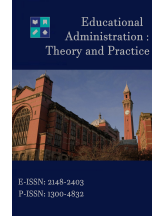




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Mediation Effect of Technology Readiness and Readiness for Change in the Relationship Between Edutech Competence and Depression

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<p>Article History</p> <p>Article Submission 15 November 2022</p> <p>Revised Submission 12 December 2022</p> <p>Article Accepted 14 February 2023</p>	<p style="text-align: center;">Abstract</p> <p>After the COVID-19 pandemic, teachers quickly adapted to an Edutech-based online, non-face-to-face class. Many teachers began experiencing a high level of depression and doubted their own teaching competence. Therefore, this study examines the dual mediation of technology readiness (hereinafter referred to as TR) and readiness for change (hereinafter referred to as RC) in the relationship between Edutech competence and depression in South Korean teachers. Questionnaires regarding Edutech competence, TR, RC, and depression were distributed to 382 teachers (136 males and 246 females). A survey was administered to middle and high school teachers in South Korea using a mobile URL of Google from July 2022 to August 2022, and 382 complete responses were analysed. It analysed survey data through frequency, correlation analysis, and structural equation modelling using SPSS 26.0 and Amos 25.0. The results indicate that, first, depression has a negative and significant correlation with Edutech competence, TR, and RC. Second, the results of structural equation modeling verify the mediating effect of TR and RC in the relationship between teachers' Edutech competence and depression. Finally, Edutech competence has a statistically significant impact on TR and RC but does not affect depression. Therefore, improving TR and RC, rather than merely acquiring Edutech competence, is necessary to address depression in South Korean teachers in the post-COVID-19 scenario.</p> <p>Keywords: Edutech Competence; Technology Readiness; Readiness for Change; Depression; Confirmatory Factor Analysis</p>
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Introduction

After the COVID-19 pandemic, teaching methods and the assessment of school education, previously performed in the classroom's physical space, have undergone profound revisions. The learning practice has shifted from a class performed at a fixed time in a limited space to an offline learning environment with no time and space limitations. This process requires increasing teachers' educational technology competence, namely, the Edutech competence. Even before the pandemic, Edutech classes utilized Information Communication Technology (ICT) in certain cases. However, with the advent of the pandemic, teachers quickly adapted to an Edutech-based, online, non-face-to-face class they had never experienced before, and encountered issues such as errors in digital devices or wireless networks and overloaded online platforms. Consequently, many teachers began experiencing a high level of depression and doubted their own teaching competence even though they were not their personal problems (Kim et al., 2021; Kwon et al., 2020; Ozamiz-Etxebarria et al., 2021).

South Korean teachers have thus begun perceiving the need to develop Edutech competence in the post-pandemic period (Kim et al., 2022; Lee & Kim, 2022). In other words, teachers' Edutech competence, a selective competence before the COVID-19 pandemic, is now regarded as essential (Seo, 2021), but there is a gap in using Edutech. Most teachers had to focus on technology-based instructional media and had difficulty solving the technical problems presented by online-based teaching and learning platforms. Even in this situation, teachers' adaptability varied according to their individual characteristics and Edutech competence, technology readiness (hereinafter referred to as TR) TR, and readiness for change (hereinafter referred to as RC).

Teachers' Edutech competence can help improve their teaching skills to efficiently operate instructional media in the post-pandemic. Teachers' perception of Edutech is influenced by their TR and RC (Jung & Yoon, 2021; Moon et al., 2021). In addition, individual differences may exist in the acceptance and use of new technologies, as TR reflects potential resistance to evolving technologies. Hence, teachers' TR and RC need to be rapidly enhanced by cultivating Edutech competence and addressing psychological depression (Fishbein & Azjen, 1975; Jeong & Choi, 2011).

Since the COVID-19 pandemic, the literature has focused on teachers' difficulties in adapting to non-face-to-face classes, the prevention of infection, heavy workload, and job stress (Jung & Yoon, 2021). Most research on teachers' depression during the pandemic targets childcare or elementary school teachers (Lee & Lee, 2017), while very few studies address secondary school teachers. However, Edutech competence, TR, and RC may increase secondary school teachers' adaptability and decrease their depression in a changing school environment. Therefore, this study examines the correlation between secondary teachers' Edutech competence, TR, RC, and depression. It verifies the mediation effects of TR and RC in the relation between Edutech competence and depression. Thus, it provides a fundamental premise for measures targeting a reduction in teachers' depression by cultivating Edutech competence and increasing their TR and RC. In addition, teachers' Edutech competence can help improve their teaching skills to efficiently operate instructional media in the post-pandemic.

Literature Review

Edu-technology Competence

Edu-technology denotes the educational technology in various class methods, including real-time online classes, online-offline connected classes, and flipped learning. This methodology has gained traction during the COVID-19 pandemic and is commonly called Edutech. In its early stage, Edutech combined video and software technology to deliver education. It then began including cognitive education, including simulation-based and social learning, by integrating ICT with education and service (Min & Kim, 2021).

In South Korea, remote learning has been carried out in schools since the first semester of 2020 (Ministry of Education, 2020). By lowering the school density according to the school level, schools first entered a new semester by teaching online to Grade 3 high schools. All classes

combined remote and face-to-face teaching. However, more online courses were delivered in middle schools than those starting a semester online. With the accelerated development of digital-based technology, school education moved toward a mix of online/offline education by combining innovative technology and artificial intelligence (AI), using various platforms such as Google Class, cyberlearning system, Zoom, Webex, Padlet, Allo, and Metaverse. Hence, most teachers suddenly began providing online teaching and were asked to rapidly cultivate their Edutech competence, build IT infrastructure at school, and sustain the insufficient technical support system (Kwon et al., 2020). This phenomenon occurred in South Korea and the rest of the world as a global phenomenon. According to the report “Distance Learning Strategies in Response to COVID-19 School Closures” by UNESCO (2020), technology, content, learning support, and management/assessment readiness are needed for effective remote education.

A survey by the Ministry of Education & Korean Educational Development Institute (2021) ranked the measures for improving online teaching and learning as (1) enhancing the digital environment for smooth communication between teacher and student; (2) developing online educational content and establishing a data system; (3) improving the competence for utilizing online classes and digital devices; (4) supporting digital devices for online courses; and (5) optimizing the number of students in each class. Furthermore, the need to establish adequate infrastructure for an online class, develop materials for students and online learning, and improve teachers' competencies in utilizing digital devices reflect the need to augment Edutech competence.

Teachers may doubt their teaching competence and experience depression when operating online teaching (Kim et al., 2021). Hence, active interactions among teachers in the teaching-learning community may help address these issues. However, institutional support and individual preparation are needed to help teachers overcome depression.

Technology Readiness (TR)

Parasuraman (2000) conceptualized TR as the personal attitude and tendency of individuals who accepted and used new technologies to achieve goals at work. TR was classified into four dimensions: motivators, including innovativeness and optimism; and inhibitors, comprising discomfort and insecurity. In contrast with an individual's emotion about the use of specific technology, TR does not reflect an individual's innate attitude but conveys a context-specific behaviour approach toward the use of a particular technology (Parasuraman, 2000; Venkatesh et al., 2012). The level of TR differs across studies, and some report that it is related to the use of technology (Parasuraman & Colby, 2015).

Blut & Wang (2020) reconceptualized research on TR through a meta-analysis, contending that a high likelihood of accepting and using technology was observed when TR was high. In addition, perceived usefulness and ease of use mediated the relationship between TR and technology usage, and motivators showed a more robust relationship than inhibitors. However, TR differences across studies depending on the sociodemographic characteristics of the samples. For example, some studies report no differences compared to research in which new technologies are used efficiently, when the study subjects are young, and their education level is high (Blut & Wang, 2020). These results imply the need to analyse the effect of TR on the relationship between Edutech competence and teachers' depression in a technology-based society, which requires an increased Edutech competence.

Readiness for change

RC is needed to successfully achieve changes. When an organization's members regard change as essential or believe they urgently need it, they exhibit a stronger will to participate in change (Meyer & Herscovitch, 2001). RC may be classified into cognitive readiness, emotional readiness, and intentional readiness. Cognitive readiness entails the consideration and perception of change, while emotional readiness relates to emotions about change and positive and negative feelings about it. Intentional readiness implies making efforts to change the process and the intention to change (Fishbein & Azjen, 1975). Previous research reported that natural sciences teachers were more RC than liberal arts teachers, with differences in their response to change depending on their major (Kondakci et al., 2017). It implies the need to elaborate measures for helping teachers increase their depending on their major, especially in the current scenario, where Edutech competence has become an essential qualification for teachers.

Depression

Teachers' depression is typically related to job stress, which may lead to job dissatisfaction and burnout, thus reducing the quality of education. Moreover, it may adversely affect the educational growth of students. Hence, lowering job stress may improve teachers' job satisfaction (Lee & Lee, 2017). During the COVID-19 pandemic, teachers experienced depression caused by heavy workloads, the sudden switch to online or online/offline integrated classes, and the exposure to infection preventive measures at school (Palau et al., 2021).

(Ozamiz-Etxebarria et al., 2021) meta-analysed various studies on the stress or depression of teachers during the pandemic, and demonstrated that teachers exhibited high levels of anxiety and depression. Teachers in Asia showed more significant anxiety than those in other regions, and school teachers exhibited higher anxiety than college professors. However, differences in teachers' depression levels based on gender and age were not statistically significant. These findings contradict the results of previous research in which female teachers showed higher depression than male teachers (Stachteas & Stachteas, 2020), and older teachers were found to be more depressed due to the digital divide (Song & Chen, 2019).

Therefore, this study ascertains the effects of TR and RC in the relationship between Edutech competence and depression and differences in teachers' depression levels targeting secondary school teachers in South Korea.

Methodology

Research model

The research model was shown in Figure 1. This study was used to verify the dual mediation effects in relation to the main variables.

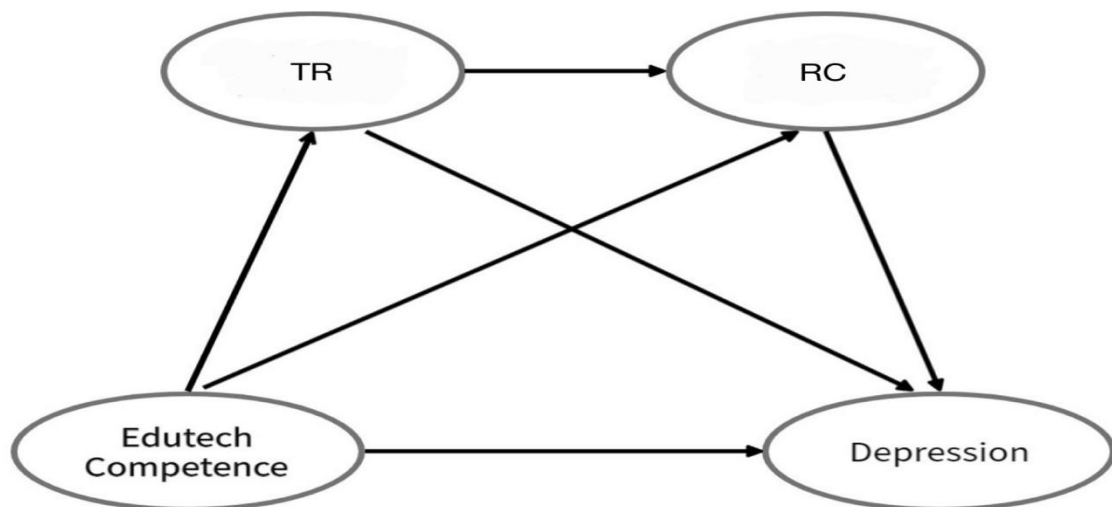


Figure 1. Research Model

Data collection procedures

A survey was administered to middle and high school teachers in South Korea using a mobile URL of Google from July 2022 to August 2022, and 382 complete responses were analysed. According to the Korea Educational Statistics Service (2021), the number of teachers in South Korean middle and high schools is 244,358; 90,531 (37.0%) are male, and 153,827 (63%) are female, with a 1:1.7 ratio. Hence, this study was designed to survey teachers using a 1:2 quota sampling. Five-year groupings classified teachers' careers to ensure even sampling. Finally, 382 teachers (0.16% of the whole population) participated in the survey with a gender ratio of 1:1.8 (136 males, equal to 35.6%, and 246 females, equal to 64.4%), thus reflecting the gender ratio of the whole population.

Instruments and procedures

The online questionnaires investigated teachers' Edutech competence, depression, TR, and RC. This study used the Edutech competence scale developed by Jung et al. (2020). This 52-item, 5-point Likert scale measures Edutech-cognition on three items, the need for improvement in the school system regarding Edutech-based aspects on five items, the necessity of Edutech-service elements on 22 items, and the willingness to apply Edutech-services on 22 items. The Cronbach's alpha value is .977.

The study adopted Parasuraman's TR index (Parasuraman, 2000), a 13-item, 5-point Likert scale that measured optimism, innovativeness, discomfort, and anxiety. This 13-item was scored on a 5-point Likert scale; one (not at all) to five (very well). In addition, these 8-13 items with opposite meanings were recorded. The Cronbach's alpha value is .897.

It used the RC scale developed by Bouckenoghe et al. (2009) and adopted by Jeong & Choi (2011) to measure cognitive, emotional, and intentional RC. This measure comprises an 11-item, 5-point Likert scale; Cronbach's alpha value is .913. Depression was assessed using the Center for Epidemiological Studies. Depression Scale (CES-D; Hoe et al., 2017). This measure consists of an 11-item, 4-point Likert scale; Cronbach's alpha value is .891.

Statistic analysis

The Statistical Package for the Social Sciences (SPSS) Version 26.0 (IBM Corp., Armonk, NY, USA) was used to calculate the frequency correlation. In addition, a confirmatory factor analysis was performed using Amos 25.0 to investigate the validity of the observed and latent variables.

Results

Characteristics of research subjects

As mentioned above, the final sample comprised 382 teachers (136 males, 35.6%; 246 females, 64.4%). In terms of age distribution, 53 participants were in their 20s (13.9%), 186 were in their 30s (48.7%), 90 were in their 40s (23.6%), 50 were in their 50s (13.1%), and three were in their 60s (0.8%). Their teaching career distribution was one year to less than five years (119; 31.2%), six years to less than 10 years (113; 29.6%), 11 years to less than 15 years (55; 14.4%), 16 years to less than 20 years (38; 9.9%), and over 21 years (57; 14.9%), a rather balanced distribution, although teachers with one year to less than 10 years of experience were slightly more numerous. In terms of the subject taught, 154 teachers taught liberal arts (40.3%), 157 natural sciences (41.1%), and 71 fine arts and athletics (18.6%). Regarding the school level, 241 teachers worked in middle schools (63.1%) and 141 in high schools (36.9%). The schools were distributed in all provinces of South Korea. Following a planned schedule, the researcher collected the survey answers one month after the questionnaire distribution. The participants have assured anonymity and they voluntarily consented to the survey. A checklist was created to evaluate the dual-mediated effect of TR and RC in the relationship between Edutech competence and depression.

Correlations between variables

To examine the correlation between Edutech competence, TR, RC, and depression, this study performed a correlation analysis (Table 1). Focusing on depression as the dependent variable, we found that the higher the Edutech competence, TR, and RC, the more substantial the negative correlations with teachers' depression. The correlation coefficient ranged between (-.419) and (.584), thus excluding potential multicollinearity.

Table 1. Correlation between variables <n=382>

	Edutech competence	TR	RC
Edutech competence	1		
TR	.371**	1	
RC	.464**	.584**	1
Depression	-.121*	-.313**	-.419**

Note. *p <.05, **p <.01.

Confirmatory Factor Analysis

To investigate the validity of the observed and latent variables, we performed confirmatory factor analysis using Amos 25.0. The results are reported in Figure 2, and Table 2, 3.

Regarding the goodness of fit of the measurement model, the χ^2 value was (402.010) ($p < .001$), thus indicating a significant difference; hence, the model's fit was not verified. However, as the χ^2 value is affected by the sample size and is meaningless when the number of observations exceeds 200 (Hong, 2000), we also evaluated the model's fit by considering other fit indices together.

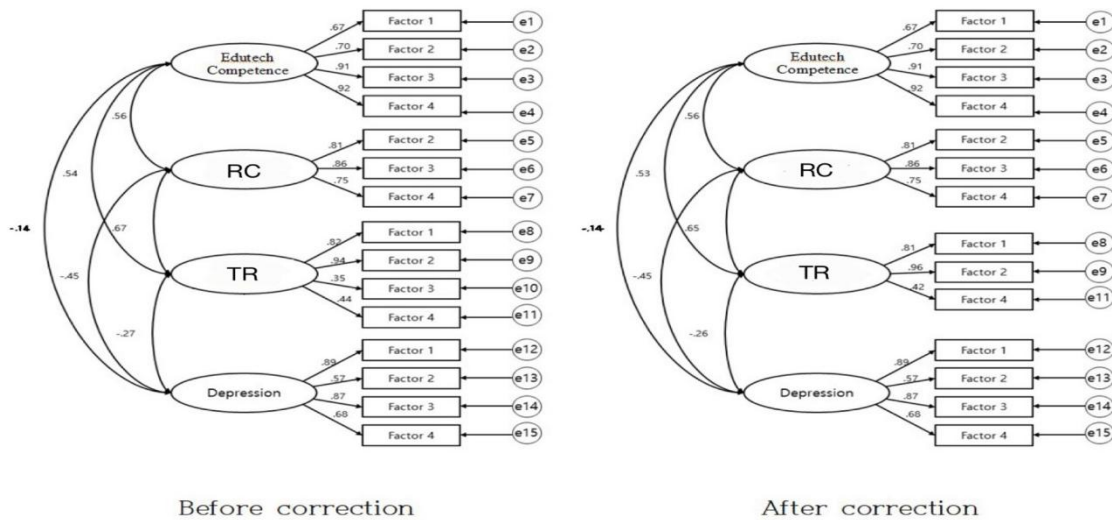


Figure 2. Path coefficient of the measurement model

Relative fitness indices were tested by NFI, TLI, and CFI, and absolute fitness indices were tested by GFI and RMSEA. First, CFI met the standard value of 9 or more, and RMSEA was .01, an adequate value, but NFI, TLI, and GFI were lower than .9; hence, the measurement model was not suitable.

As the factor loading of the [TR → Factor 3] path is (.35), lower than .5, the measurement model was modified by deleting the observed variable. Although the factor loading of the [TR → Factor 4] path was (.42), lower than .5 when the three observed variables were included in the model, on removing the variable, the construct meaning changed. Therefore, the variable was not discarded.

Regarding the model's fit after modification, the χ^2 value was (223.372) ($p < .001$), which had the same significant difference as before the correction. However, NFI, TLI, CFI, and GFI met the standard value of (.9) or higher. RMSEA was (.077), a fair value; hence, the measurement model was judged suitable. In addition, all standard factor loadings of the measurement model after modification were equal to or above .5, and all Z values are above 1.95 and statistically significant. The variance extraction index (AVE), which may confirm the concentration validity, was .5 or more (.648~.794), and the conceptual reliability (CR) was .7 (.834~.938). Hence, the concentration validity and CR were confirmed (Lee & Lim, 2011).

Table 2. The goodness of fit index of the measurement model

	χ^2	df	NFI	TLI	CFI	GFI	RMSEA(LO90 ~ HI90)
Measurement model	402.010***	84	.878	.876	.900	.872	.010 (.090~.110)
Modified model	223.372***	71	.924	.931	.946	.916	.077 (.067~.089)

Note. *** $p < .001$.

Table 3. Verification of the measurement model after modification <n=382>

Variables		Factor loading		Z value	Dispersion	AVE	CR
		B	β				
Edutech competence	Factor 1 (cog)	1.000	.672	-	-	.794	.938
	Factor 2 (imp)	.825	.696	12.384***	.067		
	Factor 3 (nec)	1.086	.907	15.454***	.070		
	Factor 4 (app)	1.214	.923	15.592***	.078		
TR	Factor 1 (inn)	1.000	.812	-	-	.648	.834
	Factor 2 (opt)	1.091	.960	17.713***	.062		
	Factor 4 (ins)	.451	.417	8.218***	.055		
RC	Factor 1 (cog)	1.000	.811	-	-	.756	.903
	Factor 2 (emo)	1.110	.860	17.682***	.063		
	Factor 3 (int)	1.126	.751	15.378***	.073		
Depression	Factor 1 (emo)	1.000	.892	-	-	.748	.920
	Factor 2 (pos)	.846	.572	11.822***	.072		
	Factor 3 (bod)	.852	.873	20.207***	.042		
	Factor 4 (rel)	.678	.680	14.788***	.046		

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Research model verification

Regarding the fit of the research model, as shown in Table 4, the χ^2 value was (303.998) ($p < .001$), thus indicating a significant difference; hence, the model's fit was not verified. However, as mentioned above, the χ^2 value was largely affected by the sample size, especially when the number of observations exceeded 200 (Hong, 2000). Hence, the model fit was evaluated by considering other fitness indices together. The NFI was .906, TLI .914, and CFI .938, which satisfies the standard value of .9 or higher. The RMSEA was .068, an adequate value; hence, the proposed model was judged suitable and was selected as the definitive research model.

Table 4. The fit index of the research model <n=382>

	χ^2	df	NFI	TLI	CFI	RMSEA (LO90 ~ HI90)
Research model	303.998***	111	.906	.914	.938	.068 (.059~.077)

Note. *** $p < .001$.

In this study, gender, school level, teaching career, and subject setting, which are control variables that affect the mediation and dependent variables, were introduced to understand the pure effect of Edutech compliance on depression through TR and RC. The results of the path coefficients are shown in Figure 3 and Table 5.

The independent variable, Edutech competence, had a statistically significant effect TR ($\beta = .551$, $p < .001$) on RC ($\beta = .284$, $p < .001$), on the dependent variable, depression ($\beta = .172$, $p < .05$). TR had a positive and significant effect on RC ($\beta = .511$, $p < .001$), and RC had a negatively significant impact on depression ($\beta = .553$, $p < .001$).

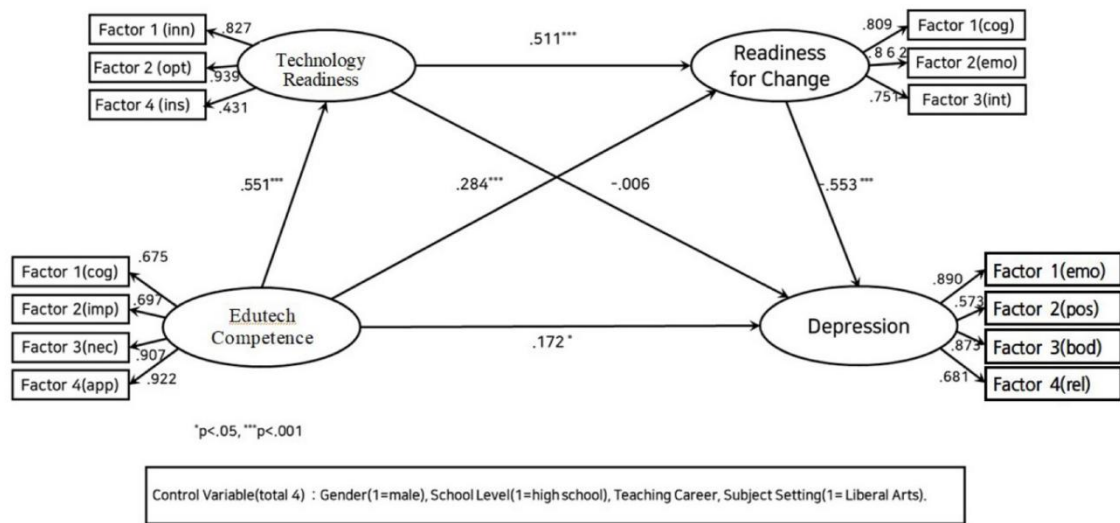


Figure 3. Paths coefficient of the research model

Table 5. Paths of the model

Path between variables			B	β	S.E.	t-value
Edutech competence	→	TR	.682	.551	.067	10.234***
gender			.371	.224	.076	4.895***
school level			-.064	-.039	.074	-.862
teaching career			-.094	-.166	.026	-3.655***
subject setting			-.103	-.064	.073	-1.417
Edutech competence	→	RC	.254	.284	.053	4.746***
TR			.368	.511	.047	7.865***
gender			.039	.033	.054	.719
school level			-.053	-.045	.052	-1.019
teaching career			.033	.080	.018	1.798
subject setting			.008	.007	.051	.164
Edutech competence	→	Depression	.151	.172	.063	2.397*
TR			-.004	-.006	.059	-.072
RC			-.546	-.553	.086	-6.320***
gender			.018	.015	.062	.286
school level			.021	.018	.059	.360
teaching career			-.009	-.024	.021	-.450
subject setting			-.065	-.057	.058	-1.120

Note. *p < .05, ***p < .001.

It decomposed the causal relationships among variables into direct, indirect, and total effects,

and verified statistical significance using the bootstrap method based on the maximum likelihood approach. The analysis results are shown in Table 6.

Table 6. Direct, indirect, and total effects (n=382)

Path			direct effect		indirect effect		total effect	
			B	β	B	β	B	β
Edutech competence	→	TR	.682	.551*	-	-	.682	.551*
Edutech competence	→	RC	.254	.284**	.251	.282*	.505	.566*
TR			.368	.511*	-	-	.368	.511*
Edutech competence	→	Depression	.151	.172	-.278	-.316*	-.127	-.145
TR			-.004	-.006	-.201	-.283*	-.205	-.289*
RC			-.546	-.553*	-	-	-.546	-.553*
R^2		TR	38.3%					
		RC	50.1%					
		Depression	23.1%					

Note. *p <.05, **p <.01.

First, the total effect of the Edutech competence on TR was (.551) (p<.05) and (.566) (p <.05) on RC. The indirect impact was (.282) (p <.05), and the direct effect was (.284) (p <.01). Second, the direct effect of TR on RC was (.511) (p <.05), the total impact on depression was (-.289) (p <.05), and the indirect effect was (-.283) (p <.05). Third, the direct effect of RC on depression was (-.553) (p <.05).

In terms of the total effect, the total explanatory power of TR was (38.3 %) ($R^2=.383$), while that of RC was (50.1%) ($R^2=.501$) and (23.1%) ($R^2=.231$) for depression.

Discussion

This study examined the dual mediation effects of TR and RC on the impact of Edutech competence on South Korean teachers' depression levels.

First, this study found that the correlations among variables were all statistically significant. This result suggests that the higher the Edutech competence, TR, and RC, the greater the negative correlations with teachers' depression. This result implies the need to improve teachers' Edutech competence, TR, and RC to lower their depression. This is a result consistent with previous studies (Blut & Wang, 2020; Kim & Kim, 2022).

Second, the proposed structural equation model, controlling for gender, school level, teaching career, and subject settings, verified the mediating effect of TR and RC in the relationship between Edutech competence and depression. The independent variable Edutech competence had a statistically significant impact on TR and RC but did not affect the dependent variable depression. TR and RC had a negative and significant effect on depression. This is consistent with the results of Jung & Yoon (2021) and Moon et al. (2021) that teachers' Edutech competence is affected by TR and RC, but the results of Fishbein & Ajzen (1975) and Jeong & Choi (2011) that affect depression were inconsistent.

These results reveal that teachers' Edutech competence does not affect depression directly but through TR and RC. Therefore, to reduce depression, TR and RC should be addressed first, before improving Edutech competence. Hence, gradual measures for increasing TR and RC are needed to improve internal/external school educational programs, including the use of the Edutech teaching and learning platform and the use of Edutech that can be applied to the classroom, taking

teachers' gender, age, teaching career, school level, and subject settings into account. Doing so would help create cooperative relationships among teachers.

Conclusion

In the post-pandemic society, Edutech competence may reduce depression when teachers perceive TR and RC more highly. Therefore, South Korean training programs should develop not only Edutech competence but also content that may enhance the cognitive, emotional, and intentional aspects of RC, thus increasing innovativeness and optimism and lowering the discomfort associated with low TR. In addition, support is needed to increase teachers' job satisfaction and reduce their depression, positively affecting students.

Despite its contributions, this study suffers some limitations. For instance, it only targets a limited number of teachers according to gender, school level, teaching career, and subject settings; hence, caution is needed in generalizing the study's results. Although the difference according to the demographic characteristics of teachers was not presented, in follow-up research, more teachers will need to be studied to deal with the differences in the variables.

Further studies should use nationwide data or data from the Korean Education Office, providing a larger sample for comparing differences in teachers' depression levels and in teachers' socio-demographic characteristics and main variables.

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