doi.org/10.17605/OSF.IO/RUS5W).

Search strategy

Four databases including MEDLINE Ovid, CINAHL Ebsco, Embase Elsevier, and Inspec IEEE Explore were utilised to conduct a comprehensive and systematic search. Relevant keywords were identified for each of the key concepts, using the Population (adults, upper limb impairment/upper extremity), Intervention (gaming devices, gaming technology, robotics, virtual reality, virtual rehabilitation, video games), Comparison (none), Outcome (occupation, occupational engagement, leisure/recreation, activities of daily living, social involvement, social participation) (PICO) framework. Consultation with a senior hospital librarian and experts in the field of Occupational Therapy, Physiotherapy, and a Mechanical Engineering with extensive gaming research experience and upper limb rehabilitation was sought to ensure relevant keywords and terms were captured. This led to the development of the final search strategy, provided in Appendix One. The search strategy was reviewed by two independent assessors using the PRESS peer review checklist. Example search terms included gaming, robotics; rehabilitation; upper limb impairment; occupation; occupational engagement. Only studies published in English were included. While video games have been researched in health as early as 1984, their surge in popularity is documented from the year 2000 (Kharrazi et al., 2012). Hence, we restricted the search to include articles published between 2000-2024.

Inclusion/Exclusion criteria

Table 1 outlines inclusion and exclusion criteria. Studies were limited to adults (18+), focusing on patient populations typically engaged in rehabilitation for upper limb impairments. As occupation refers to the everyday activities that bring meaning and purpose to life (Leufstadius et al., 2024), we included activity and participation outcome measures as observable indicators of occupation. Outcome measures are defined as the observable changes documented in a client's status and are attributable to a therapeutic intervention (Unsworth, 2000). Upper limb disability can affect the fulfilment of life roles and completion of personally meaningful occupations (Poltawski et al., 2016). Applying a broad scope to include activity and participation outcome measures enhances objective insight into how upper limb impairment may affect daily occupations. Given the inherently subjective nature of occupational engagement that cannot be directly observed, the broad inclusion of measures also contributes to our understanding of how occupation and occupational engagement is currently defined and evaluated. Protocols and systematic reviews were excluded to prioritise primary data. Gaming devices were defined by the following criteria: a) games operated voluntarily by a user e.g. gaming device, robotic e.g. exoskeleton, virtual reality devices, off-the-shelf commercial gaming device; b) games that include a set of rules; c) games that include a main objective e.g. collect coins; OR d) games that include a feedback system e.g. how many coins collected (Warsinsky et al., 2021). Measures focused solely on body structure and function (e.g., Fugl-Meyer, ARAT) were excluded to maintain an occupational perspective (Kim and Shin (2022); Salter et al. (2013); Santisteban et al. (2016). Appendix Two includes details of example outcome measures eligible for inclusion.

Table 1. Inclusion/Exclusion criteria

Inclusion Criteria	Exclusion Criteria
Adults 18 and above with an acute or chronic upper limb impairment **AND**	Studies not in English
Use of an electronic device for therapeutic/rehabilitation purposes and including gaming component **AND**	Protocols, Systematic and Cochrane reviews
Quantitative or qualitative exploration of occupation* and/or occupational engagement/participation such as the Stroke Impact Scale, Canadian Occupational Performance Measure, Activity Card sort (refer Appendix Two) **OR**	Gaming devices used for purposes other than improving or involving the upper limb e.g. lower limb, cardiac rehabilitation
Quantitative or qualitative measures of activity such as the Functional Independence Measure, Barthel Index, and upper extremity measures such as the Wolf Motor Function Test (refer Appendix Two)	Devices used for improving physical activity or balance only e.g. targeting frailty, cardiac
Any study designs e.g. Clinical trial, quasi-experimental, feasibility study, pilot study, case study, case series, mixed method studies, qualitative studies (interviews and focus groups)	Devices used for improving cognitive function only e.g. attention and memory training with NO upper limb impairment identified
	Studies investigating efficacy of devices for motor/sensory retraining only e.g. body structure and function domains

*Occupation is defined as "an activity or group of activities that engages a person in everyday life, has personal meaning and provides structure to time (and) seen by the individual as part of his/her identity" (Creek, 2006, p. 4)

Selection of studies

Results from the search strategy were extracted into EndNote Version 20, duplicates removed and exported to Covidence. Screening of titles and abstracts and full text articles was completed independently by two authors (MW and AV, or LO) against inclusion and exclusion criteria, with conflicts resolved by a third reviewer. Full details are documented in PRISMA, Figure 1. Given the large number of articles that met the eligibility criteria, the original questions published in the registered protocol were modified to focus on the key concepts of occupation and occupational engagement. Assessments that were re-classified as body structure and function outcome measures (e.g. ARAT, Fugl Meyer) were excluded (Kim & Shin, 2022; Metcalf et al., 2007). Focusing on occupational outcomes via activity and participation outcome measures narrowed the number of eligible studies.

Data Extraction

A customised data extraction tool was developed (refer to supplementary material data extraction tables). Data were charted using an iterative process, allowing refinements as necessary. The extracted data included publication characteristics (author(s), year of publication, country of study), study characteristics (aim, study design, sample size, participant demographics), gaming device details (gaming device, and game type), intervention details (administration of device, rehabilitation context), and outcome measures used (activity and participation measures). In addition, patient-reported or patient-rated outcome measures that explored individual, subjective, and/or meaningful goals of participants were categorised as measures of occupational engagement as defined by authors (MW, DH, MK). Occupational engagement measures were defined as those that explored occupational engagement through a specific daily occupation, were self-rated by the client and evaluated a client's capacity to fulfil occupations of importance (activity and/or participation), along with its subjective meaning or value to the client. Examples of measures include the Canadian Occupational Performance Measure (COPM), Goal Attainment Scale (GAS) and Activity Card Sort (ACS). The COPM effectively captures the personal significance of occupations unique to each individual while integrating dimensions of participation (Kirsh & Cockburn, 2009). Similarly, the GAS is a patient-centred tool that establishes individualised goals and captures meaningful change often overlooked by generic measures (Cheema et al., 2024). The ACS further informs goal development by assessing the impact of a condition on occupation, serving as a measure of health and well-being, a critical component of occupational engagement (Tyminski et al., 2020). This broad scope ensured that relevant studies were not omitted.

Data was extracted by one reviewer (MW or AV), and a subset of data was independently reviewed by other authors (MK, CS, VC, DH) to ensure consistency. Data extracted from qualitative studies were completed by two reviewers (MW, DH) and independently coded. Preliminary themes were developed by MW and DH and reviewed by all authors. Following this, themes were finalised by all authors and grouped in relation to the primary research question, including perceptions of gaming as a meaningful occupation (during rehabilitation or post-intervention) and the perceived benefits of gaming (social benefits, perceived changes in upper limb, occupation or occupational engagement).

Results

This review was updated on 6th December 2024 and identified 9058 studies following the removal of duplicates. Figure 1 illustrates the full details of the process. A total of 282 studies met the inclusion criteria: 258 used a quantitative design, 12 a qualitative design and 12 mixed-methods studies. A full list of all included studies is provided in Appendix Four.

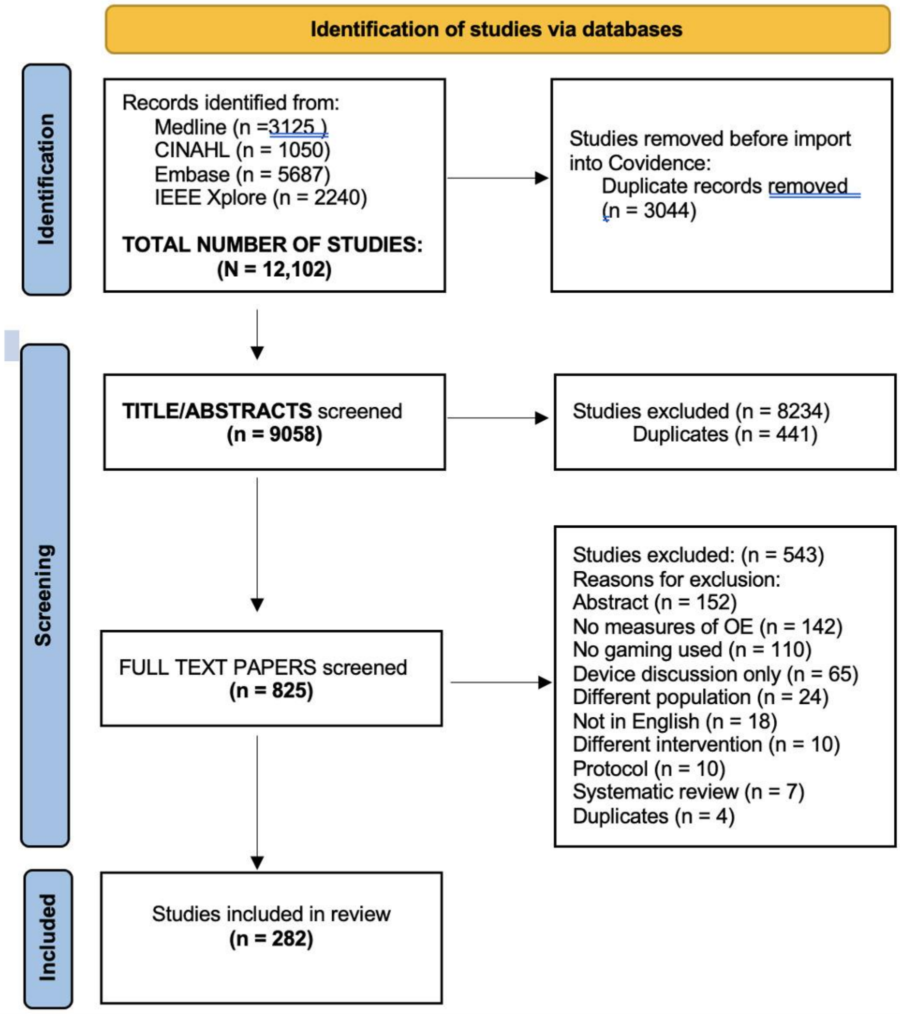

Figure 1. PRISMA flowchart

Population Groups

The majority of studies (n=237) focused on stroke populations or interviewed clinicians who worked with stroke survivors. Aside from stroke, other neurological conditions studied included Multiple Sclerosis (n=16), Parkinson's Disease (n=7), Spinal Cord Injury (n=6), Traumatic Brain Injury (n=2), and Brain Tumour (n=1). Gaming devices were also used to rehabilitate clients with orthopaedic and musculoskeletal conditions (n=9) such as rotator cuff injury, arthroscopic shoulder injury, proximal humeral fracture, and wrist fracture. A small number of studies (n=4) explored the effectiveness of gaming for clients with scleroderma and burns (refer Figure 2a Population groups). Age of participants ranged from 20-91 years and sample sizes ranged between 1-240 participants.

Context

Studies were conducted worldwide, with Asia/Middle East as the prevalent region (n=108), followed by Europe (n=93). Northern America conducted 64 studies, 10 studies originated from Australia/Pacific region, and seven studies from South America (refer Figure 2b World regions). Studies were predominantly conducted in a hospital setting (n=150), with 20 studies conducted as multi-site trials. Gaming devices were used at home in 49 studies. Other settings include research facilities (n=8) or universities (n=9). Five studies explored the efficacy of devices in dual settings, such as home and hospital, or in the home and a research laboratory.

It was unclear where the study was conducted in 41 studies (refer Figure 2c Environmental settings). Excluding qualitative studies conducted with therapists (n=3), typically a health professional such as an Occupational Therapist or Physiotherapist (medical, care assistant, rehab personnel, therapist, technologist, AHA), administered the gaming device (n=145). In the remaining studies, devices were self-administered independently or with a carer (n=27); by research staff or technicians (n=21), a mixture of personnel e.g. participant and therapist; therapist and researcher (n=8). There were 72 studies that failed to report who was responsible for administering the device. Three studies evaluated gaming devices in a group setting, with devices self-administered (n=1), and by an Occupational Therapist (n=1). One study failed to report who was responsible for administering the device. Of the three studies examining the effectiveness of gaming implemented in two-player mode, the device was researcher-controlled in two studies, while in the remaining study, participants independently operated the device (refer Figure 2d Administration of gaming devices).

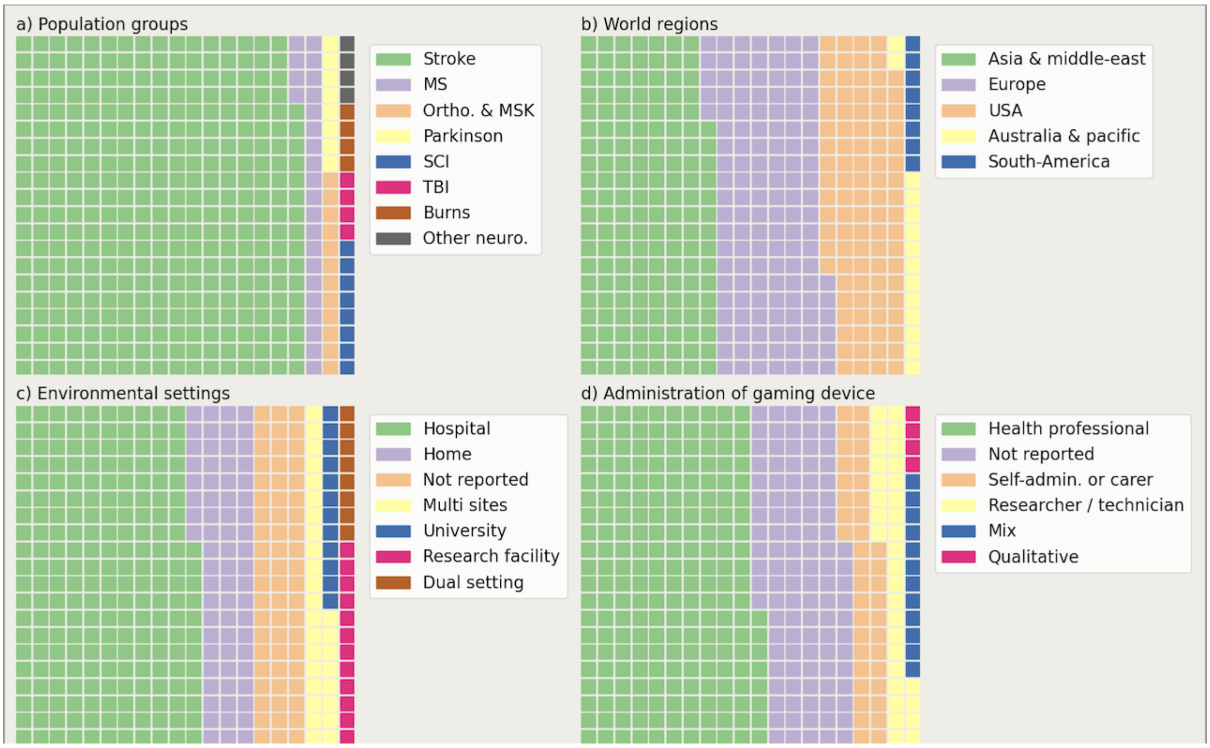

Figure 2. Synthesis of population groups and contextual variables

Devices

To the best of our knowledge, a relevant systems taxonomy does not exist in current literature; therefore, the authors developed the classification matrix outlined in Table 2 to categorise devices based on a) the intended purpose of the device (e.g. commercial versus rehabilitation specific), and b) the setup of the device hardware or complexity of the system (e.g. non-motorised system, immersive virtual reality (VR). A total of 157 different systems were used. Common devices used include: Tyromotion Amadeo, Armeo Power, Leap Motion Controller, Nintendo Wii, InMotion 2.0, RAPAEL smart glove, Armin II, ReoGo, and Unity 3D game engine. Only three studies explored the efficacy of two different devices among participants. There was insufficient detail to classify the device used in seven studies.

Table 2. *Summary of devices used*

Total number of studies (n= 282)	Non-motorised systems	Immersive VR	Electromechanical systems (robotic)	Other	Unknown	Total
Commercial, not rehabilitation specific	52	4	3	0	0	59
Commercial, rehabilitation specific	53	15	53	4	1	126
Custom or modified system	51	4	30	8	0	93
Unclear	3	0	1	3	0	7
Total	159	23	87	15	1	285*

†Commercial, not rehabilitation specific: devices that were not originally designed or commercialised for use in a rehabilitation setting e.g. Nintendo Wii; Commercial, rehabilitation specific: designed and targeted for use in rehabilitation e.g. AbleX; Custom or modified system refers to laboratory experimental devices or devices which have been physically modified for the purpose of the study. Non-motorised systems: devices that do not provide physical force to the upper limb e.g. Leap Motion; exclusive of Immersive VR includes headset with controller or motion tracking sensors; Electromechanical systems, commonly called robot or robotic systems have capacity toprovide a physical force to the user and correspond to Class II devices under most regulations. e.g. Amadeo, Bi-Manu Track. *Some studies involved more than one device.

Games Type

Game design varied among studies (refer data extraction gaming device table in supplementary material). A total of 109 studies used task-oriented games (e.g. popping balloons, catching butterflies, and collecting coins). Another 47 studies used task-oriented motor target training only to achieve a specific number of repetitions per session (e.g. 200 repetitions). In 68 studies, games simulated occupations or everyday activities e.g. cooking (n=10), and shopping (n=7). A combination of task-oriented and simulated occupations was found in 34 studies. The combination of motor repetitions followed by task-oriented games was applied in seven studies, and five studies chose a combination of motor repetitions followed by simulated occupations. It was unclear in 12 studies what game design was used. Of the 68 studies that used games that simulated occupations, 34 different devices were used. Notably, the Nintendo Wii, a non-rehabilitation device, emerged as the most prevalent device for simulating occupations in 22 studies. A combination of task-oriented games and simulated occupations was delivered among 28 different devices. In contrast, task-oriented games were used on 82 different devices, and the combination of motor repetitions and task-oriented games was used on 39 devices (refer Sankey diagram in Appendix Three for an illustration of the relationship between device and game type using our classification system).

Quantitative exploration of occupation

213 studies explored occupation quantitatively. The majority of studies were randomised controlled trials (n=122) and clinical trials (n=83). Other study designs included case studies (n=26), pilot studies (n=21), feasibility studies (n=11) and other designs (n=3) such as ethnographic-based anthrolopological study (n=1). A total of 56 activity outcome measures

and 29 participation outcome measures were identified. The Wolf Motor Function Test (n= 66), Box and Block Test (n= 57) and Motor Activity Log (n=49) were the most frequently used activity measures. The Stroke Impact Scale was the most common participation measure used in 56 studies. Activity and participation measures were used a total of 600 times across studies (refer data extraction outcome measures table in supplementary material). Only 10 studies (3.5%) used occupational measures such as the Canadian Occupational Performance Measure (COPM), Goal Attainment Scale (GAS) and Activity Card Sort (ACS). It is unclear what meaningful occupations were documented in eight of these 10 studies and how the quantitative results reported impacted the participants' capacity to fulfil valued occupations.

Qualitative exploration of occupation

Twenty-four studies collected qualitative data, with twelve utilising a mixed-methods design (refer data extraction qualitative table in supplementary material). Qualitative data was collected through focus groups (n=7), surveys (n=1), semi-structured interviews (n=15) or a self-rated questionnaire (n=1). Eleven studies reported that participants were motivated to engage due to the enjoyable nature of gaming. Participants commonly expressed how gaming was "more fun than exercising or doing therapy", (Fluet et al., 2024, p. 282) how it offered variety and health benefits to participate in rehabilitation (Thomson et al., 2016) and how challenges and rewards aided engagement (Thomson et al., 2020). Other motivations include alleviating boredom, feeling challenged by games, improved self-efficacy and mood.

Participants reported improved physical upper limb function and ability to perform everyday occupations such as dressing or eating in 83% (n=20) of studies. Participants reported gains in their ability to "dress myself, cut my food" (Cherry et al., 2017, p. 25) turning on the television or radio, brushing teeth, turning the page of a newspaper and handling coins (Paquin et al., 2015). Gaming also facilitated participants to resume occupations they had discontinued after stroke (Mashizume et al., 2021) and continue engaging in valued occupations such as "driving my sports car" (Bailey, 2022, p. 4) or fulfilling valued roles such as carrying a grandchild (Tedesco Triccas et al., 2022). One study reported an improvement in participants' perceived arm function and performance during gameplay. However, assessments at the six-week follow-up yielded mixed findings regarding overall arm function outside the gaming context. While two participants noted improvements in specific tasks, these self-reported gains did not align with the functional outcome measures used in the study (Lewis et al., 2011).

Social connection also emerged as a key benefit of gaming in 12 studies, with participants valuing competing with others, family and peer interaction and peer socialisation. One participant valued attending training sessions, citing benefits such as social interaction and the opportunity to "pass time and meet people" (Tedesco Triccas et al., 2022, p. 4). Other studies found positive feedback and family support were pivotal in encouraging participants to use gaming devices (Allegue et al., 2022; Allegue et al., 2021; Standen et al., 2015). Families who involved themselves in gaming found that it became a social activity and a source of conversation (Thomson et al., 2020). One study also reported the social connection with peers as a key benefit of gaming (Tatla et al., 2015). The ability to use a device at home also increased feelings of safety with peers in an environment where the person's disability was not visible. This positively influenced practice and adherence due to the strong motivation and social networking afforded by gaming (Tatla et al., 2015).

Only two studies revealed participants' perceptions regarding the value of gaming as a meaningful activity (Thomson et al, 2020). These participants reported immersion in gaming, playing for longer than planned and forgetting the device was originally prescribed for exercise. Some participants transformed the use of devices into a new leisure activity and continued use post-rehabilitation (Thomson et al., 2020) or were not opposed to purchasing the same game if they had owned the device at home (Paquin et al., 2015).

Discussion

This review found that while there is extensive research into gaming devices for people with upper limb impairment, particularly for people with stroke, most of the research is focused on the impact through observable changes in activity domains and conducted in the hospital setting. While the administration of gaming devices was primarily undertaken by health professionals, such as Occupational Therapists, few studies have explored gaming as a meaningful occupation, and the evaluation of occupation and occupational engagement remains underexplored. Eight of the 10 studies that utilised occupational engagement measures did not report what meaningful occupations were established and how occupation and occupational engagement have been impacted. Despite the inclusion of these measures, their use remains quantitative in nature and limits our understanding of the meaning and value of occupations to participants. Future research is required to explore the untapped potential of gaming to enhance occupational engagement, social participation, and overall well-being beyond its current employment in rehabilitation.

A range of gaming systems were used, including commercial non-rehabilitation specific devices (e.g. Nintendo Wii), commercial purpose-built rehabilitation devices (e.g. Armeo Spring) and custom-built devices. No clear relationship between the type of device used and game type was observed, reflecting the complexity of this area. Although commercial gaming devices support multiplayer functionality, most studies only utilised single-player mode. Only three studies incorporated two-player modes using custom-built rehabilitation devices (Baur et al., 2023; Pereira et al., 2019; Pereira et al., 2021). Collaborative gaming modes were found to enhance social involvement and therapy adherence (Pereira et al., 2021). Similarly, participants from qualitative studies reviewed suggested improvements to gaming device design, including leaderboards and scoring systems to foster healthy competition and facilitate connection with other players, thus ultimately increasing device utilisation (Chen et al., 2023; Thomson et al., 2020). These findings highlight the value of gaming as a meaningful occupation. It aligns with existing recreational gaming literature, identifying a key motivator for gaming as playing with others, task achievement, and improved mood and mental health benefits (Brand et al., 2023). Additionally, engaging in occupations alongside others has been linked to a sense of belonging, which directly correlates with well-being (Cruz et al., 2023). These findings suggest there are potential missed opportunities to harness the collaborative capacity of gaming and as a meaningful occupation for fostering occupational engagement.

Participants also reported how gaming fosters opportunities for a meaningful means of "passing the time" while maintaining a sense of control over their condition (Stockley &

Christian, 2022; Tatla et al., 2015). The secondary impact of social connection with peers was also identified as a significant benefit, particularly in environments where disabilities were masked, fostering increased practice and adherence (Tatla et al., 2015). These findings parallel contemporary gaming research, where motivations include forming new friendships online, strengthening existing relationships, and maintaining family and social connections. This suggests that gaming may serve as a socially meaningful occupation for individuals with upper limb impairments, bridging rehabilitation with daily life. Given that individuals with upper limb impairments experience higher levels of social isolation, such applications are particularly relevant. Among stroke populations, a correlation has been identified between upper limb impairment and limitations in everyday occupations, decreased mood, and social isolation (Li et al., 2025). Thus, gaming's combined social and emotional benefits highlight its potential to impact overall health and well-being beyond physical recovery.

Although gaming was rarely conceptualised as a valued occupation, many devices were used to simulate everyday activities such as meal preparation, gardening, and shopping. The incorporation of immersive, "real-life" environments and increasing virtual reality efficacy through realism suggests potential for enhancing functional skills. However, the inclusion of participation measures that evaluate their effectiveness remains limited. Occupational games may be intended to bridge virtual and real-life tasks, but the absence of explicit clinical reasoning and evaluation of their efficacy on participation may limit their integration into practice and hinder meaningful rehabilitation outcomes. This highlights the need for rehabilitation clinicians and researchers to critically consider the rationale for using such technologies to maximise the benefits of these devices.

The extent to which these simulated activities were perceived as meaningful by users also remained unclear, with the transfer of skills from virtual to real-world occupations insufficiently examined (Pau et al., 2023). The benefits of engaging in meaningful occupations include fostering identity, autonomy, social connection, and competence (Hammell, 2017). Importantly, the personal meaning attributed to an activity plays a central role in rehabilitation (Hammell, 2017), distinguishing meaningful occupations characterised by choice, personal significance, and emotional engagement from purposeful, goal-directed occupations that all individuals typically engage in (Hinojosa & Kramer, 1997).

While upper limb motor recovery is important, the link between improvements in body structure/function and activity domains—and their translation into participation and occupational engagement—remains unclear. The Barthel Index (BI), the most frequently used activity outcome measure in this review, primarily assesses mobility and self-care. Although gaming-based interventions may support independence in these areas, the BI offers limited insight into broader participation or occupational engagement. Furthermore, such functional measures often fail to capture individual routines and preferences (Metcalf et al., 2007), potentially leading to misinterpretations of disability impact and discrepancies between professional and client perspectives (Nothnagl et al., 2005).

Qualitative studies within this review revealed that participants described an improvement in arm function following gaming intervention that facilitated engagement in everyday occupations, such as brushing teeth, meal preparation, turning a television knob, and making the bed (Allegue et al., 2021; Donoso Brown et al., 2015; Paquin et al., 2015). One participant described enhanced hand dexterity post-gaming that enabled them to operate an electric lawn mower and, importantly to the person, drive a sports car (Bailey, 2022). Participants also reported that engagement in gaming was attributed to perceived physical upper limb function, fun, enjoyable experiences, and feelings of self-worth (Lewis et al., 2011; Tedesco Triccas et al., 2022; Thomson et al., 2020). Although improvements in everyday function are commonly reported as primary motivations for incorporating gaming into upper limb rehabilitation, the potential for gaming to support individuals to re-engage in meaningful occupations following upper limb impairment must not be overlooked or undervalued. These findings align with current rationales for using gaming in contemporary research, however, the assessment and understanding of the impact of gaming on personally meaningful occupations remain limited.

A broader issue concerning the use of participation tools and the accuracy of these measurements has been identified (Eyssen et al., 2011). The Stroke Impact Scale (SIS) was the most frequently used participation measure in this review. The SIS is a self-reported tool that evaluates body structure and function alongside activity domains, including memory and hand function (Salter et al., 2005). Given this, it is unlikely to comprehensively measure participation and unlikely to fully align with this ICF domain. Only 3.5% of studies incorporated outcome measures assessing upper limb impairment reflecting personally meaningful goals. Specifically, eight studies employed the Canadian Occupational Performance Measure (COPM), one utilised the Goal Attainment Scale (GAS), and one implemented the Activity Card Sort (ACS). Failure to accurately assess participation and occupational engagement may hinder the understanding of the relationship between upper limb impairment, gaming, and meaningful occupational engagement. Similar challenges have been identified in research on intellectual disabilities, burns rehabilitation, and post-stroke cognition, emphasising the need for a broader exploration of participation that includes occupational engagement and is not exclusive to upper limb rehabilitation (Mole & Demeyere, 2020; Sharfi & Rosenblum, 2014).

Only one study in this review (Thomson, 2020) examined continued gaming use post-rehabilitation, highlighting its normalisation and value as a leisure occupation beyond therapeutic intent. Similarly, participants in another study acknowledged the benefits of having a gaming device at home and recommended its use to others (Paquin et al., 2016). While motivation and gamification appear to support long-term engagement, further research is needed to identify the factors that facilitate sustained use and adoption of gaming as a meaningful occupation beyond rehabilitation. Given the significant impact of upper limb impairment on independence, identity, and quality of life, rehabilitation must extend beyond functional recovery to include personally significant occupations. Framing gaming as a meaningful occupation may offer additional therapeutic benefits, and with broader acceptance and integration into rehabilitation, overlooking its occupational value risks missing a powerful opportunity to promote health, well-being, and the right to occupational engagement (Hammell, 2017).

Limitations

This review purposefully utilised a broad approach to mitigate the risk of excluding potential studies, which resulted in a large number of included articles. Despite the broad approach of this scoping review, it is possible that some relevant studies were not captured. Variability in how “occupation” and “occupational engagement” are defined may have contributed to the omission of pertinent literature. The search strategy may not have identified all relevant studies, given that grey literature and non-English publications were excluded, potentially underrepresenting international perspectives. The lack of an existing classification system to categorise gaming devices and the insufficient detail included when reporting robotic devices in the current literature could have resulted in discrepancies or inconsistencies. Future research should include clear and specific information regarding the intervention and technology used. Future research exploring the relationship between contextual variables e.g. setting and gaming device used; disciplines administering the device and country; etc will be valuable.

Conclusions

Gaming can build connections with friends and family, improve mental health and well-being and, most importantly, be enjoyed as a fun occupation. This review highlights that while many studies have explored the impact of gaming for people with upper limb impairment through the lens of occupation as an activity, few studies have explored gaming through the lens of a meaningful occupation. This gap may limit the potential to use gaming to enhance engagement in meaningful occupations, well-being, and quality of life for people with upper limb impairment. Clinicians may consider shifting their focus from using gaming devices as a therapeutic intervention to participating in a meaningful activity. Further research should develop and validate outcome measures that capture dimensions of occupational engagement, such as perceived meaning and social benefits, to bridge gaming's therapeutic and occupational roles. The inclusion of participation outcome measures may provide a better insight into occupational engagement.

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CRediT author statement

Marlies Wanasili: Conceptualisation, Methodology, Data Curation, Formal Analysis, Investigation, Writing – Original Draft, Writing – review & editing, Project administration; **Vincent Crocher:** Conceptualisation, Methodology, Formal Analysis, Investigation, Writing – review & editing; Supervision; **Danielle Hitch**: Conceptualisation, Methodology, Formal analysis, Investigation, Writing – review & editing; Supervision; **Anne Vu:** Formal Analysis, Investigation, Writing – review & editing; **Lana O'Neil:** Investigation, Writing – review & editing, **Marlena Klaic:** Conceptualisation, Methodology, Formal analysis, Investigation, Writing – review & editing; Supervision; **Catherine Said:** Conceptualisation, Methodology, Formal Analysis, Investigation, Writing – review & editing, Supervision, Project administration

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Lana O'Neil is an Occupational Therapist with expertise in stroke rehabilitation.

Dr. Marlena Klaic is an Occupational Therapist with expertise in the use of implementation science methods to identify barriers and enablers to the uptake of evidence in practice.

Professor Catherine Said is an experienced Physiotherapy researcher and clinician, with expertise in exercise and rehabilitation in older people and people with stroke.

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APPENDIX One: Scoping Review Search strategy (Medline, Embase, CINAHL, IEEE Xplore)

Ovid Medline

1 exp Video Games/
2 Exergaming/
3 Augmented Reality/
4 Robotics/
5 Screen Time/
6 exp "Play and Playthings"/
7 Virtual Reality/
8 User-Computer Interface/
9 Therapy, Computer-Assisted/
10 Gamification/
11 (gaming or gam* or gamification or virtual rehab* or augmented reality or virtual reality or "off the shel*" or "nintendo wii" or "xbox" or "x-box" or playstation* or console or software app* or mobile app* or "screen time" or robot-assisted).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
12 (gam* adj3 (rehab* or commercial or digital* or health or online or computer or video or virtual reality or serious or robotic* or computer or immersive or interactive)).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
13 entertainment.mp.
14 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13
15 exp Upper Extremity/
16 hand deformities/ or hand deformities, acquired/
17 (arm or arms or upper limb or shoulder* or forearm* or hand* or finger* or wrist* or upper extremit* or axilla).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
18 15 or 16 or 17
19 Occupational Therapy/
20 Occupational Therapists/
21 exp Leisure Activities/
22 Hobbies/
23 Recreation Therapy/
24 Pleasure/
25 Social Participation/
26 Social Identification/
27 "Activities of Daily Living"/
28 "Quality of Life"/

29 (occupation* adj3 (engagement or performance or meaningful or "based practice")).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

30 (activit* of daily living adj3 (enhanced or instrumental)).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

31 ("activit* of daily living" or "ADL" or "day-to-day activities" or "daily activities" or "functional skills" or "functional activities" or "occupation*" or "quality of life" or "social participation" or "social involvement" or "immersion" or "flow" or "engaged-behaviours" or "enjoyment" or "occupational science" or "leisure" or "recreation").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]

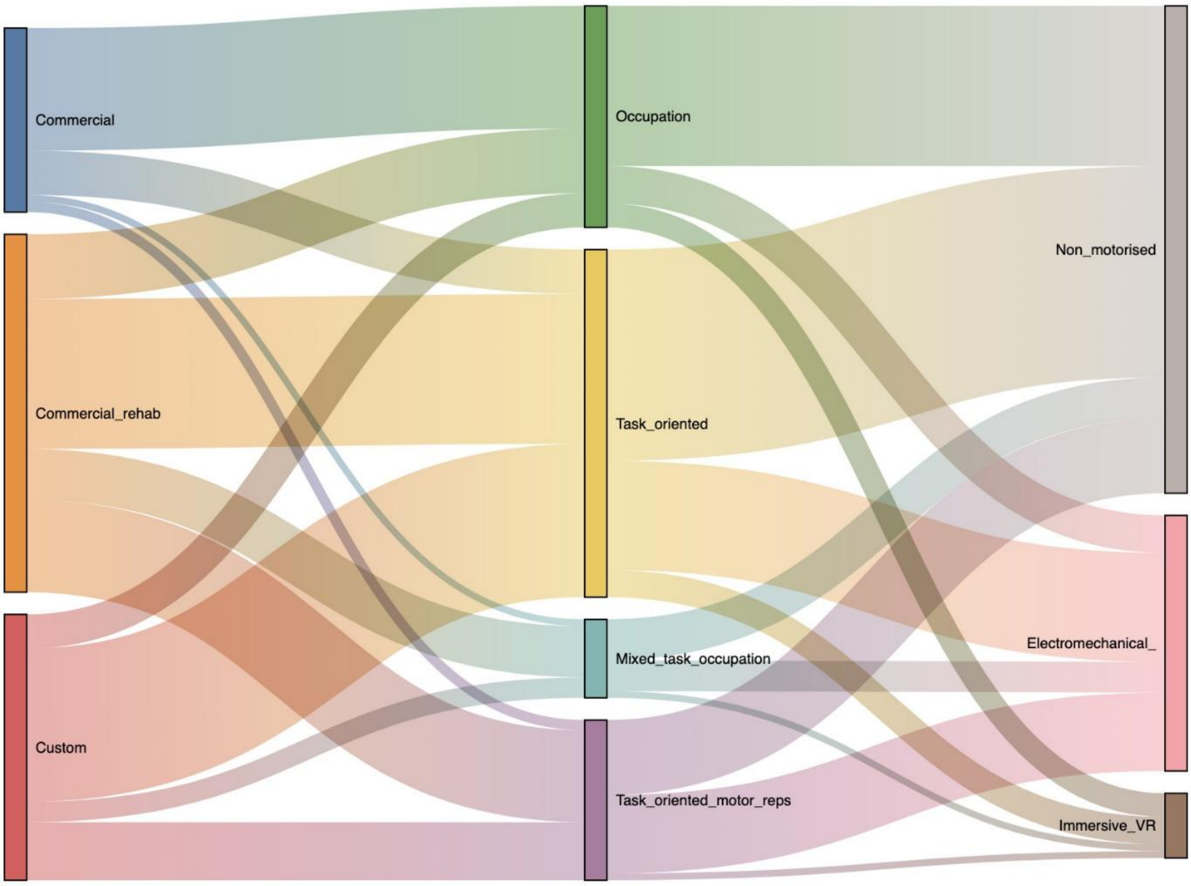
32 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31

33 14 and 18 and 32

APPENDIX Two: Examples of Outcome measures considered eligible for inclusion

Activity Outcome measures	**Participation measures**
Functional Independence Measure (FIM)	EuroQol Quality of Life Scale (EQ-5D-5L)
Barthel Index (BI)	Goal Attainment Scale (GAS)
Chedoke Arm and Hand Inventory (CAHAI)	Canadian Occupational Performance Measure (COPM)
Wolf Motor Function Test (WMFT)	Short Form – 36 (SF-36)
Motor Activity Log (MAL)	Stroke Impact Scale (SIS)
Jebsen Taylor Hand Function Test (JTHFT)	Activity Card Sort (ACS)

APPENDIX Three: Sankey diagram illustrating the relationship between type of device and game types used



Column One: intended purpose of the device e.g. Nintendo Wii; Column Two: game type; Column Three: setup of the device hardware or complexity of the system e.g. Armeo Spring

APPENDIX Four: Reference list of included studies in review

Adams, R. J., Ellington, A. L., Kuccera, K. A., Leaman, H., Smithson, C., & Patrie, J. T. (2023). Telehealth-Guided Virtual Reality for Recovery of Upper Extremity Function Following Stroke. *OTJR: Occupational Therapy Journal of Research*, *43*(3), 446-456. https://doi.org/https://dx.doi.org/10.1177/15394492231158375

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