Advancing open education through open-source software: examining UTAUT 2 factors in adoption and implementation

Chenggui Duan
School of Information Technology in Education, South China Normal University, Guangzhou, China and
School of Open Learning, Hong Kong Metropolitan University, Hong Kong, China

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Abstract

Purpose – This study aims to examine the factors influencing university students' adoption of open-source software (OSS) within the context of open educational practices (OEP) by applying an extended Unified Theory of Acceptance and Use of Technology (UTAUT 2) model.

Design/methodology/approach – The research employs a quantitative approach, gathering data from 156 students at Hong Kong Metropolitan University through an online survey. The survey was designed to test nine hypotheses derived from the UTAUT 2 model, incorporating additional constructs relevant to OSS. Structural equation modelling (SEM) was used to analyse the data and test the relationships between constructs.

Findings – The results indicate that Performance Expectancy (PE), Effort Expectancy (EE), Price Value (PV), Self-Efficacy (SE) and Value Alignment (VA) significantly influence students' Behavioral Intention (BI) to adopt OSS. Conversely, Social Influence (SI), Facilitating Conditions (FC), Hedonic Motivation (HM) and Habit (HT) were not significant predictors. The findings suggest that while UTAUT 2 provides a useful framework for understanding OSS adoption, it requires adaptation to fully capture the unique characteristics of OSS in educational settings.

Originality/value – This study contributes to the literature by extending the UTAUT 2 model to the context of OSS adoption in higher education, highlighting the importance of economic factors and user alignment with OSS values. The results offer practical insights for higher education institutions aiming to promote OSS, emphasizing the need for support structures, training, and the promotion of OSS's economic and collaborative benefits.

Keywords Open educational practices, Open-source software, UTAUT 2, Technology adoption, Higher education

Paper type Research paper

1. Introduction

In recent years, the landscape of higher education has been significantly transformed by the open education movement, which aims to increase access to and participation in education through the removal of barriers (Peter and Deimann, 2013). A key concept within this movement is open educational practices (OEP), which has gained considerable attention from researchers, educators and policymakers alike (Cronin and MacLaren, 2018).

The term "open educational practices" first emerged in 2007, described as "practices that involve students in active, constructive engagement with content, tools and services in the

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learning process and promote learners' self-management, creativity and working in teams" (Geser, 2007, p. 37). Since then, numerous scholars worldwide have contributed to refining and expanding this concept. One of the most widely cited definitions of OEP comes from Ehlers (2011), which defines it as "practices which support the (re)use and production of open educational resources (OER) through institutional policies, promote innovative pedagogical models, and respect and empower learners as co-producers on their lifelong learning path (p. 4)."

The concept of OEP encompasses at least three core elements: OER, open educational technologies and open pedagogy (Cronin, 2017; Ehlers, 2011). However, to date, the vast majority of research on OEP has primarily focused on OER and open pedagogy, while studies on open educational technologies remain surprisingly scarce (Havemann, 2020; Duan and Jiao, 2023).

This imbalance in research attention is particularly noteworthy given the crucial role that technology plays in modern education (Bulfin *et al.*, 2015). Open educational technologies, which include open-source software (OSS) and other freely available digital tools, have the potential to significantly impact the implementation and effectiveness of OEP (Wiley and Hilton, 2018). Yet, their role has been largely underexplored in the academic literature.

The limited research on open educational technologies represents a significant gap in our understanding of OEP. This gap is particularly problematic for several reasons (Nascimbeni and Burgos, 2016; Paskevicius, 2017; Weller, 2020; Zawacki-Richter *et al.*, 2020):

(1) *Technological foundation:* Open technologies often serve as the foundation for implementing OER and open pedagogy, making them a critical component of the OEP ecosystem.

(2) *Rapid technological advancement:* As technology continues to evolve at an unprecedented pace, the potential applications and impacts of open educational technologies are constantly expanding, necessitating ongoing research.

(3) *Digital literacy:* Understanding and effectively utilizing open educational technologies is crucial for both educators and students in the digital age, yet we lack comprehensive studies on how these technologies are being adopted and integrated into educational practices.

(4) *Sustainability and scalability:* Open educational technologies can offer cost-effective and scalable solutions for educational institutions, but without adequate research, their full potential may remain unrealized.

(5) *Innovation in teaching and learning:* Open technologies can facilitate novel approaches to teaching and learning, but these innovations may be overlooked without dedicated research attention.

(6) *Interconnectedness with OER and open pedagogy:* The effectiveness of OER and open pedagogy can be significantly enhanced by appropriate open technologies, yet the interplay between these elements is not well understood due to the lack of research.

Addressing this research gap is crucial for developing a comprehensive understanding of OEP. More studies should aim to explore the role of open educational technologies in various educational contexts, their impact on teaching and learning outcomes, challenges in their implementation and strategies for their effective integration into OEP.

2. Open-source software and UTAUT 2 model

2.1 Open-source software (OSS) in education

The development of OSS has evolved from the free software movement to its current widespread application and promotion. Stallman (2007) argues that the free software

movement laid the foundation for OSS development, while Raymond (1999) attributes the widespread adoption of OSS to its open development model and community support. This paper posits that the primary role of OSS in open education is manifested in its openness, modifiability and community collaboration.

Existing research on the integration of open education and OSS can be broadly categorized into three main themes:

(1) *Application of OSS in education:* One perspective suggests that OSS can significantly reduce educational costs and improve accessibility (Hilton, 2016; Weller, 2014; Wiley, 2006). Another view emphasizes the flexibility and modifiability of OSS as its greatest advantage in meeting diverse educational needs (Hylén, 2006; Yuan *et al.*, 2008).

(2) *Effectiveness of OSS in different educational environments:* Some researchers argue that OSS is particularly effective in resource-poor educational settings, addressing the lack of educational resources (Hilton, 2016; Wiley, 2006). Others contend that in resource-rich environments, OSS applications are more focused on achieving personalized education and innovative teaching methods (Ehlers and Conole, 2010; Weller, 2014). Geith and Vignare (2008) explain from an educational technology perspective that OSS application can enhance educational efficiency and promote teaching innovation and teacher professional development.

(3) *Specific practices and case studies:* Perryman and Coughlan (2013) conducted a detailed study on OSS application at the Open University in the UK, revealing its significant role in the development and sharing of OER. Similarly, Knox (2013) investigated OSS application in Scottish higher education institutions, finding that OSS not only promoted OER development but also advanced educational equity and inclusivity. In the context of Hong Kong, Li *et al.* (2014) examined the readiness of Hong Kong students for OER. They found that students generally possessed adequate technological readiness and showed positive attitudes towards OER use. However, the study also highlighted areas for improvement, such as enhancing students' awareness of OER and developing their skills in effectively utilizing these resources.

Despite these valuable contributions, existing research has not fully addressed several important aspects:

(1) *Research design:* There has been more focus on OSS application in resource-poor educational environments, with less attention given to its application and effects in resource-rich settings.

(2) *Methodology:* Qualitative research methods have been predominant, with fewer quantitative studies systematically evaluating the effects of OSS application.

(3) *Argumentative focus:* Existing research has primarily focused on the technical advantages of OSS, with less attention to the challenges and issues in its practical educational application.

2.2 Adoption of OSS in higher education

Despite its advantage of being free, safe and adaptive, the adoption rate of OSS varies significantly across different settings. Li *et al.* (2011) observed a huge discrepancy between the adoption rate of OSS in organizations and that at an individual level. Even in cases where university students are moderately aware of the existence of OSS and noticed the benefits brought by OSS, the actual acceptance of OSS may be deterred due to the difficulties in its adoption (Nayak and Binjha, 2022). Students' actual adoption of OSS in their learning is low

(Li *et al.*, 2011; Nayak and Binjha, 2022), which is counter-intuitive given the substantial amounts of evidence supporting the advantages of adopting OSS in teaching and learning.

2.3 Theoretical framework: the UTAUT 2 model

The users' acceptance of innovative technologies has been a widely studied topic in information system literature since the 1980s. Several competing technology acceptance models (TAMs) were proposed to explain users' intention and subsequent behaviour of implementing technologies and information systems. Venkatesh *et al.* (2003) formulated the first unified model for understanding user acceptance applicable in organizational settings, known as the Unified Theory of Acceptance and Use of Technology (UTAUT) model.

The UTAUT model was further extended by Venkatesh *et al.* (2012) into a conceptual model in a wider consumer-use context (UTAUT 2). New constructs (hedonic motivation (HM), price value (PV) and habit (HT)) were identified and relationships between constructs were modified to conceptualize key predictors of user behaviour in technology adoption.

Alrawashdeh *et al.* (2020) developed a conceptual model for the implementation and acceptance for OSS adoption in organizational settings based on UTAUT 2. Five new factors were introduced, such as Software Interoperability, Self-Efficacy (SE), software security and software quality, based on the characteristics of OSS. While this model aims to address employee's behaviour in an organizational, non-educational setting, some of its constructs can be adapted for studying students' behavioural intention (BI) and adoption of OSS in educational contexts.

Given the research gaps identified in the literature review, this paper aims to investigate OEP empowered by OSS from the perspective of university students in Hong Kong. Based on the UTAUT 2 model, which provides a unified conceptual model for measuring factors, our study develops nine research hypotheses about factors affecting user acceptance of OSS and user behaviour in the adoption of OSS amongst students at the Hong Kong Metropolitan University. These hypotheses will be tested using the maximum likelihood model of structural equation modelling.

3. Research design

3.1 Data collection

The data were collected through a Qualtrics online survey distributed to the students at Hong Kong Metropolitan University. The questionnaire was distributed either in person through QR codes or online via email. A total of 875 questionnaires were sent out over four distribution rounds.

A total of 186 responses were received. Among these, 147 were identified as valid responses, while 39 were considered invalid due to duplications and straight-linings. Re-invitations were sent via email to the respondents who submitted invalid responses, requesting them to complete the questionnaire again. From these re-invitations, 9 respondents re-submitted their responses.

In total, 156 valid responses (147 initial valid responses + 9 re-submitted valid responses) were collected from our target population, representing an effective response rate of 17.83%.

3.2 Research hypothesis

This research studies the user acceptance of students of adopting OSS in their learning. The conceptual model in this paper is developed from the UTAUT 2 model. According to Venkatesh *et al.* (2012), BI is one of the determinants of the actual user behaviour in technology adoption, which is influenced by seven constructs, namely PE, Effort Expectancy (EE), Social Influence (SI), PV, HM, HT. Literature review suggests that the "technical" and

"open" features of OSS affect users' acceptance and use of OSS cannot be fully captured by the constructs in Venkatesh *et al.* (2003, 2012). To better accommodate our research purpose, which is to study factors affecting students' adoption of OSS, "Self-efficacy" and "Value-Alignment" are constructed to account for how students' perception on their ability to use OSS and their endorsement of the value and characteristics of OSS would contribute to their intention to adopt OSS.

3.2.1 Performance expectancy (PE). PE is how much a user believes the technology may improve his/her job performance (Venkatesh *et al.*, 2003). According to Venkatesh *et al.* (2016), PE is a strong predictor of use intention. Compeau and Higgins (1995) showed that the expectation of enhancement of the outcomes is the necessary condition of the users' intention of adopting the technology. Individuals are more willing to use the technology when they anticipate a better performance with the assistance of it. Thus, it is reasonable anticipation that PE will have a positive influence on BI of students in using OSS in their learning. The following hypothesis is formulated:

H1. PE has a positive impact on students' intention to use OSS.

3.2.2 Effort expectancy (EE). EE is the extent to which a user believes that technology adoption would be easy and effortless (Venkatesh *et al.*, 2003). The expectation of ease of use and low complexity would affect the intention of the students to incorporate OSS in their learning. Thus, the following hypothesis is formulated:

H2. EE has a positive impact on students' intention to use OSS.

3.2.3 Social influence (SI). SI refers to the extent to which a user perceives those important others, especially friends and colleagues, think he or she should adopt the technology. Previous studies which are conducted across technological contexts provided strong evidence that SI is involved in the process of forming belief (Moriuchi, 2021) and is a strong indicator of BI (Maruping *et al.*, 2017). The following hypothesis is formulated:

H3. SI has a positive impact on students' intention to use OSS.

3.2.4 Facilitating conditions (FC). FC are the level and amount of support and resources available perceived by a user (Venkatesh *et al.*, 2003). Kamarozaman and Razak (2021), and Rosaline and Wesley (2017) provide empirical evidence which confirms the direct relationship between the users' perception on support they can receive and their BI. The following hypothesis is formulated:

H4. FC has a positive impact on students' intention to use OSS.

3.2.5 Hedonic motivation (HM). HM is the entertaining element or pleasure derived from adopting the technology (Venkatesh *et al.*, 2012). Pleasure derived directly from the use of new technology is one of the key factors affecting the behaviour of consumers (Brown and Venkatesh, 2005). The following hypothesis is formulated:

H5. HM has a positive impact on students' intention to use OSS.

3.2.6 Price value (PV). PV is the user's evaluation upon the cost and benefits of adopting new technology (Venkatesh *et al.*, 2012). PV reflects individuals' tendency to maximize their net profit and utility in technology adoption. Studies have confirmed that a higher expected payoff would produce an increased level of satisfaction and hence related positively to BI of the user in technology adoption.

H6. PV has a positive impact on students' intention to use OSS.

3.2.7 Habit (HT). HT measures tendency of the user to perform repeated, learned, routine behaviours of technology adoption (Venkatesh *et al.*, 2012). It explains the adoption of

technology as part of the daily routine and automatic behaviour of individuals. Thus, the following hypothesis is formulated:

H7. HT has a positive impact on students' intention to use OSS.

3.2.8 Self-efficacy (SE). SE measures students' perceptions of their ability to perform the task well (Chao, 2019; Nikou and Economides, 2017). Chao (2019) showed that SE positively influenced user's BI through increasing the perceived enjoyment and the sense of satisfaction created by technology adoption.

H8. SE has a positive impact on students' intention to use OSS.

3.2.9 Value alignment (VA). Value alignment (VA) measures the extent to which users agree with the values behind the open-source initiative of OSS. OSS has been characterized as low-cost, safe, open and valuing collective contributions. It is suggested that this image of OSS is reasons behind OSS popularization and success in organizational settings (Benkler, 2002). The collaborative characteristics of OSS have attracted a vivid community of users who are actively involved in discussions, maintenance and contribution to debugging of the software. Feller *et al.* (2008) provided empirical basis for the security and privacy of OSS. Thus, it is hypothesized that these values behind and characteristic features of OSS would have a positive impact on users' intention in adopting OSS.

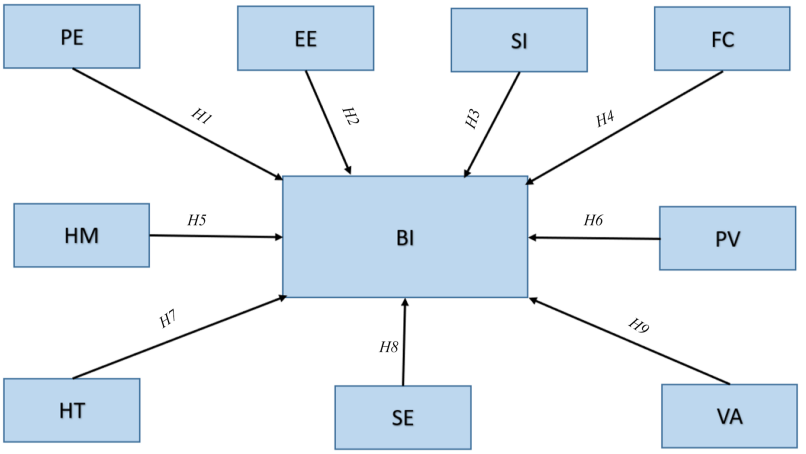
H9. VA has a positive impact on students' intention to use OSS.

Accordingly, the research model developed is shown in Figure 1 below, and the questionnaire developed consists of the seven constructs of the UTAUT 2 and the two constructs added to the model (Table 1).

4. Results and findings

4.1 Data analysis tools

IBM SPSS Statistics 26 was used to perform descriptive statistics and reliability analysis and IBM SPSS AMOS 26 was used to perform structural equation modelling (SEM).



Source(s): Figure by author

Figure 1.
The conceptual model and research hypothesis

Construct	Item	Measures	Justification	References
Performance expectancy (PE)	PE1	I find OSS very useful in my daily life	The expectation of enhancement of the outcomes is the necessary condition of the users' intention of adopting the technology. Individuals are more willing to use the technology when they anticipate a better performance with the assistance of it	Venkatesh *et al.* (2003, 2016), Compeau and Higgins (1995)
	PE2	Using OSS helps me get things done faster		
	PE3	Using OSS can increase my productivity		
	PE4	The use of OSS has helped me to complete my studies		
Effort expectancy (EE)	EE1	Learning to use OSS was easy for me	The expectation of ease of use and low complexity would affect the intention of the students to incorporate OSS in their learning	Venkatesh *et al.* (2003)
	EE2	When I use OSS, I feel that the operation is simple and straightforward		
	EE3	I think OSS is easy to use		
	EE4	It is easy for me to become a skilled user of OSS		
Social influence (SI)	SI1	I will use OSS if someone important to me thinks I should	Previous studies which are conducted across technological contexts provided strong evidence that SI involved in the process of forming belief and is a strong indicator of BI	Moriuchi (2021)
	SI2	I will use OSS if the people who influence me think I should		
	SI3	Those whose opinions I value prefer me to use OSS		
Facilitating conditions (FC)	FC1	I have the necessary resources to use OSS	Studies have provided empirical evidence which confirms the direct relationship between the users' perception on support they can receive and their BI	Venkatesh *et al.* (2003), Kamarozaman and Razak (2021), Rosaline and Wesley (2017)
	FC2	I have the necessary knowledge to use OSS		
	FC3	The OSS is compatible with other systems I use		
	FC4	When I have trouble with OSS, I can get help from other people		
Price value (PV)	PF1	The cost of using OSS will be free or inexpensive	Studies have confirmed that a higher expected payoff would produce an increased level of satisfaction and hence related positively to BI of the user in technology adoption	Venkatesh *et al.* (2012), Brown and Venkatesh (2005)
	PF2	The cost of the work involved in switching to OSS will be free or very low		
	PF3	Switching to OSS is unlikely to be financially burdensome		
	PF4	Compared with commercial software, the cost of using OSS is reasonable		
	PF5	Overall, the OSS is good value for money		

(*continued*)

Table 1.
Measurement items

Construct	Item	Measures	Justification	References
Behavioural intention (BI)	BI1	I intend to use OSS to improve my work or study	Studies have confirmed BI as a reliable predictor of user's actual use of information system	Venkatesh *et al.* (2003), Zhang *et al.* (2008)
	BI2	I will always try to use OSS in my daily life		
	BI3	I would highly recommend my colleagues/students to use OSS		
Self-efficacy (SE)	SE1	I feel confident using OSS if it comes with help tips	The individual's perception of his aptitude and ability to succeed in completing technology related task has been identified as a crucial factor as to his acceptance of the technology	Chao (2019), Ozturk *et al.* (2016), Nikou and Economides (2017)
	SE2	If I have enough time, I am confident that I can use OSS to complete my tasks		
	SE3	As long as someone tells me what to do, I have confidence in using OSS		
	SE4	I have the confidence to use OSS even if no one around me is telling me what to do		
Hedonic motivation (HM)	HM1	Using OSS is fun	Pleasure derived directly from the use of new technology is one of the key factors affecting the behaviour of consumers	Brown and Venkatesh (2005), Venkatesh *et al.* (2012)
	HM2	Using OSS is enjoyable		
	HM3	Using OSS is very interesting		
Habit (HT)	HT1	Using OSS has become a HT for me	It explains the adoption of technology as part of the daily routine and automatic behaviour of individuals	Venkatesh *et al.* (2012)
	HT2	I am passionate about using OSS		
	HT3	I must use OSS		
Value alignment (VA)	VA1	I agree with the spirit of collaboration and sharing behind OSS	Studies have shown how the social-psychological factor play a motivational role underlying the success of OSS	Benkler (2002), Raymond (1999)
	VA2	I would recommend OSS to others	The motivation of users' action to recommend and promote the use of OSS have been widely discussed in the literature	Shah (2006), Von Krogh *et al.* (2003)
	VA3	I trust that OSS is safe and reliable	Safety and security have been regarded as the advantages of OSS over commercial software	Feller *et al.* (2008)
	VA4	I think open source is an inevitable trend in software development	Studies have discussed how the success of OSS has persisting influence on the trend of innovation	Chesbrough (2003), Weber (2004)

Table 1.

Source(s): Table by author

4.2 Results

The data analysis consisted of two steps. First, the reliability and validity of the measurement constructs were assessed quantitatively by Cronbach's alpha, composite reliability (CR) and discriminant validity (Fornell–Larcker criterion). Second, the strength of the relationships between constructs in the conceptual model were evaluated by the path coefficients using the maximum likelihood method of structural equation modelling.

4.2.1 Internal reliability. The criterion for internal consistency of the instruments was assessed by whether the Cronbach's alpha (α) exceeds the 0.70, which is the threshold widely accepted across researchers to test structural models in the literature of technology adoption (Kim and Lee, 2020; Tavakol and Dennick, 2011). As summarized in Table 2, α value of all measures in our instruments are greater than 0.7, which indicates a satisfactory level of internal reliability manifested by our data.

Construct	Items loading	CR	A	AVE
Performance expectancy (PE)	0.799	0.898	0.849	0.688
	0.843			
	0.846			
	0.829			
Effort expectancy (EE)	0.776	0.884	0.823	0.656
	0.831			
	0.876			
	0.75			
Social influence (SI)	0.829	0.861	0.758	0.675
	0.872			
	0.759			
Facilitating conditions (FC)	0.795	0.870	0.800	0.625
	0.783			
	0.781			
	0.803			
Price value (PV)	0.795	0.912	0.867	0.847
	0.818			
	0.81			
	0.825			
	0.792			
Behavioural intention (BI)	0.793	0.857	0.750	0.668
	0.864			
	0.792			
Self-efficacy (SE)	0.776	0.866	0.793	0.617
	0.822			
	0.819			
	0.722			
Hedonic motivation (HM)	0.828	0.889	0.813	0.728
	0.857			
	0.874			
Habit (HT)	0.829	0.848	0.732	0.651
	0.81			
	0.78			
Value alignment (VA)	0.811	0.867	0.796	0.621
	0.723			
	0.836			
	0.777			

Source(s): Table by author

Table 2.
Internal reliability and convergent validity

4.2.2 Discriminate validity. According to Fornell and Larcker (1981), the discriminant validity can be assessed by comparing the square root of the AVE value of a construct with the correlation coefficients between the construct and other coefficients. The discriminant validity is confirmed if the square root of AVE is greater than the correlation coefficients. As shown in Table 3, the square root of AVE of each construct is found to be greater than its correlations with other constructs.

4.2.3 Structural model. A path analysis is conducted to evaluate the proposed conceptual model. The outcome of the hypothesis testing is summarized in Table 4.

4.3 Key findings

(1) PE and EE have significant positive influences on students' BI to adopt OSS (H1 and H2 supported). This suggests that students weigh both the performance advantages and ease of use when considering OSS adoption.

(2) SI does not significantly affect BI (H3 not supported). This may indicate that peer or important others' opinions are not decisive in OSS adoption decisions among students.

	PE	EE	FC	SI	PF	BI	SE	HM	HT	VA
PE	0.688	0.456**	0.439**	0.467**	0.437**	0.369**	0.363**	0.298**	0.216**	0.363**
EE	0.456**	0.656	0.511**	0.437**	0.440**	0.391**	0.442**	0.286**	0.268**	0.442**
FC	0.439**	0.511**	0.675	0.418**	0.527**	0.461**	0.514**	0.443**	0.384**	0.514**
SI	0.467**	0.437**	0.418**	0.625	0.385**	0.375**	0.336**	0.298**	0.198*	0.336**
PF	0.437**	0.440**	0.527**	0.385**	0.847	0.571**	0.526**	0.479**	0.329**	0.526**
BI	0.369**	0.391**	0.461**	0.375**	0.571**	0.668	0.557**	0.597**	0.387**	0.557**
SE	0.363**	0.442**	0.514**	0.336**	0.526**	0.557**	0.617	0.592**	0.483**	1.000**
HM	0.298**	0.286**	0.443**	0.298**	0.479**	0.597**	0.592**	0.728	0.480**	0.592**
HT	0.216**	0.268**	0.384**	0.198*	0.329**	0.387**	0.483**	0.480**	0.651	0.483**
VA	0.363**	0.442**	0.514**	0.336**	0.526**	0.557**	1.000**	0.592**	0.483**	0.621

Table 3.
Inter-construct correlations and discriminant validity

Note(s): **Correlation is significant at the 0.01 level (2-tailed). **<0.01
Source(s): Table by author

				Estimate	*P*	Result
H1	BI	←	PE	0.186	0.023	Yes
H2	BI	←	EE	0.204	0.015	Yes
H3	BI	←	SI	0.078	0.312	No
H4	BI	←	FC	0.095	0.201	No
H5	BI	←	PV	0.312	0.001	Yes
H6	BI	←	SE	0.223	0.009	Yes
H7	BI	←	HM	0.102	0.187	No
H8	BI	←	VA	0.198	0.018	Yes
H9	BI	←	HT	0.089	0.256	No

Note(s): PCMIN/DF = 1.892, CFI = 0.928, RMSEA = 0.063
This study aimed to investigate the factors influencing university students' adoption of OSS using the UTAUT 2 model. We proposed nine hypotheses and analysed survey data from students using structural equation modeling. The results reveal interesting findings that provide new insights into students' acceptance of OSS
Source(s): Table by author

Table 4.
Hypothesis testing

(3) FC do not significantly impact BI (H4 not supported), possibly reflecting insufficient support for OSS use in the current higher education environment.

(4) PV has the strongest positive influence on BI (H5 supported), indicating that economic factors are crucial in students' consideration of OSS adoption.

(5) SE significantly positively influences BI (H6 supported), suggesting that students' confidence in their ability to use OSS increases their adoption intention.

(6) HM does not significantly affect BI (H7 not supported), which may indicate that students do not view using OSS as an entertaining or enjoyable activity.

(7) VA has a significant positive influence on BI (H8 supported), demonstrating that students' alignment with open-source principles promotes their willingness to adopt OSS.

(8) Habit (HT) does not significantly influence BI (H9 not supported), possibly suggesting that OSS use has not yet become a widespread habit among the student population.

5. Conclusion

This study aimed to expand our understanding of university students' adoption of OSS within OEP by applying UTAUT 2 model. Through a quantitative analysis of survey data collected from students at Hong Kong Metropolitan University, we tested nine hypotheses concerning the factors influencing students' BI to adopt OSS.

The findings reveal that PE, EE, PV, SE and VA significantly influence students' intention to adopt OSS. These results suggest that students are primarily motivated by the perceived performance benefits, ease of use, cost-effectiveness, personal confidence in using OSS and alignment with the values of the open-source movement. Interestingly, factors such as SI, FC, HM and Habit (HT) were not significant predictors of intention, indicating that external pressures, available support, enjoyment and routine use do not play substantial roles in students' OSS adoption decisions.

These findings underscore the need for higher education institutions to focus on enhancing the perceived usefulness and ease of use of OSS, while also emphasizing its economic benefits. Furthermore, fostering a strong sense of SE and VA among students could be pivotal in increasing OSS adoption rates. The lack of significance for SI and FC highlights potential gaps in institutional support and peer influence, suggesting areas for improvement in the promotion and integration of OSS in educational settings.

The study contributes to the literature by demonstrating that while the UTAUT 2 model is effective in explaining certain aspects of OSS adoption, it requires adaptation to fully capture the unique attributes of OSS. The introduction of constructs such as SE and VA provides a more nuanced understanding of the factors driving OSS adoption in educational contexts.

However, this research is not without limitations. The sample was drawn from a single institution, which may limit the generalizability of the findings. Future research should consider expanding the sample to include students from diverse educational backgrounds and regions. Additionally, longitudinal studies could provide insights into how students' attitudes towards OSS evolve over time. Finally, qualitative research methods, such as in-depth interviews or focus groups, could complement the quantitative findings by exploring the underlying reasons behind students" adoption behaviors in greater detail.

In conclusion, this study sheds light on the critical factors influencing OSS adoption among university students, offering both theoretical and practical insights. As OSS continues to play an increasingly important role in education, understanding the drivers of its adoption will be essential for educators, policymakers and software developers alike. By

addressing the factors identified in this study, higher education institutions can better harness the potential of OSS to enhance learning and promote more open and accessible educational practices.

References

Alrawashdeh, T.A., Elbes, M.W., Almomani, A., ElQirem, F. and Tamimi, A. (2020), "User acceptance model of open source software: an integrated model of OSS characteristics and UTAUT", *Journal of Ambient Intelligence and Humanized Computing*, Vol. 11 No. 8, pp. 3315-3327, doi: 10.1007/s12652-019-01524-7.

Benkler, Y. (2002), "Coase's penguin, or, Linux and 'the nature of the firm'", *The Yale Law Journal*, Vol. 112 No. 3, pp. 369-446, doi: 10.2307/1562247.

Brown, S.A. and Venkatesh, V. (2005), "Model of adoption of technology in households: a baseline model test and extension incorporating household life cycle", *MIS Quarterly*, Vol. 29 No. 3, pp. 399-426, doi: 10.2307/25148690.

Bulfin, S., Johnson, N.F. and Bigum, C. (Eds) (2015), *Critical Perspectives on Technology and Education*, Palgrave Macmillan US, London, doi: 10.1057/9781137385451.

Chao, C.-M. (2019), "Factors determining the behavioral intention to use mobile learning: an application and extension of the UTAUT model", *Frontiers in Psychology*, Vol. 10, p. 1652, doi: 10.3389/fpsyg.2019.01652.

Chesbrough, H.W. (2003), *Open Innovation: the New Imperative for Creating and Profiting from Technology*, Harvard Business School Press, New York.

Compeau, D.R. and Higgins, C.A. (1995), "Computer self-efficacy: development of a measure and initial test", *MIS Quarterly*, Vol. 19 No. 2, pp. 189-211, doi: 10.2307/249688.

Cronin, C. (2017), "Openness and praxis: exploring the use of open educational practices in higher education", *International Review of Research in Open and Distance Learning*, Vol. 18 No. 5, pp. 15-34, doi: 10.19173/irrodl.v18i5.3096.

Cronin, C. and MacLaren, I. (2018), "Conceptualizing OEP: a review of theoretical and empirical approaches", *Open Praxis*, Vol. 10 No. 2, pp. 127-144, doi: 10.5944/openpraxis.10.2.825.

Duan, C. and Jiao, J. (2023), "An exploration of the current state of research related to open education practices—a visual analysis based on CiteSpace", in Tso, A.W.B., Chan, W.W.L., Ng, S.K.K., Bai, T.S. and Lo, N.P.K. (Eds), *Critical Reflections on ICT and Education*, Springer Nature, Singapore, pp. 3-19, doi: 10.1007/978-981-99-7559-4_1.

Ehlers, U.-D. (2011), "Extending the territory: from open educational resources to open educational practices", *Journal of Open, Flexible, and Distance Learning*, Vol. 15 No. 2, pp. 1-10.

Ehlers, U.-D. and Conole, G. (2010), "Open educational practices: unleashing the power of OER", Open Educational Quality Initiative (OPAL).

Feller, J., Finnegan, P., Fitzgerald, B. and Hayes, J. (2008), "From peer production to productization: a study of socially enabled business exchanges in open source service networks", *Information Systems Research*, Vol. 19 No. 4, pp. 475-493, doi: 10.1287/isre.1080.0207.

Fornell, C. and Larcker, D.F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18 No. 1, pp. 39-50, doi: 10.2307/3151312.

Geith, C. and Vignare, K. (2008), "Access to education with online learning and open educational resources: can they close the gap?", *Online Learning*, Vol. 12 No. 1, doi: 10.24059/olj.v12i1.39.

Geser, G. (2007), "Open educational practices and resources: OLCOS roadmap 2012", *Salzburg Research, EduMedia Group*, available at: https://www.olcos.org/cms/upload/docs/olcos_roadmap.pdf

Havemann, L. (2020), "Open educational resources and practices: a perspective from the UK", *Journal of Learning for Development*, Vol. 7 No. 2, pp. 243-255.

Hilton, J.L. (2016), "Open educational resources and college textbook choices: a review of research on efficacy and perceptions", *Educational Technology Research and Development*, Vol. 64 No. 4, pp. 573-590, doi: 10.1007/s11423-016-9434-9.

Hylén, J. (2006), "Open educational resources: opportunities and challenges", OECD's Centre for Educational Research and Innovation.

Kamarozaman, Z. and Razak, F.Z.A. (2021), "The role of facilitating condition in enhancing user's continuance intention", *Journal of Physics: Conference Series*, Vol. 1793 No. 1, 012022, doi: 10.1088/1742-6596/1793/1/012022.

Kim, J. and Lee, K. S.-S. (2020), "Conceptual model to predict Filipino teachers' adoption of ICT-based instruction in class: using the UTAUT model", *Asia Pacific Journal of Education*, Vol. 4 No. 42, pp. 699-713, doi: 10.1080/02188791.2020.1776213.

Knox, J. (2013), "The limitations of access alone: moving towards open processes in education technology", *Open Praxis*, available at: https://openpraxis.org/article/10.5944/openpraxis.5.1.36/

Li, Y., Tan, C.-H., Xu, H. and Teo, H.-H. (2011), "Open source software adoption: motivations of adopters and amotivations of non-adopters", *ACM SIGMIS – Data Base: The Database for Advances in Information Systems*, Vol. 42 No. 2, pp. 76-94, doi: 10.1145/1989098.1989103.

Li, K.C., Yuen, K.S. and Wong, B. T.-M. (2014), "Readiness for open educational resources: a study of Hong Kong", available at: https://weko.wou.edu.my/?action=pages_view_main&active_action=repository_view_main_item_detail&item_id=374&item_no=1&page_id=23&block_id=39

Maruping, L.M., Bala, H., Venkatesh, V. and Brown, S.A. (2017), "Going beyond intention: integrating behavioral expectation into the unified theory of acceptance and use of technology", *Journal of the Association for Information Science and Technology*, Vol. 68 No. 3, pp. 623-637, doi: 10.1002/asi.23699.

Moriuchi, E. (2021), "An empirical study on anthropomorphism and engagement with disembodied AIs and consumers' re-use behavior", *Psychology and Marketing*, Vol. 38 No. 1, pp. 21-42, doi: 10.1002/mar.21407.

Nascimbeni, F. and Burgos, D. (2016), "In the search for the open educator: proposal of a definition and a framework to increase openness adoption among university educators", *International Review of Research in Open and Distance Learning*, Vol. 17 No. 6, pp. 1-17, doi: 10.19173/irrodl.v17i6.2736.

Nayak, K. and Binjha, P.B. (2022), "Student's awareness of free and open-source software (FOSS) in higher education: a descriptive survey", in Yildirim, A. (Ed.), *Research Highlights in Language, Literature and Education*, Book Publisher International (a part of SCIENCEDOMAIN International), Vol. 1, pp. 53-62, doi: 10.9734/bpi/rhlle/v1/3802A.

Nikou, S.A. and Economides, A.A. (2017), "Mobile-based assessment: investigating the factors that influence behavioral intention to use", *Computers and Education*, Vol. 109, pp. 56-73, doi: 10.1016/j.compedu.2017.02.005.

Ozturk, A.B., Bilgihan, A., Nusair, K. and Okumus, F. (2016), "What keeps the mobile hotel booking users loyal? Investigating the roles of self-efficacy, compatibility, perceived ease of use, and perceived convenience", *International Journal of Information Management*, Vol. 36 No. 6, pp. 1350-1359, doi: 10.1016/j.ijinfomgt.2016.04.005.

Paskevicius, M. (2017), "Conceptualizing open pedagogy: the use of open educational resources to support teaching and learning", *The Journal of Learning for Development*, Vol. 4 No. 3, pp. 357-365.

Perryman, L.-A. and Coughlan, T. (2013), "The realities of 'reaching out': enacting the public-facing open scholar role with existing online communities", *Journal of Interactive Media in Education*, Vol. 2013 No. 2, p. 17, doi: 10.5334/2013-21.

Peter, S. and Deimann, M. (2013), "On the role of openness in education: a historical perspective", *Open Praxis*, Vol. 5 No. 1, pp. 7-14, doi: 10.5944/openpraxis.5.1.23.

Raymond, E.S. (1999), *The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary*, O'Reilly Media, Sebastopol.

Rosaline, S. and Wesley, J.R. (2017), "Factors affecting students' adoption of ICT tools in higher education institutions: an Indian context", *International Journal of Information and Communication Technology Education*, Vol. 13 No. 2, pp. 82-94, doi: 10.4018/ijicte.2017040107.

Shah, S.K. (2006), "Motivation, governance, and the viability of hybrid forms in open source software development", *Management Science*, Vol. 52 No. 7, pp. 1000-1014, doi: 10.1287/mnsc.1060.0553.

Stallman, R. (2007), *Free Software, Free Society: Selected Essays of Richard M. Stallman*, GNU Press, London.

Tavakol, M. and Dennick, R. (2011), "Making sense of Cronbach's alpha", *International Journal of Medical Education*, Vol. 2, pp. 53-55, doi: 10.5116/ijme.4dfb.8dfd.

Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003), "User acceptance of information technology: toward a unified view", *MIS Quarterly*, Vol. 27 No. 3, pp. 425-478, doi: 10.2307/30036540.

Venkatesh, V., Thong, J. and Xu, X. (2016), "Unified theory of acceptance and use of technology: a synthesis and the road ahead", *Journal of the Association for Information Systems*, Vol. 17 No. 5, pp. 328-376, doi: 10.17705/1jais.00428.

Venkatesh, T., Xu and Xu (2012), "Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology", *MIS Quarterly*, Vol. 36 No. 1, pp. 157-178, doi: 10.2307/41410412.

Von Krogh, G., Spaeth, S. and Lakhani, K.R. (2003), "Community, joining, and specialization in open-source software innovation: a case study", *Research Policy*, Vol. 32 No. 7, pp. 1217-1241, doi: 10.1016/S0048-7333(03)00050-7.

Weber, S. (2004), *The Success of Open Source*, Harvard University Press, New York. doi: 10.2307/j.ctv26071g2.

Weller, M. (2014), *The Battle for Open: How Openness Won and Why it Doesn't Feel like Victory*, Ubiquity Press, London.

Weller, M. (2020), *25 Years of Ed Tech*, Athabasca University Press, Athabasca.

Wiley, D. (2006), "On the sustainability of open educational resource initiatives in higher education", OECD Centre for Educational Research and Innovation (CERI).

Wiley, D. and Hilton, J. (2018), "Defining OER-enabled pedagogy", *International Review of Research in Open and Distance Learning*, Vol. 19 No. 4, pp. 133-147, doi: 10.19173/irrodl.v19i4.3601.

Yuan, L., MacNeill, S. and Kraan, W. (2008), *Open Educational Resources – Opportunities and Challenges for Higher Education*, JISC CETIS.

Zawacki-Richter, O., Bedenlier, S., Bond, M. and Buntins, K. (2020), "Systematic review of research on open educational resources adoption and impact", *Open Learning: The Journal of Open, Distance and e-Learning*, Vol. 35 No. 2, pp. 134-150.

Zhang, S., Zhao, J. and Tan, W. (2008), "Extending TAM for online learning systems: an intrinsic motivation perspective", *Tsinghua Science and Technology*, Vol. 13 No. 3, pp. 312-317, doi: 10.1016/S1007-0214(08)70050-6.

Corresponding author
Chenggui Duan can be contacted at: dduan@hkmu.edu.hk