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Students' Acceptance of Social Robots as Teachers in Business Education—Insights from India

Aditi Naidu
Shri Vaishnav School of Management , Shri Vaishnav Vidyapeeth Vishwavidyalya, Indore, India

Abstract. The study assesses students' attitudes, anxiety, trust and intention to use social robots as teachers within the ambit of higher education in business management in a major emerging economy, India. Assessing student readiness to accept social robots as teachers, is particularly relevant with the rising use of robotic technologies in India. Using a mixed methods approach comprising of a thematic analysis and a multiple-linear regression analysis, the study broadly finds that students have an ambivalent reaction towards social robots as teachers in higher business education in India as they exhibited moderate attitudes, anxiety and trust towards social robots. Additionally, it was found that while attitude and anxiety do not impact the students' intention to use social robots, trust does have an impact. Besides being based in India, where such an exploration is rare; this study focuses on adult learners, as against most studies that have focused on children. Within these contexts, the study adds to the understanding of social robots uptake in the higher education sector.

Keywords: social robots, attitude, anxiety, trust, intention to use, higher education.

1. Introduction

Recent times have witnessed an increasing emergence of robots in various industries (Chen *et al*., 2023; Allan *et al*., 2022; Naneva *et al*., 2020; Kazandzhieva & Filipova. 2019) and the education sector has been no exception. Within the education sector, social robots are being used for teaching in Japan and Korea and have displayed encouraging evidence of their effectiveness as teachers (Sharkey, 2016). However, despite various advantages attributed to robots as teachers, expert opinions dismiss the possibility of robots taking over the role of teachers (Edwards & Cheok, 2018). Several scholars have argued that robots may not be suitable for teaching since robots lack human attributes, (Manyika *et al*.,2017 cited in Edwards & Cheok, 2018). Nonetheless, this has been changing with rapid advancements in social robotic technologies (Yang *et al*., 2018).

While India lags some nations in the number of robots, the adoption of robotics technologies in the country is expected to increase rapidly in the coming years, driven by factors such as increasing labour costs, technological advancements, and the need for greater efficiency and productivity across various sectors (Sinha, 2022). For instance, there are already a few humanoids being used in India for rendering various services, e.g.- 'Mitra'- a humanoid was widely used in hospitals during the COVID pandemic; 'IRA'- a robot has been used by an Indian bank in the country to greet and guide customers; 'RADA' - a robot used for customer assistance in an Indian airline and 'RoboCop', a sub-Inspector ranked robot, stationed at a police headquarter, tasked with managing the front office at the headquarter (Jain, 2022). The education sector too has used service robots in the form of humanoids in the country - 'Eagle' and 'Shalu' are two such robots that have been used as teachers (Ullas, 2019; Sinha, 2022).

The increasing emergence and adoption of robotic technologies makes user acceptance of robots both essential and compelling in the future, and it calls for ample research to understand and appreciate people's attitudes and behaviours towards their adoption of robots (Allan *et al*., 2022; Luo *et al*., 2021; Sharkey, 2016; De Graff & Allouch, 2013). However, particularly in the field of education, this examination of acceptance of social robots is at an emerging stage (Chen *et al*., 2023; Luo *et al*.,2021). Most studies on the adoption and behaviours of people towards robots have primarily been carried out in the context of USA, Japan, Germany. Such studies cannot be generalised (Abou-Shouk *et al*.,2021; Homburg & Merkle 2019) to a culturally diverse country such as India, with culture having been established as influencing interactions with robots (Lim *et al*., 2021).

Moreover, there is little research specific to social robots in higher education since extant research has mostly focused on children rather than adults (Donnermann, *et al*., 2020). Further, along with attitudes, examination of trust and anxiety towards social robots may be necessitated with attitudes not found to predict behavioural intentions reliably (Naneva *et al*., 2020). Accordingly, this study assesses higher education students' attitudes, anxiety, trust and intention to use a social robot in the context of the management department of a major Indian university.

The study has a few pertinent contributions. First, by examining attitudes, anxiety and trust towards social robots in higher business education, the study assesses students' readiness to accept social robots as teachers. Second, with most studies relating to robot adoption in the education sector across developed countries, this study is salient because it has been done within the context of a developing country like India where robotic technology adoption is set to rise. The third contribution relates particularly to India's cultural ethos, which has been inspired by the 'Guru-Shisya Parampara' (the tradition of the mentor/disciple relationship), whereby such an academic inquiry on replacing 'human teachers' (gurus) by robots would substantially add to adoption of robots/humanoids/AI in higher education.

Additionally, India has been witnessing an emerging environment within its higher education sector as determined by its recently introduced National Education Policy (NEP), 2020 that emphasizes on the importance of technological adoption and integration in order to enhance educational access, quality and efficiency through integrating emerging technologies, such as AI and robotics. Against this context, this study contributes by exploring the readiness to adopt these technologies within the Indian higher education space. Here it may be noted, Benny and Thankalayam (2024) observed that introducing educational robots in India would improve the overall level of education in the country and in the process, reduce the digital divide between rural and urban areas. Besides it would also help in generating a positive attitude towards greater adoption and implementation of educational robots vis-a-vis learning outcomes (Benny & Thankalayam, 2024) . Accordingly, in the present context of India, this study would be important in providing valuable insights on the adoption of social robots in the higher education of the country.

2. Literature Review

Intention to Use Social Robots

Bartneck and Forlizzi (2004, p. 592) define social robots as "an artificial intelligent system, which has physical embodiment, is autonomous or semi-autonomous and interacts and communicates with humans by following the behavioural norms expected by the people with whom the robot is intended to interact". Studies have used 'intention to use' to understand the acceptance of social robots such as in the hospitality sector (Kervenoael *et al*., 2020). As Kervenoael *et al*. (2020) state, the need for the empirical understanding of the drivers of intention to use robots in services has become an "urgent necessity" for their deployment (p.1). 'Intention to use' has been a primary dependent construct in studies in the context of different technologies in education as well. For instance, students' intention to use has been examined in the context of mobile learning (Almatari *et al*.,2013; Althunibat, 2015; Saroia & Gao,2018) and e-learning (Park, 2009; Saeed Al-Maroof *et al*., 2021). With reference to robotics, intention to use is defined as "the indication of the user's readiness to use the robot" (de Graaf and Allouch, 2013 b, p. 1479). Intention to use robots is an "acknowledged predictor of actual behaviour", making it "relevant for studying user acceptance of social robots" (de Graaf and Allouch, 2013 b, p. 1479).

Accordingly, this study uses 'intention to use' social robots as the primary dependent variable.

Attitudes Towards Robots

Using robots in education, Belpaeme *et al* (2018) reported that humanoid robots, with socially supportive behaviours and personalised interaction can lead to gains

in the learning experience in the forms of "compliance, engagement and conformity" (Belpaeme *et al*., 2018, p.5). For instance, in a study within a university setting, students rated a learning activity as significantly more interesting with a robot than when it was facilitated by a tablet and a human instructor (Rosenberg-Kima *et al*., 2020).

While various benefits are expected for an industry from the deployment of robots, successful introduction of robots depends on their acceptance (Kazandzhieva & Filipova. 2019).

Attitudes are primarily "mental predispositions" or feelings towards an object that explain behaviour (Spatola &Wudarczyk, 2021, p.1149). Attitudes towards robots may determine people's uptake, use and interaction with robots (Naneva *et al*., 2020; Spatola & Wudarczyk, 2021; Kazandzhieva & Filipova, 2019). For instance, favourable customer attitudes are essential for usage of robot in tourism (Ivanov *et al*., 2020; Abou-Shouk *et al*., 2021). Negative attitudes adversely affect adoption of robotic technologies (Staple & Eyssel, 2022).

Further, De Graff and Allouch (2013 a) suggested that attitude has an impact on behaviour towards robots - for instance, women's negative attitude towards robots explained the degree of their interaction with robots. Past research demonstrates moderately positive affective and cognitive attitudes and neutral general attitudes towards social robots and their use (Naneva *et al*., 2020).
Furthermore, demographics such as age, gender and education have been reported to influence attitude towards social robots (Ivanov *et al*., 2018; Hudson *et al*., 2017). Both gender and age were found to be important determinants of attitudes in the case of educational robots (Reich-Stieber & Eyssel 2015). Particularly, attitude towards robots were found to have the highest direct influence on the intention to use robots (Chatzoglou *et al*., 2023).

Accordingly, it is hypothesised that:
H1: Attitude towards educational social robots has a direct impact on the intention to use them .
H2: Demographic variables, such as gender, age and education affect attitude towards educational social robots.

Anxiety Towards Robots

Technological interventions, such as mobile game-based applications can serve as valuable education resources (Benson, *et al*., 2024). However, anxiety has been reported to adversely affect behavioural intention to use technology products, such as e learning (Alenezi *et al*., 2010); internet banking (Giao *et al*., 2020), autonomous vehicles (Keszey, 2020); smart health wearable devices (Jeng *et al*., 2022) and Artificial Intelligence powered tutoring system for learning English (Ni & Cheung ,2023). Alongside attitude, several studies report that anxiety also impacts the intention to use social robots, as well as the quality of people's interface with them(Naneva *et al*., 2020). Further, anxiety has been reported to