



The use of technology for online learning among older adults in Hong Kong

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Abstract

The use of technology to facilitate better living and learning is gaining popularity worldwide. More and more older adults are technology users and participating in online learning. While there is ample research examining the factors affecting older adults' behavioural intention to use technology more generally, less is known about their views of using technology in online learning environments. Applying the *model for the adoption of technology by older adults* (MATOA) developed by Kenneth Hsiche Wang et al., the authors of the study presented here investigated the attitudes of older adults towards technology adoption for online learning. They interviewed 20 adults aged 52–73 who had enrolled in a diploma course in a higher educational institution in Hong Kong. The results show that participants held favourable attitudes towards online learning after several practice sessions. While they had confidence in their future use of technology, they stated that the availability of technical and social support affected their intention of continuous learning using technology in online settings.

Keywords older adults · model for the adoption of technology by older adults (MATOA) · online learning · technology · lifelong learning

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Résumé

Utilisation de la technologie par les seniors à Hongkong pour apprendre en ligne – Utiliser la technologie pour faciliter l'amélioration de la qualité de vie et l'apprentissage, une activité qui jouit d'un engouement croissant dans le monde entier. De plus en plus de seniors se servent de la technologie pour se livrer à des activités d'apprentissage en ligne. Tandis que de nombreuses recherches portent sur les facteurs qui influent sur l'intention comportementale des seniors à utiliser la technologie d'une manière plus générale, nous savons peu de choses sur leurs points de vue à ce sujet dans les environnements d'apprentissage en ligne. S'appuyant sur le modèle pour l'adoption de la technologie par les seniors (*model for the adoption of technology by older adults/MATOA*) élaboré par Kenneth Hsiche Wang et coll., les auteurs de la présente étude se sont penchés sur les attitudes des seniors concernant l'adoption de la technologie pour apprendre en ligne. Ils ont interviewé 20 adultes âgés de 52 à 73 ans qui s'étaient inscrits à un cours diplômant dans un établissement d'enseignement supérieur à Hongkong. Les résultats indiquent que les participants se montraient favorables à l'apprentissage en ligne une fois qu'ils avaient participé à plusieurs séances d'entraînement. Tout en se sentant confiants quant à l'utilisation qu'ils feraient à l'avenir de la technologie, ils ont déclaré que la disponibilité d'un soutien technique et social influait sur leur intention d'apprendre en permanence en utilisant la technologie dans un environnement en ligne.

Introduction

An increase in human life expectancy has led to an unprecedented growth in the proportion of older citizens within countries' populations worldwide. Predictions estimate that between 2015 and 2050, the percentage of the world's population aged 60+ will almost double from about 12% to 22% (from 605 million to 2 billion) (WHO 2021). Population ageing presents governments with various challenges such as an increasing demand for health services, an increasing need for long-term care and social services, and increasing strain on pension and social security systems. Fostering citizens' successful ageing is important in preventing isolation and maintaining the independence and productivity of older adults.

The role of information and communication technology (ICT) devices and applications in supporting people of all ages in experiencing a healthier, safer and enjoyable life has grown exponentially in the 21st century. Technology can now be usefully harnessed to support *ageing in place*¹ and enhance well-being among older adults (Bobillier Chaumon et al. 2014; Helbostad et al. 2017; Monaco et al. 2019). Although older adults are still engaging with technology at lower levels compared to the younger population, they are more digitally connected than over-sixties generations before them. The ICT devices most commonly used by older adults are computers and smartphones, enabling them to overcome geographic barriers or limited mobility,

¹ "Ageing in place is a term used to describe a person living in the residence of their choice, for as long as they are able, as they age. This includes being able to have any services (or other support) they might need over time as their needs change" (AgeInPlace 2022).

and increase contact with family and friends, especially grandchildren (Wagner et al. 2010). Besides those using their ICT devices mainly for phone and video calls, i.e. communication purposes, there is an increasing number of older adults also engaging in other internet-based functions via computers and mobile phones, including education, financial management, health monitoring and social media (Martínez-Alcalá et al. 2018; Perrin 2015).

Engaging with technology to access the internet not only enhances older adults' social participation and connectivity, – it also offers them more educational opportunities (Aarts et al. 2015; Hutto et al. 2015; Morrison and McCutcheon 2019; Yu et al. 2016). Older adults seeking health information from the internet have been found to increase their engagement in healthy behaviour and health literacy (Hall et al. 2015; Kobayashi et al. 2015). With awareness of such benefits rising, online learning, defined as

learning experiences in synchronous or asynchronous environments using different devices (e.g., mobile phones, laptops, etc.) with internet access (Dhawan 2020, citing Singh and Thurman 2019),

has become one of the latest trends in the world of education. The thematic content that learners aged 60+ choose to study is eclectic. While most older adults are interested in health-related knowledge like prevention and treatment of their health issues, these topics are followed by other areas of practical use such as learning how to obtain finance-related information and access entertainment using a mobile device (Jin et al. 2019). Some older adults pursue higher education and qualifications. Hence, both informal and formal online learning opportunities offered by various institutions have attracted increasing enrolment of older learners from different educational backgrounds in recent years (Xiong and Zuo 2019).

A considerable proportion of older adults in the United Kingdom (UK) are already engaging in massive open online courses (MOOCs) (Liyanagunawardena and Williams 2016).² Discussion forums and live video chat discussions integrated into online learning help older learners to engage in a virtual learning community with increased satisfaction (Boulton-Lewis 2010; Xiong and Zuo 2019). Some older adults may learn better in informal learning environments which allow for self-paced learning and other options to satisfy different learning needs and preferences, compared to the strict formal curriculum mode (Jin et al. 2019).

As the online learning approach is rapidly becoming more popular worldwide – a trend accelerated in particular due to preventive “distancing” measures imposed during the COVID-19 pandemic –, it is worth finding out how some older learners adapted to a sudden change from traditional face-to-face learning to online learning, thus helping educators to develop effective support that facilitates and improves online learning. Many pre-pandemic studies adopted *quantitative* approaches and

² In the UK, the idea of older citizens engaging in distance learning is not unusual. The Open University (OU) started offering courses in 1971 (involving radio and TV broadcasts combined with print materials and a limited number of face-to-face tutorials). Among the students it attracted in 1972, 5% were aged 51+; this percentage rose to 5.2% in both 1973 and 1974 (Geis 1975, p. 249).

cross-sectional surveys to investigate older adults' intention to engage with ICT devices and learn how to use them (Hauk et al. 2018).

In our own study, we used a *qualitative* approach to examine factors that affect technology use for online learning among older adults. We collected detailed personal views from older adults by carrying out qualitative interviews. By adopting the *model for the adoption of technology by older adults* (MATOA) developed by Kenneth Hsiche Wang et al. (2017), we aimed to obtain a better understanding of older adults' views on technology use for online learning, thus helping to improve the promotion of lifelong learning through technology adoption. We begin with a brief introduction to the wider theoretical background of our investigation, supported by a review of the relevant literature. We then introduce the particular research framework we chose for our study and provide details of our research methods, before presenting and discussing our results. Barriers to adoption and attitudes towards online learning among older adults are also discussed. Finally, we consider limitations and ideas for future studies, and conclude with a summary of the benefits older learners are already gaining from online learning, pointing out areas for further improvement and development.

Theoretical background and literature review

Older adults may face more challenges than younger generations when engaging with technology. There are different models that attempt to explain the attitudes and behaviour affecting human action associated with the use of technology. For instance, the *theory of reasoned action* (TRA) explains that a person's intention to perform a certain behaviour is determined by attitudes and subjective norms (Fishbein and Ajzen 1975), while the *technology acceptance model* (TAM) considers perceived ease of use and perceived usefulness as the most important attitudinal factors in using a new technological innovation (Davis et al. 1989).

To overcome the weakness of TAM, which mainly ignores external variables and the relationship between usage attitude and usage intention, the more recent *unified theory of acceptance and use of technology* (UTAUT) has identified four determinants, namely *performance conditions*, *social influence*, *effort expectancy* and *facilitating conditions*, that affect behavioural intention in using technology (Venkatesh et al. 2003). *Gender*, *age* and *experience* are moderators of the key UTAUT relationships. In the updated version, UTAUT 2, three additional factors – *hedonic motivation*, *price value* and *habit* – have been included to explain that the actual use of technology is also influenced by these (Venkatesh et al. 2012). The inclusion of these factors has expanded the scope of UTAUT to a consumer context.

The UTAUT 2 model has been employed extensively in research examining the use of emerging technologies in various contexts, including higher education, e-commerce, mobile shopping services, mobile health and telehealth services (Raman and Don 2013; Escobar-Rodriguez and Carvajal-Trujillo 2013; Yang and Forney 2013; Cimperman et al. 2016; Hoque and Sorwar 2017). It was found that most of the variables of UTAUT 2 were significant predictors of older adults' use of the internet (Macedo 2017). However, UTAUT has also been criticised by a number of research-

ers. Most of them raised concerns that more external variables could affect the acceptance of technology. For instance, Jalayer Khalilzadeh et al. (2017) demonstrated that *risk*, *security* and *trust* are important determinants, with direct and indirect impacts in terms of affecting intentions to make mobile payments. Other factors such as *confidence*, *perceived enjoyment*, and *tendency to underestimate computer-related abilities and the availability of technical support* have also been shown to affect older adults' adoption of technology for online learning (Mitzner et al. 2010; Berkowsky et al. 2017; Hargittai et al. 2019).

Yvonne Barnard et al. (2013) have proposed a research framework related to technology acceptance and rejection in older adult learners from two perspectives. One is the ease of learning perspective, and the other one is the system and user perspective. The framework takes into account that social environment influences how individuals gauge their own learning ability and self-efficacy. Older adults are more likely to start the learning process when their self-perception is not negative. Their readiness to experiment with new technology is influenced by the availability of technical and emotional support. In addition, the characteristics of the learning system and interfaces will affect the ease of learning.

Likewise, the *senior technology acceptance model* (STAM) has highlighted the relationship between facilitating conditions such as availability of support and experimentation and exploration, actual use, and acceptance by senior users (Renaud and Van Biljon 2008). It states that poor experience in experimenting and exploring new technology can lead to a perception of the device being too difficult to learn and use, thus resulting in rejection. Ke Chen and Alan Hoi Shou Chan (2014) have proposed a STAM model that includes older adults' self-reported health conditions, cognitive ability and physical function as constructs to explain their acceptance and usage of technology. While age may not be the most significant determinant in affecting the intention to use technology, the decline in physical and cognitive functions due to ageing may have impacts on technology usage behaviour (Chen and Chan 2014). However, the STAM model proposed by Renaud and Van Biljon only specifies the process of acceptance, rejection and adoption of technology among senior users, failing to account for how older adults learn to use technologies. In general, findings from STAM research are mixed, with some research indicating that perceived usefulness and ease of use are insignificant predictors of ICT adoption, while some suggested social cognitive variables such as self-efficacy and anxiety are better predictors (Neves and Vetere 2019).

Research framework: the MATOA model

For the research framework of our own study, we chose the *model for the adoption of technology by older adults* (MATOA) developed by Wang et al. (2017), which takes older adults' perspectives into account (Fig. 1). Combining relevant determinants from both UTAUT and STAM, MATOA constitutes a new and enriched framework which is particularly suitable for investigating older adults' attitudes towards and intention to use technology. In more recent research, Junfang Wang et al. (2021) provide empirical findings on the MATOA determinants, including biophysical aging

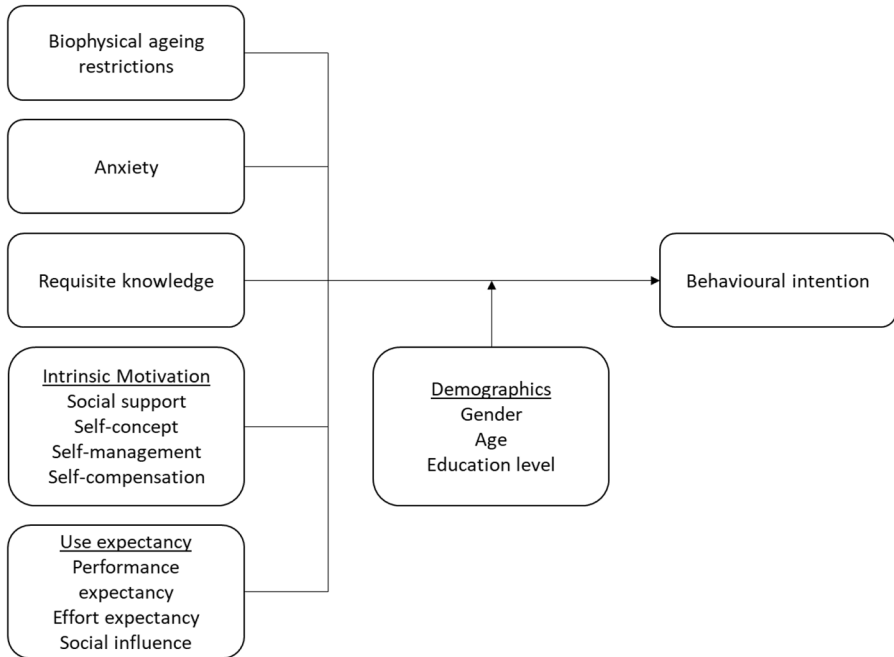


Fig. 1 Constructs of MATOA (based on Wang et al. 2017)

restrictions, anxiety, requisite knowledge, intrinsic motivation and use expectancy, emerging from “A systematic review of factors influencing attitudes towards and intention to use the long-distance caregiving technologies for older adults” (ibid.).

Constructs of MATOA

MATOA combines aspects such as older adults’ health conditions, physical and cognitive capabilities which are taken into account separately in the STAM model (Chen and Chan 2014), into a single construct labelled *biophysical ageing restrictions* (Wang et al. 2017). Concerns about physical and cognitive decline with ageing, including decline in vision and hearing, processing speed, memory and concentration, remain impediments in the use of technology among older adults, and this is an important factor to be included when examining older populations (Abdelrahman et al. 2021).

MATOA’s second construct, *anxiety*, refers to the apprehension when a “newbie” user is faced with the possibility of using technology (Venkatesh et al. 2003), while the third construct, *requisite knowledge*, refers to older adults’ understanding of mobile phone interfaces and functions, and their relevant operational background knowledge which facilitates their mobile phone user intention.

The fourth MATOA construct, labelled “intrinsic motivation”, includes four dimensions. *Social support* has been proven to be particularly important to keep older adults on board both at the initial stage of their engagement with technology and as their technology learning progresses (Tsai et al. 2017). The encouragement and sup-

port from family members and friends affect older adult learners' acceptance of new technology and their willingness to learn how to use it (ibid.). An individual's *self-concept* includes their self-esteem and self-image, and older adults may like to learn using technology in order keep up with communication trends and engage with members of younger generations (Wang et al. 2017). *Self-management* means that older adults keep a positive attitude towards the use of technology independently, while *self-compensation* means appreciating the benefits of using technological products because they did not own one previously (ibid.).

In the fifth construct, MATOA groups the elements of *performance expectancy*, *effort expectancy* and *social influence* from the UTAUT model under the construct of "use expectancy". *Performance expectancy* means the degree to which the user believes technology helps to enhance performance in certain activities; *effort expectancy* means the degree to which the user perceives the use of technology to be effort-free; and *social influence* is the extent to which the user is influenced by others (e.g., family members and friends) (Venkatesh et al. 2012). Applying this to online learning contexts, older adults who recognise that online learning can provide benefits and convenience in their learning activities possess some experience in using technology and learn how to use new technology quickly. This means their user expectancy of online learning is high, which increases their adoption intention.

Lastly, while they are included as a separate group (see Fig. 1), demographic variables such as gender, age and education level are not significant moderating factors in the MATOA model.

Research methods

Participants

Participants were recruited from a Diploma of Active Ageing (DAA) course offered by a self-financing tertiary educational institution in Hong Kong. DAA enables older students aged 50+ to continue pursuing further education. Research looking at adult learners nearing or entering retirement ("third agers") and related topics has referred to participants aged 50 years or above as "older adults", therefore we considered all DAA students as eligible participants (Chen and Janiki 2020; Mizrachi et al. 2020; Tsai et al. 2020). We invited a total of 36 DAA students, and the acceptance rate was 55.6% ($n=20$). Of the 20 participants, aged between 52 and 73 years, 3 identified as male and 17 as female. Due to the COVID-19 pandemic, they had experienced a shift from face-to-face learning to online learning in their course. The online lessons were conducted via Microsoft Teams. They participated in our study voluntarily, and no remuneration was given.

Measurement

We opted for a qualitative descriptive design of our study, including individual interviews in order to obtain a wider understanding of participants' opinions and views about the use of technological devices in lifelong learning. Each interview consisted

of 6 sociodemographic questions and 11 questions based on individual MATOA constructs. The sociodemographic questions included age, gender, educational level, information on the use of technological devices, and experience of online learning.

The MATOA model was particularly suited for the purposes of our study as it helped us to investigate the intention of using technological devices when shifting from the conventional face-to-face learning to online learning among older adults. The interviews helped us to gather deeper information and opinions on each construct of MATOA. A sample question in the construct of requisite knowledge was “*Do you think you have enough understanding of the technological functions, services, and potential benefits in an online learning setting?*”. A sample question in the construct of social support was “*During online learning, have you received adequate support from friends and family to overcome the encountered anxious situations and/or difficulties?*”. The last question “*Do you intend to continue using technology to participate in online learning?*” directly asked participants about their behavioural intention to continue using technology to participate in online learning.

Data collection and consent

Between 27 October and 11 November 2020, we conducted 10 individual interviews via Microsoft Teams and 10 WhatsApp calls. We obtained informed consent about video and audio recording verbally for every interview, with the understanding that information provided would be anonymised and used for research purposes only. The present study followed the Code of Ethics for Research Involving Human Subjects of the College of Professional and Continuing Education, The Hong Kong Polytechnic University. No ethical approval was required as this study did not involve financial incentives and all subjects were able to provide informed consent. Participants understood that they could withdraw from the study at any time if they wanted to.

We began each interview by providing general background information about our research topic and objectives. Participants were encouraged to answer freely from their own perspectives and share their experiences of online learning and technology use. All interviews, each lasting for approximately 20 minutes, were conducted in Cantonese.

Data analysis

Our research team included the four authors of this article. The recorded interviews were transcribed verbatim and translated into English. We reviewed and refined the transcripts in order to retain meanings. We fed our collected data into Qualitative Data Analysis (QDA) Miner 5 of Provalis Prosuite. We conducted our analysis of participants’ views and experiences using our theoretical research framework based on the MATOA model (Wang et al. 2017). The “top-down” approach helped us to organise the data in accordance with the MATOA constructs. We read and analysed the transcripts carefully, generated initial codes that were relevant to the research questions, and coded the units of analysis to fit with the themes and sub-themes derived from the MATOA constructs. To protect our participants’ anonymity and confidentiality, we masked their names and assigned them code names of A1, A2, A3 ... A20 instead.

Table 1 Demographic profiles of participants

Participants	Gender	Age	Education level
A1	F	69	Bachelor's degree
A2	F	62	Secondary school
A3	F	63	Secondary school
A4	F	67	Secondary school
A5	F	52	Secondary school
A6	F	70	Secondary school
A7	M	59	Secondary school
A8	F	61	Secondary school
A9	F	59	Diploma
A10	M	66	Secondary school
A11	F	67	Bachelor degree
A12	F	60	Secondary school
A13	F	58	Master's degree
A14	F	71	Master's degree
A15	M	64	Bachelor's degree
A16	F	62	Master's degree
A17	F	57	Secondary school
A18	F	not mentioned	Diploma
A19	F	73	Bachelor's degree
A20	F	66	Secondary school

Results

Participants

Our group of 20 participants, with a mean age of 63.5 years, were predominantly female (Table 1). All participants had already used mobile phones on a daily basis before enrolling in the DAA course. Three of them were using computers daily due to the nature of their current job.³ Eighteen participants were experiencing formal online learning via the use of technological devices and online platforms for the first time as their DAA course switched to online mode, while the other two had already had one year of online learning experience prior to the diploma course. Nonetheless, the majority of our participants had previously used technological devices for leisure purposes such as watching YouTube videos and searching for daily news.

MATOA analysis

Biological ageing restrictions

Biological ageing restrictions, particularly eye fatigue and physical strain caused by static reading positions, were reported by some of the participants. However, Participant A1 had learned to connect the laptop to her television screen to enlarge text and images for easier reading. Most participants agreed that their memory skills declined

³ These three were the only members of our sample who were employed at the time of our study.

as age progressed and therefore it was difficult to memorise the correct buttons and steps for different functions. They found that this improved with practice.

Anxiety

Only a few participants recalled that they had felt nervous, annoyed and stressed when encountering unresolved technical issues. Participant A14 had a bad experience with online presentation due to hardware limitations. She recalled that

“I do not have camera and microphone on my computer, so I turn on the camera and speaker function of my smartphone to show my face for the presentation. However, the microphone of my smartphone was malfunctioning. My group-mate helped me to present my part at last. I still have no idea what happened”.

Participant A1 also shared that “I have encountered some technical issues like being unable to hear the others and sudden disconnection in the middle of online classes”.

Requisite knowledge

All participants except for one regarded themselves as beginners in using technology and navigating online learning settings. Most of them reflected that they only understood the basic skills of operating technological devices and online software platforms. Participant A12 stated that

“I think the skills I have learned so far are fair enough for me to engage in online learning. But I know there are many other functions that I don’t know or have never got in touch with. There is still a lot to explore”.

Participant A5 said “I still do not know how to share my screen and documents with other classmates during online lessons”. Although most of them commented that they were not sure whether they had enough understanding of the technological functions, they understood the advantages and disadvantages of using technology and online software platform for online learning.

Intrinsic motivation

Social support– All participants received support from others to overcome anxious situations and difficulties encountered during online learning. They mostly turned to their family members first for assistance. Then they asked their classmates for help via WhatsApp and the difficulties were solved most of the time. They also appreciated the support provided by the Information Technology Unit of the educational institute. Participant A17 pointed out that the support from her lecturer had been important and helpful. She appreciated that “the lecturer ran a trial online session with us a day before the actual lesson. We tried out the buttons and functions together, and we discussed the common issues”.

Self-concept – Participants generally welcomed that online learning enabled them to keep up with technical innovations and made communication with the younger generation easier. Participant A20 agreed that it helped her to keep up with the current trend and avoided falling behind in society. Participant A4 thought that knowing how to use technological devices and online communication tools “breaks the age barrier and brings everyone from different backgrounds together”. Among the four participants with opposite views, two commented that “using technological devices for online learning is very personal”, and “I do not see online communication methods bring extra benefits in communicating with the younger generations”.

Self-management– 17 out of 20 participants had a positive attitude towards their own future use of technology and thought they could manage using technological devices for online learning. Participant A13 thought “I am sure I can manage, and I am not worried about it. I believe technological devices will only be getting more user-friendly rather than [more] complicated.” While three participants were unsure about their ability in managing future technology because they thought new technology would be developed rapidly in the market, Participant A5 commented that current IT support to older adults was limited. She said that

“It depends on the availability of education and support. I believe there are many older adults who are still struggling to manage technology. Without adequate IT support, they are unwilling to learn and will never know how to use technological devices.”

A few participants commented that they were easily distracted by other matters at home and failed to fully concentrate during online lessons.

Self-compensation– Participants had got used to the common usage of technology nowadays. They had used mobile phones for years and some of them who were now retired had used computers in their jobs a long time ago. They agreed that there was a wide price range for technological devices like smartphones and tablets, mostly affordable for them so far. From a customer’s perspective, participants hoped that the adoption of technology would become cheaper. A few participants thought it likely that prices would be lowered as technology became more common.

Use expectancy

Performance expectancy– Participants agreed that the advance of technological devices was useful to learning in online settings and helpful to promote online learning. They thought online learning could save travelling time and costs. Academically, they could search for more information on the internet and this enhanced productivity. Participant A14 mentioned that once when her leg got hurt, she was still able to have online lessons at home. But a few participants pointed out that online settings were only helpful in terms of the academic aspect of acquiring knowledge. They said such technology failed to bring benefits for older adults in terms of the social aspect since they preferred face-to-face communication with each other. While they welcomed online learning, they would still choose a face-to-face learning environment over an online one when given the choice.

Effort expectancy— Two participants thought it was very easy for them to engage in online learning via technological devices. Only one participant was still worried about online learning as she felt her technology skills were very weak. For the rest of the participants, most of them agreed it was a bit challenging when first engaging in an online setting, but after getting used to the operations they found it much easier than they had expected. Participant A3 emphasised that

“many older adults refuse to accept or learn new things. In fact, they just need more time to understand and practise how to operate different technological devices and platforms. Older adults just need more opportunities to experience different uses of technology.”

Social influence— Half of the participants agreed they were affected by the global trend of technology adoption. Participant A7 mentioned that “I keep hearing positive feedback from other people around me and I see many people are very much enjoying using technological devices. That makes me want to try as well.” While the other half mentioned they were not influenced by anyone and they mainly considered personal needs, a few participants mentioned they needed to use a computer for work and that this had helped them to be familiar with technological devices.

Behavioural intention

Overall, participants held positive views on online learning and six participants gave confident answers in their intention to continue participating in online learning as they had already been familiar with the setting. They were also affected by the current technology trend and wanted to communicate with members of younger generations. Participants pointed out the availability of IT support, and friends and family were the most important factor in affecting their behavioural intention. The rest also stated that they were interested in online learning, but had inhibiting concerns like course nature and location. Most of them preferred face-to-face learning.

Discussion

Measures put in place to combat the COVID-19 pandemic included a shift from face-to-face learning to online mode by schools and universities to avoid social contact in the hope to stop the virus from spreading. Besides being a pandemic-related preventative measure, this suspension of face-to-face classes also provided the opportunity for learners of all ages – including older adults – to experience the online mode of learning. Given the urgency of the need to implement preventative measures, the shift from face-to-face learning to online mode was rather sudden. Neither educational institutions and their teaching staff nor learners had much time to adjust, or even make a conscious decision to engage in online teaching and learning. Older adult learners in particular were thrown in at the deep end.

The research we present here constitutes one of the few studies investigating the use of technology for formal online learning among older adults in Hong Kong. The

majority of our informants showed positive attitudes towards the use of technology for online learning. However, when their course moved online, they had initially been reluctant to learn the new technology mainly due to uncertainty and the lack of relevant experience in formal online learning. They subsequently discovered that it was not as difficult as they had originally thought. Participants soon understood the advantages and disadvantages of online learning and they had the confidence to handle future technology. They held similar views to a pre-pandemic study by Kenneth Hsiche Wang et al. (2018) which found that older adults would consider using more technology in online learning only with adequate and essential support and training (ibid.). These findings demonstrate that social support and training are indispensable in motivating older adults to adopt the use of technology for any purposes, whether in online learning or searching for health information.

Our findings suggest that the MATOA construct of *biological ageing restrictions* does not seem to be a major factor influencing older adults' behavioural intention of using technology. Some of our participants experienced fatigue in online learning, confirming insights from a similar study which found that older adults worried about fatigue and blurred vision after surfing the internet (Chiu et al. 2016). Students need to concentrate on the screen for a certain period of time, and so they easily suffer from eye fatigue. Eye fatigue may lead to a reduction of mental concentration, and this affects reading comprehension (Jeong 2012). However, participants mentioned that eye fatigue and physical strains had not affected their intention to continue online learning.

Another factor affecting the intention to use online learning among older adults is the MATOA construct of *requisite knowledge*. Although some of the participants had used technology (i.e. computers) in their previous working experience, they had no experience in having online lessons and were not familiar with the interface of the new and advanced technology. Furthermore, older adults with greater self-assessed computer and internet skills are more willing than their less experienced peers to adopt a new technology (Berkowsky et al. 2017). With insufficient self-competency in adopting technology for online learning, older adults may not intend to try learning in the online setting or even refuse to try it. Therefore, technical support and training are vital in motivating older adults to use the technology.

Aligning with studies that found older adults needed support from family members, friends or instructors in assisting them to solve difficulties associated with new technology, we found social support (part of the MATOA construct of *intrinsic motivation*) to particularly affect the intention of continuing online learning (Tsai et al. 2015; Francis et al. 2018). On the other hand, modest and non-users of technology among older adults are significantly associated with the frustration arising from difficult experiences with the current technology and may not try to use technology in the future (Vroman et al. 2015). Kerryellen Vroman et al. found that older adults treasured technical and social support that built up their confidence and interest in using technology (ibid.) – an attitude shared by participants in our own study. These findings suggest that providing and improving support must be an effective way of promoting technology adoption among this group of users, thus increasing their confidence and good experience to facilitate their sustainable use of technology, while the lack of confidence and increased anxiety can reduce their perceived benefits,

satisfaction and willingness to continue their usage (Meuter et al. 2003). Therefore, coaching by experts, peers and family members is undoubtedly crucial for the adoption of technology among older adults (Wang et al. 2011).

Apart from technical and social support, affordability – part of self-compensation in the MATOA construct of *intrinsic motivation* – is also one of the facilitators or determinants in technology adoption by older adults (Lee and Coughlin 2015). The study by Chaiwoo Lee and Joseph Coughlin also revealed that from the affordability perspective, participants pointed out that lower pricing of technology could increase the incentive to adopt and use modern technology – again, a belief shared by participants in our own study. The initial cost followed by recurrent expenses might be a burden to some older adults. Incentives and subsidies, particularly health-related ones, could play an important role in encouraging older adults to use technology (Lee and Coughlin 2015).

As technologies continue to play a significant role in people's lives across all age groups, the demand for lifelong learning opportunities to acquire technology user skills will continue to increase. In terms of fostering the growth of an informed citizenry, it is indeed in the interest of governments to design and implement policies which help older adults to engage more in the information society (Hargittai et al. 2019). This includes policies concerning funding of adult education and learning. Financial concerns can inhibit the willingness to participate in lifelong learning, and governments could encourage non-governmental organisations (NGOs) to provide training and education programmes for low-income older adults to enhance their attitude towards and their knowledge and literacy in technology use (Lindeman and David 2017; Wang et al. 2021). For higher education that requires more expensive tuition fees, governmental subsidy of continuing education should start to include more online programmes and courses, helping older learners to engage in a variety of learning opportunities with the use of technology.

Limitations and ideas for future studies

Our study has two main limitations. First, it was an exploratory study, with a small sample of participants (not gender-balanced) from a single educational institution. Furthermore, our sample was also restricted to learners from a course purposefully designed to enable older people to pursue further education. In terms of their attitude, the learners enrolled in this course may have been willing to try their best to adapt to and learn new things. Therefore, the results of our study might not be representative of all older learners in the experience of online learning in Hong Kong.

Second, we did not measure our participants' intention of using technology for online learning before their course shifted to online mode somewhat suddenly because of the unforeseeable circumstance arising from the pandemic. Hence, we were unable to objectively assess the changes of behavioural intention. Future studies might usefully examine the effect of the availability of technical support at schools and universities on the intention to participate in online learning through technology among older adults.

Apart from technical support, what older adults newly joining online learning also need, of course, is the technical hardware. Promoting online learning expects older adults to purchase suitable technological devices like computers with web cameras. Future studies might also investigate financial incentives as a factor affecting the adoption of technology for online learning.

Despite these limitations, this study has provided some insights and directions for future research and promotion in technology adoption for online learning among older adults.

Conclusion

The trend of using technology (for communication purposes, for being part of the information society, for participating in online learning etc.) is no longer limited to the young generation. Today's older adults are now more receptive to new technology and they are more willing to learn new skills like engaging in an online learning environment. However, it may take them more time to learn new technology skills and get used to them. Biological constraints like memory and visual decline arising from ageing do not constitute the major barriers to their adoption of technology. In fact, the main factors that contribute to their intention of using technology for online learning are availability of technical and social support. Although an online learning environment cannot replace physical face-to-face interactions with peers, it still helps older adults to maintain their learning ability and capacity, which are highly valued and appreciated among the age group of older adults. Promoting older learners' participation in formal online learning can also enable them to meet new friends and maintain social participation and engagement.

Our study not only brings out that older adults hold a positive attitude towards the use of technology, but also demonstrates their ability to participate in online learning through technology. It brings different insights and important messages regarding learning opportunities for older learners, including formal tertiary education. Our findings reflect that online learning is a viable alternative option for older adults to continue their lifelong learning as long as technical issues can be overcome. Universities have sufficient resources to enable older adults to experience higher education. Facilities such as computer laboratories and human resources like technical support teams can be incentives for older learners to enrol in formal courses. Mixed modes of learning (i.e. face-to-face and online settings) can be developed further in universities so that older learners can have more flexibility and choices. On the other hand, community health centres and NGOs, which adopt an informal approach to learning, can include online platforms for older adults to participate for leisure purposes. Further research and studies should be conducted to identify the socio-demographic factors that affect older adult learners' use of technology, which could then help policymakers to better shape the direction of current and future technologies that benefit older adults.

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