


The Role of a Non-Immersive Interactive Technology (BITS) in Enhancing Occupational Therapy Outcomes: A Pilot Study

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ABSTRACT

Background: Non-immersive interactive technologies offer cost-effective and engaging tools for rehabilitation, yet limited research has examined occupational therapists' (OTs) perceptions of their effectiveness and clinical value. This study investigated how OTs view the role of the Bioness Integrated Therapy System (BITS) in enhancing patient outcomes.

Methodology: This pilot study used a cross-sectional survey to evaluate occupational therapists' (OTs) views of the Bioness Integrated Therapy System (BITS), a non-immersive, screen-based rehabilitation technology for visual, cognitive, and motor training. Licensed OTs (N = 10) from acute care, inpatient, and outpatient settings completed a custom-designed survey assessing perceived benefits, challenges, and satisfaction. Data were analyzed using descriptive statistics and the One-Sample Wilcoxon Signed Rank Test.

Results: There were significant agreement that non-immersive technologies improve patient motivation (Z = -2.803, p = .005), engagement (Z = -1.990, p = .047), and therapy effectiveness (Z = -2.803, p = .005). However, responses regarding training adequacy (Z = -1.051, p = .293) and promotion of independence (Z = -0.314, p = .753) were more neutral.

Conclusion: These findings suggest OTs value non-immersive technologies for supporting therapy but emphasize the need for training and integration strategies. The study highlights therapist perspectives as critical for guiding evidence-based adoption in occupational therapy practice.

Keywords: occupational therapy, non-immersive interactive technology, rehabilitation technology, patient engagement, Bioness Integrated Therapy System (BITS)

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INTRODUCTION

Occupational therapy (OT) helps people participate in daily activities and promotes independence and quality of life (WFOT, 2019). Assistive technologies (AT) support this goal by improving function and engagement for individuals with various impairments (Cook et al., 2020). Recently, digital technologies such as virtual reality (VR), motion-sensing systems, and game-based platforms have shown promise for enhancing therapy (Agrawal Dwarkadas et al., 2024). VR comes in immersive and non-immersive formats. Immersive VR uses headsets that fully surround the user, while non-immersive VR uses regular screens, motion sensors, or gaming consoles, allowing users to remain aware of their surroundings (Agrawal Dwarkadas et al., 2024; Fusco & Tieri, 2022). Non-immersive systems are typically more accessible, affordable, and practical, especially in resource-limited settings or with patients prone to cybersickness or cognitive overload (Ren et al., 2024; Soares et al., 2025).

Evidence shows that non-immersive interactive technologies can improve physical, cognitive, and psychosocial outcomes in rehabilitation. In stroke patients, non-immersive VR improves upper-extremity function, grip strength, balance, and cognition compared to traditional therapy (Lee et al., 2020; Rizvi et al., 2021). Game-based rehabilitation also enhances lower-extremity function, mobility, and adherence, with moderate training doses being most effective (Agrawal Dwarkadas et al., 2024; Kim, 2025). Exergaming can boost aerobic capacity and reduce anxiety with few side effects (Peinado-Rubia et al., 2024). For people with mild cognitive impairment or dementia, non-immersive VR improves cognition and balance and is better tolerated than immersive systems

(Ren et al., 2024; Soares et al., 2025). Non-immersive technologies also increase motivation and engagement, which are important in occupational therapy. Traditional therapy can feel monotonous, but game-based systems use real-time feedback, adaptive difficulty, and goal-oriented tasks to keep patients engaged (Agrawal Dwarkadas et al., 2024; Kim, 2025). For example, the ReHab game, as one such technology, is a system that tracks movement and adjusts challenges to fit the user, supporting motor learning and engagement (Esfahlani et al., 2018). Advances in artificial intelligence (AI) and human-computer interaction (HCI) are expanding the impact of interactive technologies in OT. AI systems can personalize therapy, analyze movement, and provide objective data for clinicians (Kansizoglou et al., 2025). Machine learning, robotics, sensors, and VR platforms are increasingly used in OT to promote meaningful participation and independence. These technologies also support clinical education through simulation, competency tracking, and remote training (Agrawal Dwarkadas et al., 2024).

Despite clear benefits, the success of non-immersive interactive technologies in occupational therapy also depends on therapist acceptance, training, and perceived value. Occupational therapists are central in choosing and adapting assistive technologies for clients (Masselink, 2018). Yet, service delivery is not always evidence-based or client-centered, and therapists often face challenges with training, time, and integrating technology into practice (Larsen et al., 2023). The Occupational Therapy Practice Framework 4th edition has also been criticized for not fully recognizing the active role of assistive technologies, which can limit their use in practice and education (Masselink, 2018). While many studies focus on the clinical

effectiveness of non-immersive technologies, fewer examine occupational therapists' views on their impact on motivation, engagement, independence, and therapy outcomes. Understanding therapist perspectives is key to evidence-based adoption, training, and ensuring that technology use aligns with professional values and client-centered care (Larsen et al., 2023; Kansizoglou et al., 2025). This study aims to assess OTs' perceptions of how a non-immersive interactive technology (the BITS) affect patient motivation, engagement, therapy effectiveness, training, and independence in clinical practice.

METHODS

Study Design: This pilot study used a cross-sectional survey to evaluate occupational therapists' (OTs) views of the Bioness Integrated Therapy System (BITS), a non-immersive, screen-based rehabilitation technology for visual, cognitive, and motor training. BITS delivers interactive tasks through a standard display with touch or motion input, letting patients practice goal-oriented activities without needing head-mounted displays (Bioness Inc., n.d.). The study focused on how OTs perceive the value, benefits, and challenges of such technologies for adoption and integration into practice. Convenience sampling recruited practicing clinicians with experience in using the BITS. Therapists not directly involved in patient care were excluded. All participants provided informed consent and completed the survey in one sitting, answering based on their clinical experience. The study was approved by the Howard University Institutional Review Board (IRB – 2025-1725).

Instrument: A custom online survey was used to collect occupational therapists' demographic information, practice background, technology use, and perceptions of BITS.

The survey included questions about clinical setting, years in practice, clinical role, experience with BITS, and frequency of its use in therapy sessions. Other questions asked about therapists' views on BITS' effectiveness for patient motivation, engagement, skill development, therapy outcomes, adequacy of training, and support for patient independence. Most responses were categorical or used a five-point Likert scale from strongly disagree to strongly agree. Survey items reflected constructs from existing research on technology adoption in rehabilitation and were reviewed by investigators for clarity and usability. The survey focused on overall impressions of BITS, not on specific modules or features (see Table 1).

Data Analysis

Data were analyzed using descriptive and nonparametric statistics suitable for ordinal data and small samples. Descriptive statistics summarized participant characteristics and survey responses (frequencies, percentages, medians, and interquartile ranges) to show overall trends and areas of agreement or neutrality. The One-Sample Wilcoxon Signed Rank Test was used on key Likert items to determine if responses differed from neutral, as it does not require normal distribution and is appropriate for small, ordinal datasets. Statistical significance was set at .05. Z values and p values were calculated for items on patient motivation, engagement, therapy effectiveness, training, and independence. As a pilot study, results emphasized direction and clinical relevance over generalizability. Open-ended responses were reviewed to provide context for the quantitative findings and guide future improvements to the instrument and study design.

Table 1: Survey Questions and Response Options

Item No.	Survey Question	Response Options
1	How many years have you been a licensed occupational therapist?	<input type="checkbox"/> 1–3 years <input type="checkbox"/> 3–5 years <input type="checkbox"/> 5–10 years <input type="checkbox"/> More than 10 years
2	What is your current primary practice setting?	<input type="checkbox"/> Acute care <input type="checkbox"/> Inpatient rehabilitation <input type="checkbox"/> Outpatient rehabilitation
3	How many years have you used the Bioness Integrated Therapy System (BITS) in clinical practice?	<input type="checkbox"/> 6 months–1 year <input type="checkbox"/> 1–2 years <input type="checkbox"/> 2–3 years <input type="checkbox"/> More than 3 years
4	How often do you use the Bioness Integrated Therapy System (BITS) in therapy sessions?	<input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Every few months <input type="checkbox"/> Every few years
5	What patient population(s) do you primarily use BITS with? (Select all that apply.)	<input type="checkbox"/> Stroke <input type="checkbox"/> Traumatic brain injury (TBI) <input type="checkbox"/> Other
6	BITS improves overall therapy effectiveness.	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
7	Patients are more motivated when using BITS during therapy sessions.	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
8	Patients engage better in therapy when BITS is used.	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
9	BITS is easy to use in clinical practice.	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
10	BITS meets the therapeutic needs of my patients.	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
11	BITS improves patients' visual attention skills.	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
12	I am satisfied with BITS as a therapeutic tool.	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
13	I feel adequately trained to use BITS in my clinical practice.	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree
14	BITS supports patient independence.	<input type="checkbox"/> Strongly disagree <input type="checkbox"/> Disagree <input type="checkbox"/> Neutral <input type="checkbox"/> Agree <input type="checkbox"/> Strongly agree

RESULTS

Participant Demographics

Figure 1 shows demographic data for the 10 licensed occupational therapists in the study. In terms of experience, 40% (4/10) had over 10 years, 30% (3/10) had 5–10 years, 20% (2/10) had 3–5 years, and 10% (1/10) had 1–3 years of practice. Therapists worked in acute care (4/10), outpatient (4/10), and inpatient rehabilitation (2/10) settings. BITS experience varied: 40% (4/10) had used it for 6 months to 1 year, 30% (3/10) for 1–2 years, 20% (2/10) for 2–3 years, and 10% (1/10) for more than 3 years. Frequency of use ranged from weekly (3/10) and monthly (3/10) to every few months (2/10) and every few years (2/10). Most therapists used BITS with post-stroke patients (6/10), followed by traumatic brain injury (3/10) and other conditions (1/10). These results highlight diversity in experience, work settings, and BITS usage patterns.

Occupational Therapists' Perceptions of BITS

One-sample Wilcoxon Signed Rank Tests assessed whether occupational therapists' perceptions of BITS were significantly different from neutral (see Figure 2). Therapists agreed that BITS improves overall therapy effectiveness ($Z = -2.803$, $p = .005$), increases patient motivation ($Z = -2.803$, $p = .005$), and enhances patient engagement ($Z = -1.990$, $p = .047$). Therapists also agreed that BITS is easy to use ($Z = -2.201$, $p = .028$), meets patient needs ($Z = -2.803$, $p = .005$), and improves visual attention ($Z = -2.201$, $p = .028$). Overall satisfaction with BITS as a therapeutic tool was also high ($Z = -2.201$, $p = .028$). However, therapists' views on training adequacy were mixed and did not differ significantly from neutral ($Z = -1.051$, $p = .293$). Similarly, responses about BITS's role in supporting patient independence were neutral and not significant ($Z = -0.314$, $p = .753$).

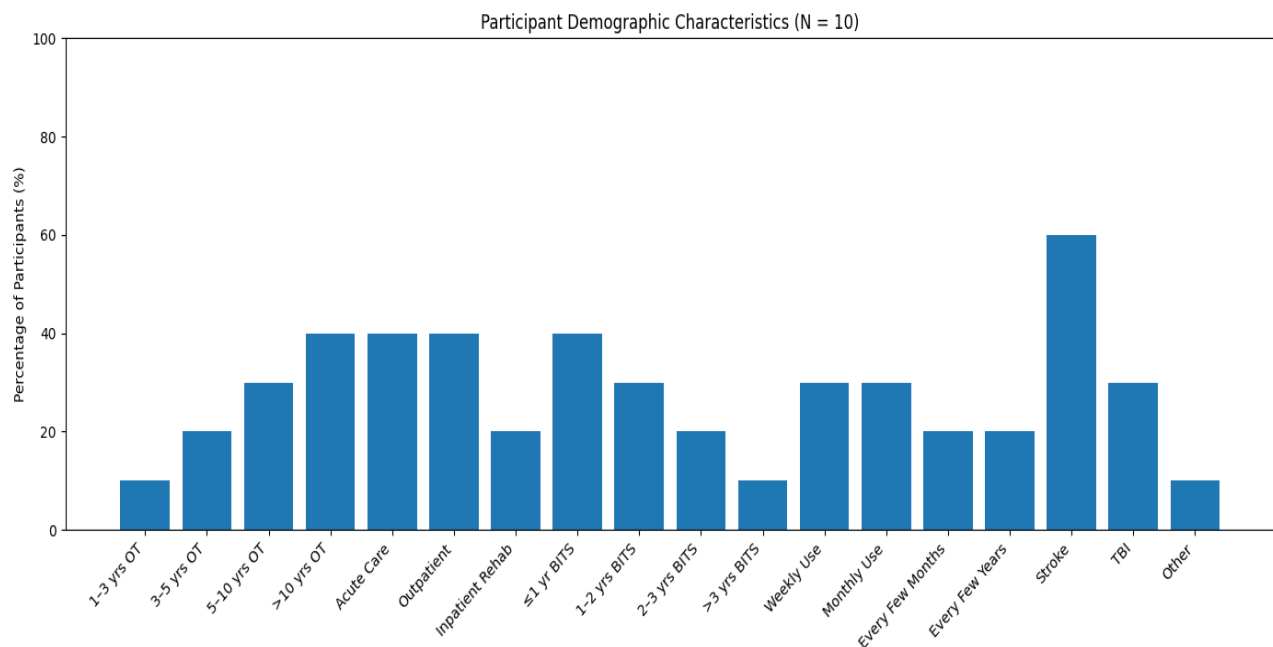


Figure 1: Frequency data for participant demographic and practice characteristics

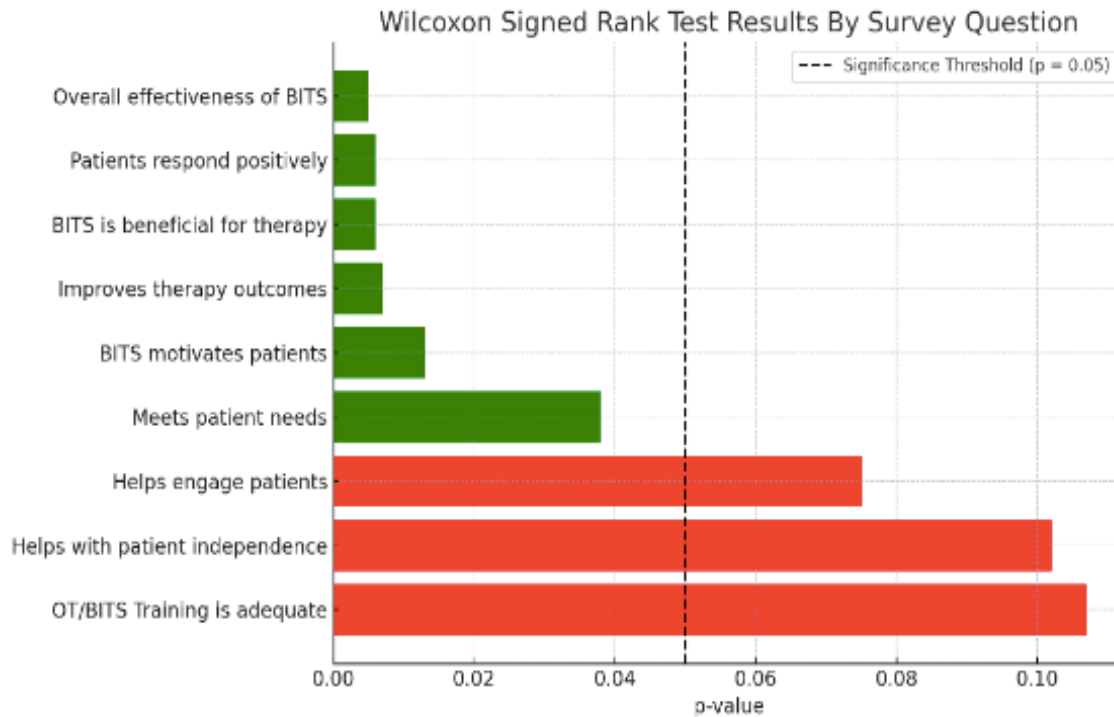


Figure 2: Wilcoxon Signed Rank Test results for occupational therapists' perceptions of the BITS

DISCUSSION

Overview of Findings: This pilot study examined occupational therapists' perceptions of the clinical value of non-immersive interactive technology, specifically the BITS, in supporting occupational therapy outcomes. Overall, findings indicate that therapists perceive BITS as an effective and valuable therapeutic tool, particularly for enhancing therapy effectiveness, patient motivation, and patient engagement. Significant agreement was also observed regarding system usability, perceived ability to meet patient needs, improvements in visual attention, and overall therapist satisfaction. In contrast, perceptions related to training adequacy and the promotion of patient independence did not differ significantly from neutral. These findings align with growing evidence that non-immersive technologies can enhance

rehabilitation processes while also highlighting persistent implementation challenges related to training and occupation-based integration (Agrawal Dwarkadas et al., 2024; Fusco & Tieri, 2022; Kansizoglou et al., 2025).

Perceived Impact on Therapy Effectiveness, Motivation, and Engagement

Therapists' strong agreement that BITS enhances therapy effectiveness and increases patient motivation is consistent with prior research demonstrating that non-immersive virtual reality (VR) and interactive technologies support active participation and task engagement during rehabilitation. Studies have shown that non-immersive, game-based interventions improve motor performance, attention, and functional outcomes across neurological populations, particularly following stroke (Kim, 2025; Lee et al., 2020; Rizvi et al., 2021). Motivation and engagement are central mechanisms through which these technologies exert therapeutic benefit, as

interactive feedback, graded task difficulty, and goal-directed activities promote sustained participation and repetition (Esfahlani et al., 2018). The moderate agreement regarding improved patient engagement further supports the use of non-immersive systems as adjunctive tools that enhance therapist-led interventions. Compared with immersive VR, non-immersive approaches may offer similar engagement benefits while remaining more accessible, tolerable, and feasible in routine clinical environments (Fusco & Tieri, 2022; Ren et al., 2024). These findings reinforce the role of non-immersive technologies as clinically viable tools that complement, rather than replace, traditional occupational therapy interventions.

Usability, Satisfaction, and Clinical Fit

Significant agreement regarding ease of use and overall satisfaction suggests that therapists perceive BITS as a feasible technology that aligns with clinical workflows. Ease of use has been consistently identified as a critical determinant of technology adoption in rehabilitation settings, where time constraints and productivity demands can limit the use of complex systems (Kansizoglou et al., 2025). Therapists' perceptions that BITS meets patient needs further indicate that the system's adaptable task design supports a range of therapeutic targets, including visual scanning, attention, reaction time, and upper-extremity coordination. Also, perceived improvements in visual attention align with existing evidence that non-immersive VR systems effectively target neurocognitive domains through repetitive, visually demanding tasks (Esfahlani et al., 2018; Ren et al., 2024). High levels of therapist satisfaction further support the system's clinical acceptability, suggesting that when technology is perceived as useful, user-friendly, and therapeutically relevant, clinicians are more likely

to integrate it into routine practice (Larsen et al., 2023).

Training Adequacy and Promotion of Independence

Despite overall positive perceptions, therapists' neutral responses regarding training adequacy highlight an important implementation gap. Similar concerns have been reported in studies examining assistive technology and digital health adoption in occupational therapy, where insufficient training and limited institutional support hinder optimal use (Larsen et al., 2023; Kansizoglou et al., 2025). Without structured onboarding and ongoing professional development, therapists may underutilize advanced system features or rely on technology primarily for impairment-level activities. Also, neutral findings regarding patient independence suggest uncertainty about how technology-based gains translate into functional performance outside therapy sessions. This aligns with broader concerns in the literature that technology use may remain siloed within preparatory or simulated activities unless explicitly linked to occupation-based goals (Maselink, 2018). From an occupational therapy perspective, independence emerges when therapeutic activities are meaningfully connected to real-world occupations. Without intentional integration, technology may enhance performance during sessions but not clearly support functional carryover.

Implications for Occupational Therapy Practice

These findings have important implications for occupational therapy practice and technology integration. Non-immersive interactive technologies such as BITS appear to be valued tools for enhancing engagement and therapy effectiveness, supporting their continued use in rehabilitation settings. However, successful adoption requires more than

access to technology alone. Structured training, competency-based education, and clinical guidelines that emphasize occupation-based application are essential to maximize therapeutic impact (WFOT, 2019). Occupational therapists may benefit from explicit frameworks that guide the use of non-immersive technologies to support participation, independence, and meaningful occupation, rather than solely impairment-focused outcomes. Aligning technology use with client-centered goals may also improve therapists' confidence in promoting independence through technology-supported interventions (Masselink, 2018; WFOT, 2019).

Limitations and Future Directions

Several limitations should be considered when interpreting these findings. The small sample size and pilot design limit generalizability, and reliance on self-reported perceptions may introduce response bias. The study did not include objective measures of patient outcomes or functional independence, limiting conclusions regarding clinical effectiveness. Additionally, variation in therapists' training backgrounds and institutional support was not formally assessed. Future research should examine the relationship between therapist perceptions, training exposure, and patient-level outcomes using larger samples and mixed-methods designs. Longitudinal studies could explore how training and experience influence sustained technology adoption and functional carryover. Qualitative investigations may further elucidate how therapists integrate non-immersive technologies into occupation-based practice and how these tools can be optimized to support independence and participation across diverse clinical populations.

CONCLUSION

This pilot study highlights occupational therapists' positive perceptions of non-immersive

interactive technologies. Specifically, therapists found the Bioness Integrated Therapy System (BITS) to be a valuable tool for enhancing therapy effectiveness, patient motivation, engagement, and visual attention in clinical practice. Therapists also considered the system user-friendly, able to meet patient needs, and satisfactory for routine use. This supports its feasibility as a complementary intervention in occupational therapy. However, therapists were neutral regarding the adequacy of training and the promotion of patient independence. This underscores the importance of structured training, ongoing professional development, and intentionally integrating technology-based activities into occupation-centered goals. Overall, these findings show the need to align non-immersive interactive technologies with evidence-based practice, therapist training, and client-centered care. Doing so can optimize therapeutic outcomes and guide informed adoption in occupational therapy practice.

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