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Teachers' Acceptance of a Mobile Telepresence Robot for the Remote Supervision of Physical Activity in Isolated Older Adults

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Conflicts of Interest

The authors declare that they have no conflict of interest.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Biographies

Nicolas Mascret is a full professor at Aix Marseille University. He works as a researcher at Institute of Movement Science. His research interests include social psychology in the sport, physical activity, and academic domains (achievement goals, psychosocial stress, technology acceptance). He is a member of the Active Aging chair.

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Jean-Jacques Temprado is a full professor at Aix-Marseille University and head of the Chair Active Aging, specializes in aging, exercise, and cognition. His research includes video games, exergames, and telepresence robots, aiming to enhance remote interventions in physical activity for older adults and advancing knowledge in healthy aging.

Abstract

In this study, we investigated the acceptance of a mobile telepresence robots (MTR) by teachers, based on the Technology Acceptance Model, for supervising adapted physical activity (APA) among isolated older adults. Previous research indicates that older adults generally accept the MTR well, but whether APA teachers exhibit hesitation following a first use is unknown, which might pose a challenge for the implementation of MTR in APA settings. The present study investigated acceptance among experienced and novice APA teachers both before and after use. It involved 20 APA teachers and 20 APA students and repeated-measures ANOVAs and one-sample *t*-tests were used to analyze the data recorded by questionnaires. Findings revealed that acceptance remained high after use, consistent with initial levels, with noteworthy increases in perceived ease of use and enjoyment post-use, with minimal variation between teachers and students. Additionally, MTR self-efficacy improved, while anxiety about robots decreased significantly after use. These results indicate a high level of acceptance of MTR among APA teachers and students for remotely supervising APA sessions with isolated older adults. It also underscores the necessity of assessing both pre- and post-use acceptance to fully comprehend the technology acceptance process.

Keywords

Technology Acceptance Model; mobile telepresence robot; physical activity; older adults; teachers

Highlights

- Isolated older adults have limited access to supervised adapted physical activity.
- The mobile telepresence robot (MTR) could be a solution to overcome this issue.
- If MTR is well accepted by older adults, teachers are initially reluctant.
- After use, MTRs are generally well accepted by teachers.

Teachers' Acceptance of a Mobile Telepresence Robot for the Remote Supervision of Physical Activity in Isolated Older Adults

1. Introduction

As the population ages and sedentary lifestyles among older adults become more prevalent (Strain et al., 2024), finding solutions to promote healthy aging through regular participation in adapted physical activity (APA) is crucial. Recent advancements in AgeTech present promising opportunities to mitigate age-related declines in functional capacity and promote “better aging”. Technologies such as computers, smartphones, and tablets play a critical role in enhancing the quality of life and independence of older adults (Singh et al., 2024). These technologies also have great potential for use in APA sessions with older adults (Manser et al., 2025; Temprado, 2021). However, while older adults may be receptive to APA-integrated technologies, APA teachers—responsible for leading these activities—may be more reluctant to use them. If the case, even if older adults are willing to adopt them, usage of technologies will inevitably decline and the market of innovative technologies dedicated to encourage older adults to be more active could be significantly impacted. Thus, the present paper addresses the timely issue of teachers' acceptance of a technology that has a great potential to help older adults breaking with sedentary lifestyle and whose development potentially depends on acceptance by APA teachers that is, mobile telepresence robot (MTR).

An MTR is a videoconferencing system mounted on a mobile base, allowing the operator to maneuver the robot around a gym and enabling more dynamic interaction with participants. Compared to traditional videoconferencing, MTRs presumably offer significant additional benefits by combining mobility with two-way video and audio communication (Wu et al., 2021). It is important to note that an MTR is neither an autonomous robot nor an AI-driven system; it must be piloted by a human (i.e., the APA teacher). The MTR used in the present study was Ubbo (Axyn Robotique™, Figure 1), a 1.60-meter-tall device that allows operators to navigate a remote environment, communicate in real time via built-in speakers and a microphone, and interact visually through its screen and dual cameras. The MTR is controlled through an online interface accessible from a computer, laptop, tablet, or smartphone, provided a Wi-Fi or 4G connection is available.



Figure 1. Picture of the Ubbo MTR. Reprinted with permission from Axyn Robotique.

MTRs offer a promising solution for overcoming the limitations of autonomous robots and videoconferencing in supervising APA for isolated older adults, particularly in the APA domain (Mascret et al., 2023). Therefore, this study primarily examines the acceptance of MTR by APA teachers. This technology is designed to facilitate remote APA instruction for isolated older adults, who do not benefit from professional physical activity supervision because they are living far from facilities that offer physical activity sessions and/or because APA teachers do not need to reach geographically remote areas thereby saving long travel times and transport costs (Navarro et al., 2024). For example, making a MTR available in the multi-purpose hall of a relatively isolated town or village would enable older adults to benefit from quality supervision by an APA professional. This supervision would take place remotely via the MTR, without the teacher having to travel, and without the need for a permanent structure dedicated to APA in the town or village, which in any case does not currently exist and would be prohibitively expensive. Supervision of the APA sessions via the MTR can be considered high quality because, unlike autonomous robots, an MTR operated by an APA teacher allows better adaptability, more effective communication of instructions, and psychological reassurance by addressing older adults' needs for human interaction. This can help reduce loneliness and even detect potential health issues, including anxiety and depression. Compared to static videoconferencing, MTRs enable teachers to observe older adults from different locations in the gym, provide real-time instructions, and offer personalized feedback. They also facilitate the supervision of group sessions more effectively than static videoconferencing. By bringing APA sessions closer to in-person experiences,

MTRs enhance personalized supervision of exercises, a crucial factor in improving functional capacity during training interventions. Given all these advantages, MTRs should, in theory, be well accepted by APA teachers. Indeed, they enable teachers to leverage their teaching expertise rather than diminish it. However, technology acceptance does not depend solely on its objective effectiveness (Ma et al., 2021).

Indeed, technology acceptance refers to the determinants of individuals' behavioral intentions to use a technology, either before experiencing it or following actual use (Alexandre et al., 2018). Understanding these determinants helps identify the variables influencing the adoption and use of new technology, as outlined in the Technology Acceptance Model (TAM; Davis et al., 1989), the most widely used model for studying technology adoption. The TAM evaluates both the intention to use a technology and its actual use. It posits that perceived ease of use and perceived usefulness are significant predictors of behavioral intention to use a technology, which in turn predicts actual use (Davis & Venkatesh, 1996). Building on the distinction initially proposed by Mayer and Girwidz (2019) in the academic context for teachers, two aspects of perceived usefulness have been identified and validated in the field of technology-based APA (Navarro et al., 2024): (i) remotely teaching APA to isolated older adults (e.g., by improving session organization or individualization) and (ii) maintaining or enhancing their physical abilities (e.g., by supporting or improving their physical performance). Perceived enjoyment has also been identified as a factor contributing to technology acceptance (Davis et al., 1992). If a technology aligns with users' expectations, preferences, and needs, scores for various TAM variables are expected to increase significantly between the pre-use and post-use phases. In other words, the more a technology is perceived as useful, easy to use and pleasant to use, the more people intend to use it, and the more they will use it. Traditionally, the TAM has been adapted to assess specific technologies, such as virtual reality devices (Mascret et al., 2020), Chat-GPT (Saif et al., 2024), assistive robots (Lee et al., 2020), and technologies designed for older adults (Chen & Chan, 2014).

To our knowledge, only four studies have examined the acceptance of MTRs for supervising older adults' physical activity. Mitzner et al. (2017) found that older adults with mobility impairments were more likely to accept MTRs if they perceived benefits such as usefulness and ease of use. In a previous study using the MTR Ubbo (Mascret & Temprado, 2023), 230 older adults were surveyed regarding their acceptance of MTRs before use. Results indicated a moderate perception of usefulness, ease of use, and enjoyment, but no

strong intention to use it—though it was not rejected either. Mascret et al. (2023) evaluated acceptance after actual use and found that older adults viewed the MTR Ubbo as useful, easy to use, and enjoyable, with an intention to use it for APA. Thus, while older adults reported good acceptance of MTRs for remote APA sessions, the question remains of whether APA teachers accept MTRs? Addressing this question is essential, as the potential of MTRs to facilitate remote physical activity for older adults hinges on teacher acceptance. Otherwise, the potential of Ubbo (and more broadly, MTRs) to encourage them to engage in remote physical activity would be limited. We addressed this issue in a previous study (Navarro et al., 2024) and found that, prior to first use, both experienced APA teachers and novice APA students exhibited similar levels of initial acceptance of MTRs for remotely teaching APA. Specifically, before using an MTR for the first time, they underestimated its relevance to their professional tasks and tended to reject the technology. However, they acknowledged the potential of MTRs (particularly Ubbo) to maintain or enhance the physical abilities of isolated older adults through remote APA interventions. This apparent contradiction suggested that their acceptance of the robot might increase after using it. Indeed, it is widely recognized (e.g., Venkatesh & Bala, 2008) that acceptance can significantly evolve (i.e., increase, decrease, or remain stable) after using a technology compared to initial acceptance before use. These scenarios require further investigation, as studies examining the evolution of technology acceptance before and after use remain relatively scarce in the literature (Scherer et al., 2019). This was the primary objective of the present study.

The present study also pursued two secondary objectives. First, to explore differences in MTR acceptance between experienced APA teachers and novice APA teachers (students), both of whom are key stakeholders in this context. Little is known about this issue. In general, studies report inconsistent findings regarding differences in technology acceptance between teachers and students training to become teachers. Some studies suggest that teachers and students perceive and accept technology differently (e.g., Russell et al., 2003), whereas others report similar attitudes and intentions to use technology (e.g., Teo, 2015). APA students have greater familiarity with technology in daily life and in their academic curriculum, which incorporates technological tools. Consequently, in APA sessions remotely supervised by MTRs, one could hypothesize that APA students would exhibit higher initial acceptance scores for MTRs compared to APA teachers. However, in a previous study, Navarro et al. (2024) found no significant differences between APA teachers and APA students in any of the MTR acceptance scores before first use. Therefore, it is relevant to determine whether this

lack of difference persists after actual use of the MTR. This was one of the objectives of the present study.

Second, as external variables have traditionally been incorporated into the TAM to enhance its explanatory power (Davis et al., 1989, 1992), two complementary variables were added to the present study: robot self-efficacy and perceived anxiety. The first variable -- robot self-efficacy -- refers to an individual's belief in his/her ability to mobilize the motivation, cognitive resources, and actions required to use a robot (in this case, an MTR; Wood & Bandura, 1989; Yang, 2010). This variable was included in the study because it is known to positively influence perceived ease of use (Igarria & Iivari, 1995; Navarro et al., 2024) and has been positively correlated with acceptance (Latikka, Turja, & Oksanen, 2019). Moreover, self-efficacy can potentially increase or decrease after using a robot. Specifically, a negative experience with an MTR may lower robot self-efficacy, whereas a positive experience may increase it. The second variable was perceived anxiety related to MTRs. It reflects the extent to which an individual feels anxious or experiences discomfort when interacting with a robot (Heerink et al., 2010). Anxiety related to robots is particularly widespread among older adults (Deutsch, Erel, Paz, Hoffman, & Zuckerman, 2019). Research on robot acceptance has primarily focused on users' psychological responses, particularly negative attitudes toward robots, such as anxiety (Toji, Ho, Tsarenko, & Pentina, 2022): the higher the anxiety, the lower the acceptance of robots. Identifying changes in MTR self-efficacy and MTR-related anxiety before and after use among APA teachers and APA students was the third objective of this study.

In summary, the present study pursued three objectives. The first one was to measure MTR acceptance before and after use among APA teachers and APA students when the MTR is employed to remotely supervise APA sessions for isolated older adults. We hypothesized that initial acceptance scores among APA teachers and APA students would be relatively low (Navarro et al., 2024) but would increase as they gained experience using the MTR. The second objective was to compare MTR acceptance between APA teachers and APA students before first use and throughout the session in which they used the MTR. We hypothesized that no significant differences would emerge between APA students and APA teachers before using the MTR (Navarro et al., 2024) and that acceptance scores would be higher after use among APA students compared to APA teachers. Finally, the third objective was to investigate changes in MTR self-efficacy and MTR-related anxiety among APA teachers and

APA students before and after using the MTR to remotely supervise APA sessions. We hypothesized that MTR self-efficacy would increase after use compared to before use and that MTR-related anxiety would decrease.

2. Methods

2.1. Participants

In total, 40 French volunteers (14 men and 26 women) aged between 21 and 50 ($M_{\text{age}} = 27.73$ years, $SD = 8.17$) participated in the present study. The main inclusion criterion for participation was being either a professional APA teacher or a student enrolled in a university-level APA diploma program (e.g., higher education leading to an APA teaching qualification). Participants were also required to have never previously used an MTR. Students were recruited from a university and were enrolled in the APA diploma program in their second, third, fourth, or fifth year. Teachers were recruited from institutions for individuals with disabilities, rehabilitation and recuperative care facilities, or were independent APA teachers.

To determine the required sample size, a statistical power analysis was conducted using G*Power software 3.1 (Faul et al., 2007). The estimated necessary sample size was 32 participants in total (16 per group) to achieve a statistical power of over 80%, assuming a medium effect size of 0.3 (based on the work of King & He, 2006) and $\alpha = 0.05$. However, to account for potential dropouts or issues during data collection, 40 participants were included in the study. The sample was divided into two groups: the APA student group, consisting of 20 participants (7 men and 13 women) aged between 21 and 28 ($M_{\text{age}} = 22.75$ years, $SD = 1.83$), and the APA teacher group, consisting of 20 participants (7 men and 13 women) aged between 23 and 50 ($M_{\text{age}} = 32.70$ years, $SD = 9.02$).

2.2. Experimental procedure

The present study design was based on a quasi-experimental, repeated-measures design. First, participants were welcomed into the laboratory in groups of four professional APA teachers or four APA students (no mixed groups). They were led to the experimental room, where they first signed the consent form and provided general information, including sex, age, diploma level, prior interactions with a “social” robot (i.e., a robot with or without artificial intelligence that allows interaction through speech), the frequency of teaching APA

to older adults, and their familiarity with using technology to teach APA. The experimental procedure was divided into three phases.

In the first phase, participants read a text with pictures introducing the MTR, detailing its characteristics and potential use for remotely teaching APA to isolated older adults. Afterward, each participant completed a questionnaire measuring various variables related to MTR acceptance before use (Measuring Time 1, MT1). At this stage of the study, participants had not yet seen or used the MTR. The purpose of this questionnaire was to assess their initial acceptance based on their preconceived notions, MTR self-efficacy, and perceived MTR-related anxiety.

In the second phase, APA teachers and APA students took on the role of older adults participating in an APA session. They were introduced to the MTR and performed a cognitive-motor task adapted for older adults, conducted by the experimenter via the MTR. The task was an adaptation of the Square Stepping Exercise (SSE), designed to engage lower-extremity functional coordination in older adults to help reduce the risk of falls (Shigematsu et al., 2006, 2008). This task had previously been used in a study with older adults in APA sessions supervised by an MTR (Mascret et al., 2023).

Participants walked along a mat measuring 2.50 meters in length and 1 meter in width, divided into 40 squares, each with a side length of 25 centimeters. Each square contained a number between 1 and 6, forming a repeated sequence (see Figure 2). Participants were instructed to walk on the mat, following the numbers in ascending order while alternating between their right and left foot. They had to cross the mat as quickly as possible without stepping on the lines separating the squares and without making mistakes in the sequence. Two different mats were used, each featuring a different level of difficulty: the first included forward and lateral movements, while the second additionally incorporated backward movements. During the task, the experimenter interacted with the participants through the MTR to help them experience the perspective of an older adult. The experimenter moved around the room using the MTR, adjusted the MTR's swivel head to modify their viewpoint, encouraged the participants, provided motor and strategic feedback, and engaged in conversation with them. After completing the task during seven minutes, each participant in the group filled out a questionnaire assessing their acceptance, MTR self-efficacy, and perceived MTR-related anxiety after experiencing an APA session supervised by the MTR (Measuring Time 2, MT2).

	6		
	4	5	
		3	
	2	1	
	6		
	4	5	
		3	
	2	1	

6	1	5	
2	4	3	
6	1	5	
2	4	3	
6	1	5	
2	4	3	
6	1	5	
2	4	3	

Figure 2. The two mats used in the present study, based on the Square Stepping Exercise (Shigematsu et al., 2006, 2008)

In the third phase lasting a total of 25 minutes, participants manipulated the robot themselves and supervised a remote task (the same task as in the previous phase). The experimenter introduced the robot control interface to the participants. First, she presented the user interface, explaining its appearance and the two available camera views: one from the camera located on the head of the MTR and another showing the robotic base to assist with spatial orientation. Then, they learned how to use the various functionalities of the MTR (e.g., how to move forward or backward, turn right or left, tilt and rotate the robot’s head, configure the sound, and control the movement speed). The experimenter also explained the anti-collision safety function, which notifies the user with a red line when the sensors on the robotic base detect an obstacle in the direction of movement. At this point, each participant took turns piloting the MTR to supervise the experimental task, while the other group members acted as participants in the task. Once all four participants had piloted the MTR, they each completed the same questionnaires used in the previous phases (Measuring Time 3, MT3).

In summary, MT1 took place after reading a text with photos introducing the MTR (acceptance before use), MT2 took place after attending an APA session supervised by the experimenter using the MTR (acceptance after use as a participant), and MT3 took place after conducting a remote APA session by piloting the MTR (acceptance after use as an APA teacher). Consequently, a 3 (Time: MT1, MT2, MT3) × 2 (Groups: APA teachers, APA students) design was used in the present study. The study was approved by the National Ethics Committee (ref. IRB00012476-2023-25-05-253).

2.3. Measures

Acceptance of the MTR. The TAM questionnaire specifically designed to assess acceptance of the MTR intended to supervise remote APA (Navarro et al., 2024) was used in the present study. The participants scored the 15 items on a Likert scale from 1 (strongly disagree) to 5 (strongly agree), with three items assessing each of the five variables of the TAM: perceived usefulness for teaching APA to older adults (e.g., “*I think that MTR would be useful to teach remotely APA to isolated older adults*”), perceived usefulness for keeping or improving older adults’ physical skills (e.g., “*Using MTR to teach APA would allow keep or improve isolated older adults’ physical skills*”), perceived ease of use (e.g., “*I think that using MTR to teach remotely APA to isolated older adults would be easy*”), perceived enjoyment (e.g., “*Using MTR to teach remotely APA to isolated older adults would be enjoyable*”), and intention to use (e.g., “*If I had the opportunity to have access to this MTR, I probably will use it to teach remotely APA to isolated older adults*”). Internal consistency was verified by McDonalds’ omegas (Dunn et al., 2014). They ranged from .780 to .980 and they were consequently acceptable for all the TAM variables at each measurement time.

Additional measures. MTR self-efficacy was assessed through three items measuring technology self-efficacy (Yang, 2010) adapted to the MTR (e.g., “*I would feel confident that I can use a mobile telepresence robot*”). MTR perceived anxiety (Heerink et al., 2010) was assessed through four items (e.g., “*I find the MTR scary*”). All the items were scored on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Internal consistency was acceptable for MTR self-efficacy (with McDonalds’ omegas ranging from .733 to .856) and for MTR perceived anxiety (with McDonalds’ omegas ranging from .745 to .778).

Each questionnaire was administered three times: before using the MTR (MT1), after using it as a participant (MT2), and after using it as an APA teacher (MT3). Descriptive statistics and results of internal consistency are presented in Table 1.

2.4. Data analyses

All the analyses were conducted with the JASP software (version 0.16.2.0) and a significant threshold at $p < .05$. Data normality was tested for each variable with skewness value $\leq |2|$ and Kurtosis value $\leq |7|$ (Curran et al., 1996). Then, Levene tests were used to check the homogeneity of each participant’s group variance for each variable and Mauchly’s tests were used to check sphericity. Two main data analyses were used in the present study.

Repeated measures ANOVAs were conducted on the scores of perceived usefulness for teaching APA to isolated older adults, perceived usefulness for keeping or improving their

physical skills, perceived ease of use, perceived enjoyment, intention to use, MTR self-efficacy, and MTR perceived anxiety, to reveal possible effects of Time, Group, and Time X Group interaction. Partial eta-squared (η_p^2) was used to calculate effect sizes and Holm tests were used to evaluate potential differences post-hoc.

One sample *t*-tests were then conducted for each of the previous variables at each measurement time to compare APA students' and APA teachers' acceptance scores with the mean of the Likert scale, to identify whether their score was significantly higher, significantly lower, or non-significantly different from the mean of the scale. For a 5-point Likert scale in which each response is coded between 1 and 5, the mean of the scale is 3. In scales for which there are no set standards, the scale mean is a threshold value that can be used to determine whether a score is above or below this threshold value. One-sample *t*-tests can be used to determine whether this difference is significant or not (Meek et al., 2007). Effect sizes were calculated using Cohen's *d*.

3. Results

3.1. Preliminary results

Data normality was validated with skewness values (max = 1.758) and Kurtosis values (max = 1.866) in line with Curran et al.'s (1996) recommendations. The variance homogeneity of the two groups has been confirmed ($p > .099$). However, Mauchly's tests of sphericity indicated that the assumption of sphericity was violated ($p < .05$). Consequently, Greenhouse-Geisser corrections were applied for all the following repeated measures ANOVA.

3.2. Main results: Acceptance of the MTR

3.2.1. Evolution of acceptance with MTR use

A significant effect of Time was found on the perceived ease of use scores ($F(1.840, 69.937) = 7.511, p = .001, \eta_p^2 = .165$). Holm post-hoc tests indicated that perceived ease of use significantly increased for the whole sample between MT1 and MT3 ($p < .001$) and between MT2 and MT3 ($p = .023$), but not between MT1 and MT2 ($p = .231$). No significant effects of Group, and Time X Group interaction were found for perceived ease of use (respectively $p = .185$ and $p = .120$).

A significant effect of Time was found on the perceived enjoyment scores ($F(1.456, 55.345) = 3.578, p = .048, \eta_p^2 = .086$). Holm post-hoc tests indicated that perceived enjoyment significantly increased between MT1 and MT3 only ($p = .046$). A significant

interaction effect between Time and Group was also found on the perceived enjoyment scores ($F(1.456, 55.345) = 4.867, p = .020, \eta_p^2 = .114$). Holm post-hoc tests indicated that perceived enjoyment significantly increased between MT1 and MT3 for the APA students' group only ($p = .003$). No significant effect of Group was found for perceived enjoyment ($p = .713$).

Finally, no significant effects of Time, Group, and Time X Group interaction were found for perceived usefulness for teaching APA (respectively $p = .522, p = .355, \text{ and } p = .082$), perceived usefulness for keeping or improving older adults' physical skills (respectively $p = .246, p = .261, \text{ and } p = .455$), and intention to use (respectively $p = .137, p = .486, \text{ and } p = .760$).

3.2.2. Levels of acceptance

The results of the one sample *t*-tests highlighted that the whole sample's scores of perceived usefulness for teaching APA, perceived usefulness for keeping or improving older adults' physical skills, perceived ease of use, perceived enjoyment, and intention to use were significantly higher than the mean of the Likert scale at each measurement time (all $p < .006$, with Cohen' *d* ranging between .461 and 2.071).

The global tendency was similar for the APA teachers' group (all $p < .017$, with Cohen' *d* ranging between .584 and 1.835), except for intention to use at MT2 ($p = .056$) and at MT3 ($p = .083$), indicating that APA teachers' intention to use the MTR was not significantly different from the mean of the scale.

The global tendency was similar for the APA students' group (all $p < .034$, with Cohen' *d* ranging between .510 and 2.328), except for perceived ease of use at MT1 ($p = .541$) and at MT2 ($p = .207$), indicating that APA students' perceived ease of use was not significantly different from the mean of the scale.

3.3. Additional results: MTR self-efficacy and MTR perceived anxiety

3.3.1. Evolution of MTR self-efficacy and MTR perceived anxiety

A significant effect of Time was found on the MTR self-efficacy scores ($F(1.469, 55.822) = 18.423, p < .001, \eta_p^2 = .327$). Holm post-hoc tests indicated that MTR self-efficacy significantly increased for the whole sample between MT1 and MT3 ($p < .001$) and between MT2 and MT3 ($p < .001$), but not between MT1 and MT2 ($p = .277$). No significant effects of Group, and Time X Group interaction were found for MTR self-efficacy (respectively $p = .145$ and $p = .546$).

A significant effect of Time was found on the MTR perceived anxiety scores ($F(1.711, 65.007) = 3.773, p = .034, \eta_p^2 = .090$). Holm post-hoc tests indicated that MTR perceived anxiety significantly decreased for the whole sample between MT2 and MT3 ($p = .027$), but not between MT1 and MT2 ($p = .408$) and between MT1 and MT3 ($p < .136$). No significant effects of Group, and Time X Group interaction were found for MTR perceived anxiety (respectively $p = .273$ and $p = .245$).

3.3.2. Levels of MTR self-efficacy and MTR perceived anxiety

The results of the one sample *t*-tests highlighted that the whole sample's scores of MTR self-efficacy were not significantly different from the mean of the scale at MT1 ($p = .264$) and at MT2 ($p = .054$) but became significantly higher than the mean of the scale at MT3 ($p < .001, d = 1.202$). The tendency was different according to groups. MTR self-efficacy was significantly higher from the mean of the scale for the APA teachers' group at MT1 ($p = .028, d = .530$), MT2 ($p = .009, d = .655$), and MT3 ($p < .001, d = 1.427$). MTR self-efficacy was not significantly different from the mean of the scale for the APA students' group at MT1 ($p = .894$) and MT2 ($p = .745$) but became significantly higher than the mean of the scale at MT3 ($p < .001, d = 1.002$).

The results of the one sample *t*-tests highlighted that the whole sample's scores of MTR perceived anxiety were significantly lower than the mean of the scale at MT1 ($p < .001, d = -.693$), MT2, ($p = .002, d = -.517$) and MT3 ($p < .001, d = -.875$). The tendency was the same for the APA teachers' group at MT1 ($p < .001, d = -1.268$), MT2 ($p = .014, d = -.608$), and MT3 ($p < .001, d = -1.123$). But differences appeared for the APA students' group: MTR perceived anxiety was not significantly different from the mean of the scale at MT1 ($p = .128$) and MT2 ($p = .080$) but became significantly lower than the mean of the scale at MT3 ($p = .001, d = -.857$).

Detailed results are presented in Table 1, and a graphical representation of the results is shown in Figures 3 and 4.

		Full sample			APA teachers			APA students			
		MT1	MT2	MT3	MT1	MT2	MT3	MT1	MT2	MT3	
Perceived usefulness for teaching APA	Mean	3.650	3.692	3.775	3.683	3.567	3.533	3.617	3.817	4.017	
	Std. deviation	0.823	0.882	0.898	0.783	0.873	0.914	0.880	0.895	0.834	
	McDonald's Ω	.782	.819	.895	.812	.862	.881	.776	.779	.905	
	One sample <i>t</i> tests	<i>t</i>	4.933	4.962	5.461	3.901	2.904	2.610	3.132	4.081	5.451
		<i>p</i>	< .001	< .001	< .001	< .001	.009	0.17	.005	< .001	< .001
	<i>d</i>	0.790	0.785	0.863	0.872	0.649	0.584	0.700	0.913	1.219	
Perceived usefulness for older adults	Mean	4.375	4.400	4.275	4.283	4.300	4.100	4.467	4.500	4.450	
	Std. deviation	0.733	0.676	0.798	0.767	0.708	0.918	0.704	0.644	0.633	
	McDonald's Ω	.921	.935	.939	.908	.943	.948	.935	.937	.916	
	One sample <i>t</i> tests	<i>t</i>	11.871	13.098	10.099	7.484	8.208	5.357	9.314	10.411	10.242
		<i>p</i>	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001
	<i>d</i>	1.877	2.071	1.597	1.674	1.835	1.198	2.083	2.328	2.290	
Perceived ease of use	Mean	3.433	3.608	3.983	3.717	3.850	3.983	3.150	3.367	3.983	
	Std. deviation	0.940	1.094	0.918	0.695	0.868	0.745	1.079	1.256	1.084	
	McDonald's Ω	.814	.925	.895	.842	.888	.780	.818	.938	.972	
	One sample <i>t</i> tests	<i>t</i>	2.914	3.518	6.773	4.156	4.377	5.902	0.622	1.305	4.057
		<i>p</i>	.006	.001	< .001	< .001	< .001	< .001	.541	.207	< .001
	<i>d</i>	0.461	0.585	1.597	0.929	0.979	1.320	0.139	0.292	0.907	
Perceived enjoyment	Mean	3.525	3.758	3.800	3.667	3.683	3.600	3.383	3.833	4.000	
	Std. deviation	0.739	0.874	0.957	0.717	0.940	0.995	0.751	0.820	0.898	
	McDonald's Ω	.780	.924	.944	.767	.940	.944	.806	.914	.949	
	One sample <i>t</i> tests	<i>t</i>	4.492	5.489	5.286	4.156	3.253	2.698	2.281	4.544	4.978
		<i>p</i>	< .001	< .001	< .001	< .001	.004	.014	.034	< .001	< .001
	<i>d</i>	0.710	0.868	0.836	0.929	0.727	0.603	0.510	1.016	1.113	
Intention to use	Mean	3.975	3.733	3.717	3.900	3.583	3.567	4.050	3.883	3.867	
	Std. deviation	1.079	1.255	1.326	1.180	1.284	1.385	0.993	1.238	1.281	
	McDonald's Ω	.955	.967	.980	.952	.967	.977	.960	.972	.989	
	One sample <i>t</i> tests	<i>t</i>	5.714	3.697	3.418	3.410	2.032	1.829	4.730	3.188	3.025
		<i>p</i>	< .001	< .001	.001	.003	.056	.083	< .001	.005	.007
	<i>d</i>	0.903	0.585	0.540	0.763	0.454	0.409	1.058	0.713	0.676	
MTR self-efficacy	Mean	3.167	3.317	3.950	3.367	3.550	4.050	2.967	3.083	3.850	
	Std. deviation	0.931	1.010	0.790	0.682	0.840	0.736	1.102	1.128	0.848	
	McDonald's Ω	.789	.856	.733	.775	.786	.764	.902	.928	.781	
	One sample <i>t</i> tests	<i>t</i>	1.133	1.983	7.605	2.371	2.929	6.383	-0.135	0.330	4.483
		<i>p</i>	.264	.054	< .001	.028	.009	< .001	.894	.745	< .001
	<i>d</i>	0.179	0.314	1.202	0.530	0.655	1.427	-0.030	0.074	1.002	
MTR perceived anxiety	Mean	2.375	2.487	2.125	2.112	2.375	2.087	2.638	2.600	2.163	
	Std. deviation	0.902	0.992	0.888	0.700	1.028	0.812	1.108	0.968	0.978	
	McDonald's Ω	.753	.745	.778	.766	.750	.741	.815	.725	.847	
	One sample <i>t</i> tests	<i>t</i>	-4.381	-3.268	-6.232	-5.670	-2.720	-5.024	-1.593	-1.848	-3.381
		<i>p</i>	< .001	.002	< .001	< .001	.014	< .001	.128	.080	.001
	<i>d</i>	-0.693	-0.517	-0.985	-1.268	-0.625	-1.123	-0.356	-0.413	-0.857	

Table 1. Descriptive statistics, internal consistency, and results of the one-sample t tests.

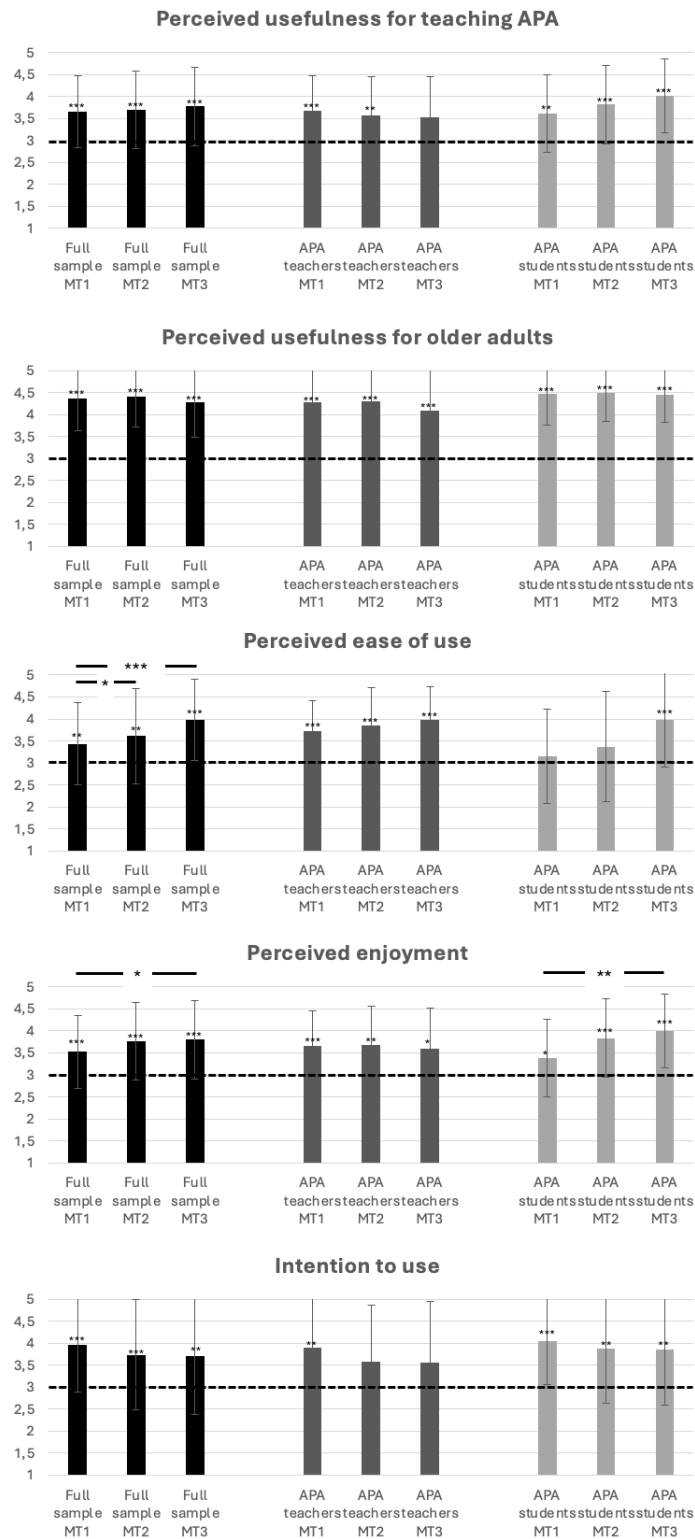


Figure 3. Scores of each variable of the TAM according to Measurement Time (MT) and Group (Full sample, APA teachers, APA students). *Notes.* The dotted line represents the mean of the scale. The stars at the top of each histogram bar represent a significant difference in score from the scale mean ($*p < .05$, $**p < .01$, $***p < .001$). Stars embedded in the middle of a horizontal line represent significant differences between measurement times.

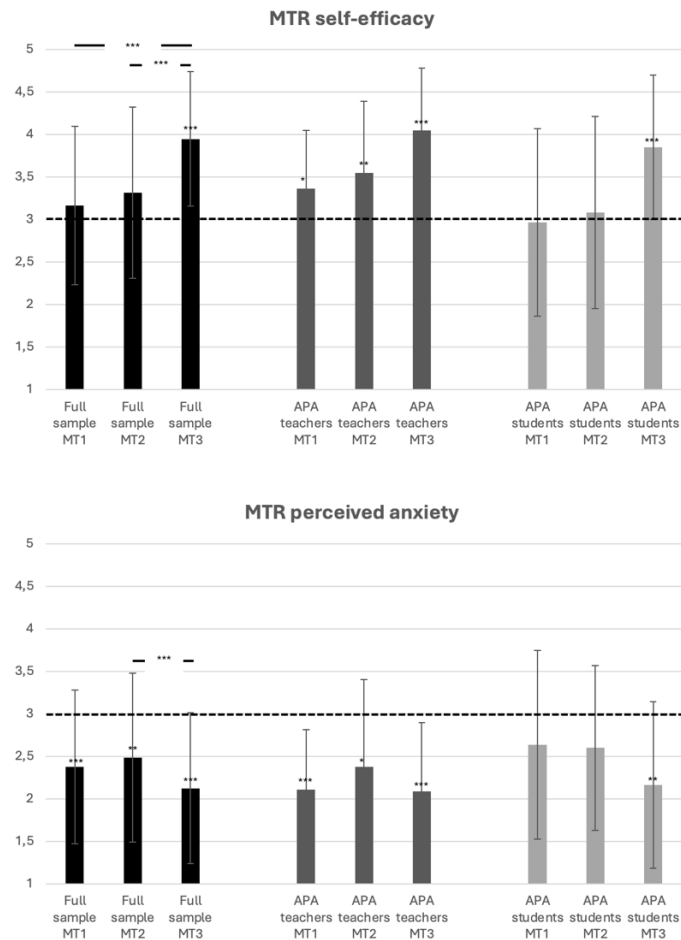


Figure 4. Scores of MTR self-efficacy and MTR perceived anxiety according to Measurement Time (MT) and Group (Full sample, APA teachers, APA students). *Notes.* The dotted line represents the mean of the scale. The stars at the top of each histogram bar represent a significant difference in score from the scale mean ($*p < .05$, $**p < .01$, $***p < .001$). Stars embedded in the middle of a horizontal line represent significant differences between measurement times.

4. Discussion

The study pursued three main objectives. First, evaluating APA teachers' acceptance of the MTR both prior to and following its use in the remote supervision of APA sessions with socially isolated older adults. Second, comparing MTR acceptance levels between teachers and students, with particular attention to differences observed before initial exposure and during active use of the MTR. Finally, the study also investigated changes in MTR-related self-efficacy and anxiety among teachers and students by assessing their levels before and after employing the MTR for remote supervision of APA sessions.

4.1. Acceptance of the MTR

Prior research indicates that technology acceptance can vary substantially following use compared to pre-use levels (Venkatesh & Bala, 2008). Acceptance may increase, decrease, or remain at a similar level depending on whether the technology aligns with users' expectations, needs, and capabilities. In the present study, acceptance was assessed across three measurement times (MT): MT1 (prior to first use of the MTR), MT2 (after performing a perceptual-motor task under MTR supervision), and MT3 (after piloting the MTR).

Findings revealed significant increases in perceived ease of use between MT1 and MT3, and between MT2 and MT3, but not between MT1 and MT2. Perceived enjoyment similarly increased between MT1 and MT3. These results suggest that piloting the MTR, rather than participating in a supervised session, was critical for enhancing both perceived ease of use and enjoyment. This outcome is consistent with evidence that progressive skill acquisition promotes technology acceptance (Kher et al., 2013). The intuitive interface of the Ubbo MTR likely facilitated rapid appropriation and skill development, presumably explaining the observed gains in ease of use. Increases in enjoyment may also reflect improved piloting competence, the ability to achieve virtual presence, and opportunities for remote interaction in supervising APA sessions. More broadly, the findings underscore the importance of direct hands-on experience, as opposed to demonstrations alone, in shaping acceptance.

In contrast, no significant changes were observed for perceived usefulness (teaching APA, maintaining or improving older adults' physical skills) or intention to use. While this might be interpreted as an absence of improvement, overall scores for perceived usefulness, ease of use, enjoyment, and intention to use were consistently above the scale midpoint at all three time points. This indicates that APA teachers and students generally perceived the MTR as useful, easy, and enjoyable to use, and expressed intention to use it throughout the study. Therefore, a lack of significant score increase does not necessarily mean the MTR has no impact on acceptance. Rather, it suggests that acceptance remained high after use, consistent with initial levels. However, while the absolute values of the whole sample remained above the scale midpoint across time points, a closer look on the results reveals a downward trend in the intention to use scores, especially among the teacher group, which will be discussed in the following section.

In sum, the results showed that the MTR was well-accepted before use by APA teachers and students to remotely supervise APA sessions, that certain dimensions of acceptance (perceived ease of use and enjoyment) improved post-use, while others remained stable but with high scores (despite a slight downward trend in intention to use scores). These findings contrast with those reported by Navarro et al. (2024), who documented initial resistance and underestimation of MTR relevance among APA professionals. The discrepancy may be attributable to methodological differences: Navarro et al. relied on online surveys of 334 participants prior to actual use, whereas the present experimental study involved 40 participants engaging directly with the MTR under controlled laboratory conditions approximating real-world APA practice. The opportunity for hands-on engagement may explain the higher initial acceptance observed here. Collectively, the findings strongly suggest that APA teachers and students exhibit high acceptance of the MTR for the remote supervision of APA sessions with socially isolated older adults.

4.2. Differences in acceptance between APA teachers and APA students

Previous research has reported mixed findings regarding differences in technology acceptance between experienced and novice teachers, with some studies indicating differences (Russell et al., 2003) and others reporting none (Teo, 2015). In the present study, differences between APA teachers and students emerged only for specific TAM variables. Perceived enjoyment increased significantly from MT1 to MT3 for students but not for teachers. As defined by Davis et al. (1992), perceived enjoyment reflects intrinsic motivation, or the pleasure derived from the activity itself. APA students appeared more eager to explore the MTR, while teachers' enjoyment remained high but stable across measurement points (Van der Heijden, 2004).

Differences were also observed for intention to use and perceived ease of use. Teachers' intention to use the MTR was initially high (MT1) but stabilized at mean levels after actual use (MT2 and MT3), reflecting a neutral stance often observed with novel or disruptive technologies (Huygelier et al., 2019), particularly among more experienced teachers prone to resistance to change (Khalil, 2013; Bhattacharjee & Hikmet, 2007). *Thus, testing the MTR as a participant and as a pilot has led APA teachers to adopt a balanced position regarding their intention to use it to supervise APA sessions for isolated seniors: they neither intend to use it, nor to reject it, while they had intended to use it before actually testing it*". By contrast, students consistently reported higher intention to use the MTR.

Regarding perceived ease of use, teachers consistently scored above the scale midpoint at all measurement times, whereas students initially adopted a neutral position (MT1 and MT2) despite their greater familiarity with technology. After piloting the MTR (MT3), students' perceived ease of use increased significantly, highlighting the critical role of hands-on experience in shaping positive perceptions of usability.

4.3. Self-efficacy and perceived anxiety

First, MTR self-efficacy increased significantly for the entire sample between MT1 and MT3, and between MT2 and MT3, but not between MT1 and MT2. Scores were initially at the scale midpoint (MT1 and MT2) and became significantly higher at MT3, consistent with Navarro et al. (2024) and prior evidence that hands-on experience enhances self-efficacy and technology acceptance (Latikka, Turja, & Oksanen, 2019).

Second, perceived anxiety decreased significantly between MT2 and MT3, while remaining below the scale midpoint at all measurement points. APA teachers and students reported low anxiety before use and after participative demonstration, which further decreased after piloting the MTR, highlighting the importance of direct experience in professional contexts (Heerink et al., 2010).

Third, differences between teachers and students emerged. Teachers consistently reported higher self-efficacy and lower anxiety across all time points, whereas students' self-efficacy increased and anxiety decreased significantly only after piloting the MTR (MT3). These findings suggest that students required hands-on interaction to develop confidence (Yang, 2010) and reduce apprehension (Toji et al., 2022), whereas experienced teachers could project their ability to integrate the MTR into practice more readily.

4.4. Limitation and directions for future studies

The present study has some limitations that future research could address. First, the study's sample of APA teachers had a relatively young average age ($M_{\text{age}} = 32.70$ years, $SD = 9.02$). It would be beneficial to conduct a similar study with older teachers nearing retirement to see how age might impact acceptance scores.

Secondly, in this study's third phase, APA teachers and students used the MTR to remotely supervise sessions with their peers, rather than older adults. Previous studies on MTR acceptance by older adults during similar sessions highlighted their strong acceptance,

especially after use (Mascret & Temprado, 2023; Mascret et al., 2023). Involving actual older adults, rather than peers, in the instructional process of a future study may influence APA teachers' and students' MTR acceptance and self-efficacy, either independently of older adults' acceptance, or through the direct influence of older adults' acceptance on their own MTR acceptance and self-efficacy. Moreover, it may contribute to identifying design elements that should be incorporated to enhance the overall quality of the experience.

Thirdly, an additional limitation pertains to the sample characteristics. The 40 APA teachers and students who voluntarily participated in the laboratory-based study involving hands-on use of an MTR may constitute a self-selected group with comparatively favorable attitudes toward technology. Consequently, this potential selection bias may restrict the extent to which the findings can be generalized to the broader population of APA teachers.

Fourthly, the acceptance measurements were taken after only brief exposure to the MTR, potentially leading to a "novelty effect" (Mascret et al., 2023). An experimental design involving repeated measures over an extended period, such as a 16-week remote APA program with isolated seniors (1-hour sessions, twice a week, per Langeard et al., 2022), could track session-by-session changes in the TAM variable scores for both APA teachers and students, as well as among older adults. This approach would also help assess the program's impact on developing physical skills compared to face-to-face programs.

Finally, acceptance measurements were based on supervising a single task, the Square Stepping Exercise (Shigematsu et al., 2006, 2008), which is suitable for videoconferencing and MTR (Navarro et al., 2024). Future studies should explore acceptance with different types of APA tasks to determine how task variety influences MTR acceptance among APA teachers and students.

5. Conclusion

The present study showed that the MTR used to remotely supervise APA for older adults was well accepted by APA teachers and students after testing it in conditions close to those of their professional activity. However, differences in acceptance may exist between more experienced teachers and students training to become teachers. If the MTR is also well accepted by older adults (Mascret & Temprado, 2023; Mascret et al., 2023) and if the initial reluctance of teachers (Navarro et al., 2024) can be overcome after actual use of the MTR, the present results are promising, as they pave the way for the implementation of APA sessions

led by qualified teachers for isolated older adults who currently lack access to such services, allowing them to experience the health benefits of physical activity as well.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material. Questionnaires used in the study (MTR acceptance, self-efficacy MTR anxiety).

IMPORTANT: To participate in this study, you must be a teacher in adapted physical activity (APA) or currently in training to become one. Completing this questionnaire takes about 5 minutes.

We thank you for your participation in this study, which focuses on the use of a mobile telepresence robot (see picture below). This is a videoconferencing system measuring 1.60 m, which allows movement within a space, hearing (via a microphone), seeing (via cameras), being seen (via a touchscreen tablet), and being heard (via speakers) in real time, giving the impression of being physically present in a distant location. The system can move forward, backward, and turn, operating safely thanks to sensors that prevent collisions. The pilot's face is broadcast in real time on the "head" of the robot, composed of a touchscreen and a camera, which can tilt up and down and rotate left and right to adjust the viewing angle. This device is remotely controlled (even from thousands of kilometers away) through a Wi-Fi or 4G network, using an interface on a computer, tablet, or smartphone.



The mobile telepresence robot can support the teaching of adapted physical activity (APA) remotely for isolated older adults. Indeed, part of this population may not have the possibility to travel, may live in remote areas, or may need to avoid direct human contact for medical reasons, making supervised in-person physical activity sessions sometimes impossible. The mobile telepresence robot therefore allows such older adults to still participate in APA sessions, remotely supervised by a specialized APA teacher, which would likely have been impossible without this type of device. It is, of course, not intended to replace APA teachers (since they are essential to operate the robot, which must be piloted by a human), but rather to expand the range of teaching options available to APA professionals in areas they cannot easily reach and/or with older adults for whom direct contact must be

avoided for medical reasons.

Even if you have not yet tried it, we would like to gather your opinion regarding this mobile telepresence robot for teaching APA remotely to isolated older adults. To do so, we will ask you a few questions in the following section.

Please read each question carefully and check your response. Note that there are no right or wrong answers — your personal opinion is what matters. It is perfectly normal to sometimes feel like you are answering the same question more than once.

For each statement, please check the box that indicates your opinion, from “*Strongly disagree*” to “*Strongly agree*”(the intermediate boxes allow you to nuance your answers).

QUESTIONNAIRE #1

1. **I think that the mobile telepresence robot would be useful for teaching APA remotely to isolated older adults.**
Strongly disagree Strongly agree
2. **I think that using the mobile telepresence robot to teach remotely APA to isolated older adults would be easy.**
Strongly disagree Strongly agree
3. **Using the mobile telepresence robot to teach APA remotely to isolated older adults would be fun.**
Strongly disagree Strongly agree
4. **I think that teaching APA with the mobile telepresence robot would be useful for maintaining or improving the physical skills of isolated older adults.**
Strongly disagree Strongly agree
5. **If I had the opportunity to have access to the the mobile telepresence robot, I probably will use it to teach remotely APA to isolated older adults.**
Strongly disagree Strongly agree
6. **Using the mobile telepresence robot would allow effective teaching of APA remotely to isolated older adults.**
Strongly disagree Strongly agree
7. **I think it would be easy to learn how to use the mobile telepresence robot to teach APA remotely to isolated older adults.**
Strongly disagree Strongly agree
8. **Using the mobile telepresence robot to teach APA remotely to isolated older adults would be pleasant.**
Strongly disagree Strongly agree
9. **I think that teaching APA with the mobile telepresence robot would enable isolated older adults to maintain or increase their physical skills.**
Strongly disagree Strongly agree

10. **If I had easy access to this mobile telepresence robot, I would like to use it to teach APA remotely to isolated older adults.**

Strongly disagree Strongly agree

11. **I think that using the mobile telepresence robot would be an effective way to teach APA remotely to isolated older adults.**

Strongly disagree Strongly agree

12. **I think that learning how to use the mobile telepresence robot would be easy to understand for teaching APA remotely to isolated older adults.**

Strongly disagree Strongly agree

13. **Using the mobile telepresence robot to teach APA remotely to isolated older adults would be enjoyable.**

Strongly disagree Strongly agree

14. **Using the mobile telepresence robot to teach APA would allow keep or improve isolated older adults' physical skills.**

Strongly disagree Strongly agree

15. **If I had easy access to this mobile telepresence robot, I would intend to use it to teach APA remotely to isolated older adults.**

Strongly disagree Strongly agree

QUESTIONNAIRE #2

1. **I would feel confident that I can use a mobile telepresence robot.**

Strongly disagree Strongly agree

2. **I expect to become proficient in using a mobile telepresence robot.**

Strongly disagree Strongly agree

3. **I would be able to use a mobile telepresence robot even if there was no one around to show me how to use it.**

Strongly disagree Strongly agree

QUESTIONNAIRE #3

1. **If I should use a mobile telepresence robot, I would be afraid to make mistakes with it.**

Strongly disagree Strongly agree

2. **If I should use a mobile telepresence robot, I would be afraid to break something.**

Strongly disagree Strongly agree

3. **I find the mobile telepresence robot scary.**

Strongly disagree Strongly agree

4. **find the mobile telepresence robot intimidating.**

Strongly disagree Strongly agree