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EXPLORING THE MEDIATING ROLE OF EFFORT EXPECTANCY: LINKING INSTRUCTORS' DIGITAL COMPETENCE TO WORK ENGAGEMENT IN CHINESE UNIVERSITIES

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Abstract: As a result of the global COVID-19 pandemic, the higher education sector swiftly transitioned to online and blended learning methods. There is a lack of study on the connection between instructors' job engagement and digital competence, as well as their expectations of effort. This is surprising considering the numerous arguments in the research literature advocating for teachers to acquire digital competence during the significant shift to online education. This research aims to investigate the correlation between teachers' job engagement and their digital proficiency and effort expectation. The study comprised a cohort of 321 active teachers who were selected from educational institutes in China. The results of the structural equation modeling revealed a strong and statistically significant relationship between instructors' job engagement and effort expectation, and their digital proficiency. Furthermore, the teachers' level of job engagement was highly impacted by their anticipated level of exertion. Ultimately, it was determined that the mediator variable, effort expectancy, had a role in mediating the connection between teachers' job engagement and digital competence. In order to enhance teachers' job engagement, solutions were proposed to complement the digital revolution.

Keywords: higher education, employment engagement, effort expectation, and digital competence

I. Introduction

The covid-19 pandemic accelerates the radical transformational change of technology application and digitalization in global higher education (krishnamurthy, 2020). The rapid change refected in pedagogy is shown by the channel of instruction shift from traditional to online settings, and from personal to virtual context (mishra et al., 2020). Given this era of transformation, digital competence occupies a prominent place in the current educational activity (basilotta-gómez-pablos et al., 2022). Teachers play a crucial role in integrating various resources with digital media and technological devices to adapt the urgent transformation process from ofine to online instructional activity (trust & whalen, 2020). Consequently, many university teachers are not only expected to develop their efective digital competencies to achieve the desired goal of education, but they are also asked to refect on and redesign their teaching subject in the context of digital transformation. With regard to this aspect, cabero-almenara et al., (2020) underlined the digital competence in future is about to take on one of the front burners in teachers' professional development. On the other hand, the study by damşa et al., (2021) indicated that teachers experienced

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many hurdles, such as the development of remote teaching methods and the need to re-design online teaching activities. In doing so, many teachers replicated face-to-face teaching online during the pandemic time, thus it wasted the additional possibility of other types of resources to work with and virtual activities to adopt (usher et al., 2021; portillo et al., 2020) proposed that teachers perceive a greater workload because of the lack of training in digital skills during the lockdown. Pedagogical continuity is only possible if teaching is taught in new and innovative ways using a variety of digital tools and resources.

II. Literature review

TEACHER DIGITAL COMPETENCE

Digital competence as a concept can be defned as abilities in the set to apply technology to enhance the efectiveness of our daily lives (ferrari & punie, 2013), illustrated as "the confdent, critical and responsible use of the technologies from the society of information for work, entertainment and education" (european commission, 2018, p. 9). Digital competence as one of the core competencies are required to master by citizens and teachers in particular in the contemporary society (cabero et al., 2020). Although the term teacher digital competence (tdc) holds varied defnitions, there are coincidences in general aspects which underline the necessity of teachers to achieve a didactic and technological understanding of digital technologies that beneft teachers to make use of them in their professional practice (basilotta-gómez-pablos et al., 2022). This broader concept of digital competence includes not only the skills of using technological devices and supplicating digital resources in an instructional activity, but also focuses on varied pedagogical dimensions in practice, such as attitude, strategies, and awareness which allow teachers to achieve teaching and learning goals by technology efectively (cattaneo et al., 2022mäläinen et al., 2021; reisoğlu & çebi, 2020). To demonstrate the multiple facets of teachers' digital competencies, there are some frameworks that have been designed (zhao et al., 2021). Among these, the framework of "general technology competency and use" (gtcu) has been selected by blayone et al., (2017) to conceptualize and evaluate university teachers' competencies of using digital technologies. In the gtcu framework, digital competence is identifed in three dimensions: epistemological, informational, and social. Additionally, six areas of competency are articulated in "european framework for digital competence of teachers: digcompedu", which are required for teachers to enhance their learning strategies to be efective, inclusive, and innovative through digital tools (caena & redecker, 2019; lu et al., 2021). Typical developed digital competence of educators is detailed in digcompedu including 22 competencies in the matrix of six levels and six areas. The 22 competence, level descriptors, and profciency statements are explicated one by one, providing detailed guidance to educators to locate their competency level and their further developmental needs. The framework aims to detail how digital technologies are adopted to promote and innovate educators' training and development.

Efort expectancy

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Efort expectancy (ee) is defned as the degree to which an individual believes that using the system would be free of efort (venkatesh et al., 2003). Eccles and colleagues (eccles & wigfeld, 1995; wigfeld et al., 2009) proposed the contemporary expectancy-value theory (evt), which attempts to show individuals' behavior of choice making, persistence, hardworking, and acting in academic context originally. About the evt, it assumes that people's behaviors are the reactions to the self-evaluated beliefs about their personal competence and the value of the task. In the context of this study, efort expectancy (ee) is defned as the degree of ease related to university instructors' adaptation to emergency remote teaching (ert). Ee relates to the tam model in the perceived ease of use construct and in tam, ert 102 g. Sang et al. 1 3 is that the easier to be perceived is more intended to use it (saade & bahli, 2005). An individual's behaviour is likely to be impacted by expectancies and values (e.g., efort and engagement) (putwain et al., 2019). Ee is the key factor to implicate technology-enhanced learning successfully. Shodipe & ohanu (2021) found that the perceived ease of use of electrical/electronic technology to teachers shows a positive correlation to teachers' use of mobile learning in actuality. In terms of the efect of ee on work engagement, prior research (statnickė et al., 2019), found that ee was a signifcant predictive factor of work engagement of mobile learning.

III. Work engagement

Work engagement is about the relationship between an employee with his work, and it is described as a mental state of a positive, fulflling, work-related mind (schaufeli, 2017). Work engagement portrays an individual's volition who is more likely to be an absorbed and resilient person during tasks, who is difcult to distract and can be able to focus their mind on the task at hand. In the present day, vigor, dedication and absorption are the general and highly recognized conceptualizations of work engagement. Vigor (vi) means the high levels of energy and resilience of mental functions in work, not being easily fatigued, even facing difcult tasks. Dedication (de) connects with the deep involvement in one's task and the undergoing feeling of importance, inspiration, passionate, pride, and challenging. Absorption (ab) is conceptualized as the concentration and positive feeling of highly focus on one's task, whereby the time passing is quick and it is not easy to detach oneself from his task in hand (schaufeli et al., 2006). These concepts have been analyzed by many studies from multiple areas, as well among teachers (van der berg et al., 2013; moreirafontán et al., 2019). Vigor is linked to the cognitive dimension, and dedication is an emotional component, while in terms of physical participation and involvement, absorption means spending a long time in an activity of working (rayton & yalabik, 2014). For educational employees, the cognitive dimension is about their teaching interest and dedication. Their emotional achievement and enthusiasm to work relate to the degree of their teaching enjoyment (kirkpatrich, 2007) and their closeness with students (c). The way how teachers are involved in the educational practice of teaching and preparation is related to the behavioural dimension, in which teachers'

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efort is evaluated by the time of work etc. Among the conditions or the impetus of work engagement, personal resource is indicated by schaufeli (2017) and van wingerden et al., (2017). Resources of individuals include the self-evaluation in a positive way which contains the sense of capacity to infuence and control the situation of tasks.

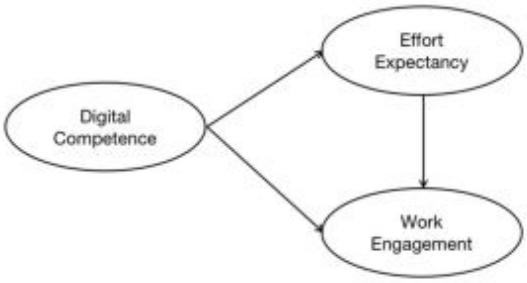
Relationships among variables and research hypotheses

The constant change and rapid development of current digital technology underline the necessity to explore the infuence of individuals' digital competence on online learning or blended learning to complete a work task. The expectancy in one's perception of technology may correlated with his/her digital competence positively (meyers et al., 2013; ungerer, 2016; he & li, 2019; hatlevik, 2017; from, 2017) illustrate that digital competence is an aspect that can explain variations in teachers' pedagogical use of digital technologies and that high levels of digital competence can contribute to a more critical and frequent use of digital technologies. Digital literacy has been found to lower stress efort expectancy mediate the relationship between instructors'… 103 1 3 levels and reduce individuals' inclination to regard their achievements disparagingly (eastin & larose, 2000), which should make them more confdent about their expected performance. In the context of the utaut2 model, prior research by mohammadyari & singh (2015)has indicated that digital literacy is positively related to efort expectancy. Moreover, individuals with a high level of digital competence have the capacity to minimize the distraction caused by digital tools during their work (hargittai, 2010), which will enhance their performance and will make them accessible and evaluate the systems easier, and will be helpful to tailor it to achieve their learning requirements and priorities. On the one hand, some studies (e.g., he & li 2019; mohammadyari & singh, 2015; nikou & aavakare, 2021) have suggested that individuals with high levels of digital competence may expect to put in less efort while using digital technology for teaching and learning activities. On the other hand, some other studies (e.g., statnickė et al., 2019; shodipe & ohanu, 2021; abd latib et al., 2014) have shown that there is a relationship between work engagement and digital competence as well as efort expectancy. Drawing on previous studies, the following hypotheses are put forward:

IV. Methods

sample and data collection

The target participants were university teachers in china. After the initial sudden closure of the institutions in the spring semester of 2020, universities in china adopted remote



Teaching. As the frst wave of the covid began to wane, starting from the fall semester of 2020 up until the spring semester of 2022, universities gradually

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reopened their campuses and returned to face-to-face teaching. Remote teaching was used temporarily when there was an outbreak of many positive cases in an area. A total of 427 teachers working at diferent higher educational institutions across china completed an online survey. These participants were recruited via the internet using the convenience sampling and snowball sampling methods. A link of the online survey was distributed through personal social media accounts from the end of june to mid july 2022. An online consent form was sent with the questionnaire detailing the purpose of the research. As indicated in the consent form, to ensure the anonymity of data collected, no employment-related personal data would be collected (e.g., respondent's institution). Preliminary data screening was conducted to eliminate invalid responses (e.g., straightlining responses, too-fast responses, inaccurate data entry). This process resulted in the removal of 94 cases. Prior to statistical analysis, variables were checked for outliers and normal distribution properties. Univariable outliers were screened using standardized scores and an absolute value greater than 3.29 was considered as a potential outlier (tabachnick & fidell, 2014). This process identifed 10 cases. Multivariate outliers were checked using casewise diagnostics and a case with an absolute standardized residual value larger than 3 was considered as potential outlier (muijs, 2011). Two cases were identifed. All 12 cases were removed and the remaining 321 cases were used for the subsequent analyses. The characteristics of the fnal sample (n=321) are presented in table 1.

Measures the online questionnaire included two parts. The frst part collected background information about the respondent including age, gender, the feld of subject taught, and prior ict training experience. The second part included 47 items that measured three aspects related to online teaching: digital competence, efort expectancy and work engagement (see appendix a). These measures were adapted from previous studies (schaufeli et al., 2006; venkatesh et al., 2012).

Table 1 Characteristics of the sample ($N = 321$)

Profile	Category	Frequency	Percentage (%)
Gender	Male	122	38
	Female	199	62
Age	≤35	98	30.5
	36–45	161	50.2
	≥46	62	19.3
Level of degree	PhD	178	55.5
	Master	125	38.9
	Undergraduate	18	5.6
Field of subject taught	Education	111	34.6
	Literature	29	9.0
	Science	68	21.2
	Management	27	8.4
	Other	86	26.8
Prior ICT training experience	No	92	28.7
	Yes	229	71.3

Digital competence the european framework for the digital competence of educators (digcomedu) proposed by redecker and punie (2017) was used to develop measures of teachers' digital competence. The digcomedu framework consists of three dimensions that point to the essential knowledge and skills needed for online instruction: professional competences, pedagogical competences and learners' competences. Professional competences were measured by one subscale: professional engagement (pe) with four items. Pedagogical competences included two subscales: digital resources (dr), empowering learners (el). Each subscale had three items. Learners' competences were measured by one subscale: facilitating learners' digital competence (fldc) with fve items. All items were scored on a fve-point likert scale with 1 indicating strongly disagree and 5 indicating strongly agree.

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Efort expectancy efort expectancy was measured using four items. These items were based on the study of venkatesh et al. (2012). All items were scored on a fve-point likert scale with 1 indicating strongly disagree and 5 indicating strongly agree.

Work engagement a short version of the utrecht work engagement scale (schaufeli et al., 2006) was used to measure teachers' work engagement. This scale measures three aspects of work engagement including vigor, dedication and absorption. Each of them had three items. All items were scored on a fve-point likert scale with 1 indicating strongly disagree and 5 indicating strongly agree.

Analysis procedure descriptive statistics were calculated using spss 25.0. Confrmatory factor analysis (cfa) and second order cfas were conducted to examine the validity of the proposed model. Second order cfas were conducted to check the measurement of the theorized structures of digital competence and work engagement. Then, a latent variable path analysis was conducted to test the hypotheses using the maximum likelihood estimation in amos 21.0.

V. Results

descriptive statistics and correlations the means and standard deviations and correlations of the measures are presented in table 2. As shown, skewness and kurtosis values fell between −1 and +1, indicating the data was roughly normal (george & mallery, 2001). The variables had positive correlations with each other signifcant at 0.01 level.

Evaluation of the measurement model the reliability and validity of the constructs in the proposed model were checked. Results are presented in t able 4. Construct reliability was assessed using composite reliability (cr). A cr value of 0.60 or more indicates good reliability (hair et al., 2014). As shown in table 4, all crs were above 0.90; the internal consistency of all constructs as measured by cronbach's alpha coefcients were greater than the cutof value of 0.70 (fornell & larcker, 1981). Convergent validity of the constructs within the measurement model was assessed using cfas and average variance extracted (ave). Second-order cfas were performed for digital competence and work engagement following the procedure suggested by byrne (2009).

The CFA results for effort expectancy revealed a good model fit ($\chi^2=2.33$, $\chi^2/df=1.16$, GFI=0.996, CFI=0.999, RMSEA=0.023, SRMR=0.013). Results of two separate second-order CFAs for digital competence ($\chi^2=139.84$, $\chi^2/df=1.73$, GFI=0.946, CFI=0.980, RMSEA=0.048, SRMR=0.032.) and work engagement ($\chi^2=23.37$, $\chi^2/$

Table 2 Descriptive statistics and correlations between the measured variables

Variable	1	2	3	4	5	6	7	8	9	10
1. PE	1									
2. DR	0.73**	1								
3. EL	0.73**	0.70**	1							
4. FLDC	0.77**	0.72**	0.77**	1						
5. Vig	0.69**	0.59**	0.61**	0.68**	1					
6. Ded	0.54**	0.49**	0.43**	0.44**	0.45**	1				
7. Abs	0.67**	0.55**	0.61**	0.64**	0.79**	0.54**	1			
8. DC	0.90**	0.88**	0.90**	0.86**	0.72**	0.53**	0.69**	1		
9. EE	0.67**	0.56**	0.63**	0.67**	0.68**	0.40**	0.63**	0.71**	1	
10. WE	0.74**	0.64**	0.65**	0.70**	0.89**	0.76**	0.92**	0.76**	0.67**	1
Mean	3.98	3.98	3.71	3.74	3.48	4.18	3.67	3.86	3.65	3.78
SD	0.62	0.69	0.81	0.70	0.75	0.64	0.72	0.63	0.72	0.60
Skewness	− 0.28	− 0.22	− 0.23	− 0.15	− 0.15	− 0.36	− 0.10	− 0.11	− 0.07	− 0.01
Kurtosis	− 0.38	− 0.71	− 0.15	− 0.25	0.13	− 0.69	− 0.14	− 0.48	− 0.07	− 0.47

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Table 3 Results for the measurement model

Construct	Item	Factor loading	Cronbach's alpha	CR	AVE
Digital competence			0.94	1.00	0.89
Professional engagement		0.96	0.76	0.93	0.47
	PE1	0.47			
	PE2	0.69			
	PE3	0.81			
	PE4	0.73			
Digital resources		0.94	0.71	0.94	0.47
	DR1	0.55			
	DR2	0.80			
	DR3	0.68			
Empowering learners		0.91	0.90	0.99	0.75
	EL1	0.81			
	EL2	0.90			
	EL3	0.88			
Facilitating learners' digital competence		0.96	0.85	0.95	0.53
	FLDC1	0.70			
	FLDC2	0.76			
	FLDC3	0.70			
	FLDC4	0.62			
	FLCD5	0.85			
Effort expectancy			0.85	0.95	0.60
	EE1	0.65			
	EE2	0.88			
	EE3	0.84			
	EE4	0.74			
Work engagement			0.87	0.98	0.69
Vigor		0.89	0.74	0.96	0.50
	Vig1	0.75			
	Vig2	0.82			
	Vig3	0.53			
Dedication		0.67	0.83	0.95	0.55
	Ded1	0.67			
	Ded2	0.91			
	Ded3	0.60			
Absorption		0.90	0.71	0.97	0.64
	Abs1	0.86			
	Abs2	0.71			
	Abs3	0.44			

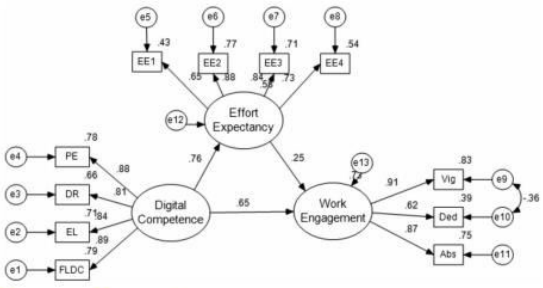

Fig. 2 Results for the Structural model

Except for two constructs (professional engagement and digital resources), the aves of all other constructs were above the recommended value of 0.50 (hair et al., 2014), indicating an acceptable convergent validity. For the two constructs with relatively low aves, fornell and larcker (1981) suggest that the ave may be a more conservative measure and the convergent validity of a construct can still be established based on solely on cr. Given that both crs exceeded 0.90, the convergent validity of the two constructs is deemed adequate. In sum, the items in the proposed measurement model demonstrated acceptable reliability and validity. Results of the check for discriminant validity are presented in table 4. The square roots of ave were greater than the correlation between each construct and all others, indicating good discriminant validity.

Testing the structural model and hypotheses the structural model demonstrated an acceptable model ft with $\chi2=116.19$, $\chi2$ /df=2.91, gfi=0.937, cfi=0.970, rmsea=0.077, srmr=0.046. As seen in fig. 2, there was a positive and signifcant relationship between teachers' digital competence and their work engagement ($\beta=0.25$, $p=.0001$). The structural coefcients of the model are presented in fig. 2. The path between digital competence and work engagement was signifcant statistically, $\beta=0.63$, p.

VI. Discussion and conclusion

Due to the global covid-19 pandemic, many higher education institutions have had to take classes online, leading to a series of huge challenges that need to be addressed properly (toquero, 2020). Given the external challenges that teachers may encounter when integrating digital competence in their professional work, it was important for us to recognize the relationship between instructors' digital competencies and their work engagement by considering the mediating role of efort expectancy, so as to provide insights into the future of teaching and learning. Our fndings confrmed the frst hypothesis, as teachers' digital competence has a positive

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and signifcant efect on their work engagement. The results of the survey mostly represent the teachers' beliefs about their competence instead of their actual level of competence. Thus, the investigation of digital competence through the digcompedu selfassessment tool is closely associated with the construct of perceived self-efcacy with regard to the use of technology in education. In this regard, the results of this study are consistent with previous studies, which indicate that self-efcacy is a signifcant personal resource associated with higher work engagement indicated that teachers who regarded themselves as more digitally self-efcacious engaged in their work more autonomously. This result reveals the signifcance of technology-related self-efcacy in the context of techno-work engagement.

Table 5 Structural equation modeling: hypotheses testing

Hypothesis	Path	Standardized Path coefficient	Conclusion
H1	Digital competence→Work engagement	0.65	Supported
H2	Effort expectancy→Work engagement	0.25	Supported
H3	Digital competence→Effort expectancy	0.76	Supported
H4	Digital competence→Effort expectancy→Work engagement	0.19	Supported

Limitations and suggestions for future research

The first limitation of the study was that the discriminant validity with several factors in the first order is not a unidimensional construct. It is possible that the Chinese government attaches great importance to online teaching due to the global covid-19 epidemic. In this case, online teaching-learning in higher education is not only starting early, but also moving fast with a high penetration rate. As a result, most of the respondents to the questionnaires have the similar options about the digital competence. Thus, following research is needed to consider intervention when examining the efects among these variables. The second limitation was that only two predictors were incorporated in the present model: digital competence and efort expectancy. Therefore, future studies need to consider other factors such as teaching autonomy and school support. Third, all members of the research group were from the department of education of a normal university, with the exception of one member. Questionnaire respondents were recruited using a convenience sampling and snowball sampling methods. Consequently, there was an over representation of respondents in the feld of education. Fourth, certain job-related variables on work engagement of staf at the university (e.g., institutional level) could not be controlled for and so could have infuenced their responses.

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