

The Relationship between Web-based Learning Tools, Self-Efficacy, Depression-Anxiety-Stress on Family Life Quality under the Circumstance of COVID-19

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Abstract

Based on the pandemic of COVID-19 in 2020, to avoid crowds and mass infection, web-based learning takes the place of traditional class teaching to become the main learning method for adults, teachers, and students, the study aims to check the relationship between web-based learning tools, self-efficacy, depression-anxiety-stress, family life quality, and general health in Chinese sample. Through a questionnaire and measurement scale to collect data in June to July 2020, adopted SPSS 25.0 and Mplus 8.3 to test the reliability and validity, structural equation modeling (SEM), multiple regression model (MRM), and other methods are used for statistical analysis and conclusions.

Introduction

Novel Coronavirus Disease 2019 (COVID-19 or 2019-nCoV) has caused over one thousand million infections across the world and more than 500 thousand life deaths, which damaging the global economic system and troubled burdensome health care system. It also affects the education system. According to World Health Organization (WHO) recognition, three pathema pandemic outbreak in 2019, which are SARS-CoV, MERS-CoV, and COVID-19 (ICTV-CSG, 2020), but COVID-19 was a little different from the first and two, it has highly infectious and readily transmitted through the air and face to face communication in the same space (Jiang, Hillyer & Du, 2020). SARS-CoV was first discovered in Guangdong Province (2002) with probably 10% (774/8098) mortality rate (Du, 2009). Similarly, MERS-CoV was becoming popular with Saudi Arabia (2012) with 34.4% (858/2494) mortality rated through 27 countries (WHO), while COVID-19 with mortality rated 4.4% (570248/12957684) (WHO). Even COVID-19 with extremely low mortality rate, but with a tremendous amount of infection.

On December 8, 2019, the novel coronavirus pneumonia pandemic (COVID-19, hereinafter referred to as the pandemic) broke out with few confirmed cases of a small scale in Wuhan, Hubei Province, and the situation was increasing. Until January 20, 2020, this phenomenon exploded, it also attracted widespread attention to governments and society. As the origin and initial place of the pandemic, Wuhan has been banned from January 23 to April 8. All public transportation and gathering places are strictly controlled on the movement towards people and risks in different regions. With differentiated management, more than 10 million permanent residents in Wuhan began a 76-day ban and stay at the home of banned outdoor activities, and the defensive battle against the novel coronavirus pneumonia pandemic was started on January 23, 2020 (www.huaxia.com). According to the People's daily newspaper (2020), Wuhan was underdone the CDIV-19 from 27th December to 19th January with a rapid expansion and rapid response to take actions. Various measures have been taken to respond and overcome this catastrophe. Meanwhile, it attacks all aspects of life, work, every normal order, and operating. Not only does the center of disease control and prevention admit the avoidance of crowd and throng (Chich, Clifton & Peace et al., 2020), but also world health organization

suggested little large gatherings. For education, the government announced that all school has to be shut down to protect our student's safety and health, and proposed to attend online classes.

The government (2020) reported that all kinds of schools and public places will be close down through this spring semester (2020.3-2020.7), high school and middle school can coordinate the situation under the prevention and control of COVID-19 pandemic. Due to the COVID-19 pandemic, students cannot have traditional instruction, students and teachers must have to structure the online course to prevent the interpersonal infection of COVID-19. Under the COVID-19 pandemic circumstances, it will be a very unusual living experience in need of a special learning approach—web-based learning. A great disaster often leads to economic turmoil and social chaos, the pandemic transformed the way that we used to organize our working and learning, it also changed the attitude when facing the disaster. As a consequence, the widespread use of web-based learning tools. To examine the contributory factor of the effectiveness of web-based learning, this research was designed to inspect the relationship between web-based learning tools, self-efficacy, depression-anxiety-stress, general health condition, and family life quality to figure out whether the pandemic may affect the quality of learning and life or not.

Literature review

Development of Web-based learning

Tracing back to the history of web-learning, it turns out to e-learning and computer-aided education. E-learning was emerged from the 1960s to learn knowledge on the internet or through the computer in higher education, computer-based learning and training were used during 1975-1990, then web-based training or e-learning was begun to develop in the 1990s with the tremendous development of internet technology and computer (Kidd, 2010, In IRMA eds.). Web-based learning was relying on website and computer when it connects to the internet to enhance learning efficiency and bring learning convenience (Chumley-Jones, Dobbie, & Alford, 2002). Thus, an individual can use a mobile device to learn anything anywhere without a computer or laptop. Although the convenience it brings, few study results witnessed the learning efficiency of Web-based learning to surpass traditional instruction (Chumley-Jones, Dobbie, & Alford, 2002). Based on constructivism learning theory, web-based learning embrace a social environment to bridge the interaction between teacher and student (Woo & Reeves, 2007). This design has been alleviating the problem of being absent from school and lack of face to face interaction and communication. For example, The absence of being in the same learning environment for teachers and students, the efficiency of Web-based learning is inferior to traditional classes as it lacked direct effects on teachers and students (Sher, 2008). However, in other cases, the benefits of Web-based learning has been found to support its usefulness and importance. A positive relationship between learning technology and student engagement and learning outcomes have been found (Chen, Lambert, & Guidry, 2010). Although the benefits have been found, Web-based learning cannot cover its shortage to take the place of traditional instruction. Despite its weakness, it was still a compromising teaching technique when students under the special circumstance of COVID-19. During the period of COVID-19, students and teachers could not go to school for instruction, they have to use Web-based learning tools to study at the home of learning new tasks and accomplish the teaching tasks.

With a lot of strength, web-based education improved students' autonomy, informal and official learning through telecommunication, hypermedia, and the availability of information and internet resources, which recognized as personalized learning style to individuals (Magoulas & Chen, 2006). It also satisfied the students' information requests (Lawless & Brown, 1997) and is a benefit of boost cognitive ability (Triantafillou, Pomportsis, & Demetriadis, 2003). Web-based teaching design using web tools to offer web-based learning and provide various courses to meet the needs of learners (Liu, Glowatz, Zappatore, et al., 2018). All of this makes the wide application of web-learning tools. As an important factor, technology can be critical to web-based learning for different kinds of learners. And other significant factors also are found in studies. For example, gender differences have been found in web-based learning for their special preferences, demands, and assistance (Large et al., 2002; Roy & Chi, 2003; Fan & Macredie, 2006). For learner's communication, based on the web environment, when people gather together in the online platform to learn knowledge, the virtual community was created and managed to achieve this purpose (Elia, Secundo & Taurino, 2010, In

Karacapilidis eds.). As an approach to acquire digital competencies for students and teachers, web-based learning provided interconnected social-cultural settings to take online courses and make communication, but the management of this learning process and elaborate courses design were definitely still needed (Cartelli, 2010, In Karacapilidis eds.). When it comes to academic achievements, its function was not that significant. According to Chilton's and Gurung's mixed study (Chilton & Gurung, 2010, In Karacapilidis eds.), Web-based learning technology may have little effects on learning achievements objectively. But there are some studies got a similar conclusion of the effectiveness of web-based learning and the traditional class was insignificant (Allen & Seaman, 2004; Allen & Seaman, 2006; Knight, 2007; Fillion, Limayem, Laferriere & Mantha, 2010, In Karacapilidis eds.), in other cases, it has been proved that the traditional class was outperformed than using web-based learning technologies (Carnevale, 2002; Fillion, Limayem, Laferriere & Mantha, 2010, In Karacapilidis eds.). Ke, Jewett, & Chávez (2010) found that Web-based learning was imbued with cultural ideology, individual character, and instruction atmosphere also is paid great attention (Chávez & Ke, 2013), diversity culture also is an impact factor (Bentley, Tinney, & Chia, 2005). Learning in a Web-based instruction environment, researchers cannot ignore multiculturalism (Parrish & Linder-VanBerschot, 2010). Furthermore, several researchers found that age has an impact on the achievements of Web-based learning in positive research (Justice & Dorman, 2001; Chyung, 2007; Hoskins & van Hooff, 2005; Shnikareva & Benson, 2007). Adults could transform the study time flexibility and satisfy their promotion needs at the same time (Cercone, 2008; Chyung, 2007), thus to develop their higher-order logistical thinking (Hoskins & van Hooff, 2005; Shnikareva & Benson, 2007). An individuals' biological and psychological features were determined by the environment and personal disposition, they need customized and elaborated design with web-based learning content (Cercone, 2008). Therefore, teaching approaches, feature to design, course contents, social interaction, communication, gender, learning style, and disposition can be important for the quality of web-learning, especially for the special taste and experience in learners. Web-based learning quality is subjected to individual psychology, social-psychological factors, and web-based learning technology. Chapnick (2000) supposed that an individuals' psychological quality, sociological context, environment and resources, facilities and instruments, knowledge, and skills are constructed as a measurement model to assess the web-based learning community. A similar model was to reference this theory and built a model to measure web-based learning willingness (Kaur & Abas, 2004). So (2005) also conducted this kind of research to investigate the willingness of web-based learning, he found that insufficient preparation in teachers and significant gender difference. Su (2005) examined a significant association between learning styles and academic achievement in web-based learning.

Thus, there are a lot of existing researches that focus on the influencing factors of web-based learning. Due to the lack of studies focused on the examination of the impact on the family life quality and web-based learning tools, self-efficacy, depression-anxiety-stress under the condition of the outbreak of a pandemic. As learners were all blocked in residence with rarely going out and gathering, the situation of their web-based learning, the relationship between family life quality, general health questionnaire and web-based learning tools, self-efficacy, depression-anxiety-stress should be examined.

Application of Web-based learning tools

In the era of information technology in the 21st century, the rapid development of information technology promotes the renewal of the education and learning approach. As a new learning technology, web-based learning is supplementing or replacing the position of traditional class teaching now. Correspondingly, web-based learning tools gain a rapid speed of innovation and application. As people often called the word "Web" stems from the Internet and World Wide Web, contains substantial information and data set, and web-based learning are often synonymous with e-learning, distance-learning or web-based learning (Davidson-Shivers, Rasmussen, & Lowenthal, 2018). Not only with the convenience of autonomy, interactivity, customize and a lot of strengths, but also with the help of transforming concepts and methods of learning, web-based learning tools were available for learners with high efficiency and low cost. Associating web-based learning tools of the pandemic, web-based learning tools had been widely popularized and used during the period of the pandemic. In response to the special requirements for evacuation under the pandemic circumstance, students in various universities, elementary and middle schools are basically not able to attend school, and they will inevitably

participate in and complete web-based learning according to requirements and arrangements. Therefore, web-based learning tools had become necessary learning tools. However, under the circumstances of the pandemic, web-based learning tools, state of health, emotional stress, self-efficacy, quality of life may interact with each other and affect student's learning achievements. For this reason and examine the effects, the study will explore the relationship between web-based learning tools, state of health, emotional stress, self-efficacy, quality of life, and its impact on students' web-based learning status during the pandemic.

Web-based learning tools (WBLTs) was defined as an artificial learning instrument, which can be connected to computer applications, mobile device, internet network, or website (Kay, 2011). Under the assistance of Web-based learning tools, students achieved better academic performance than traditional instruction in Medical education (Ochoa & Wludyka, 2008). There is a wide range of WBLTs in the Chinese education system now, such as Alibaba Dingding (www.dingtalk.com), Tencent meeting (cloud.tencent.com), etc. Rely on WBLTs, teachers can organize teaching activities online at home, thus prevent the pandemic from spreading, reduce touching, and avoid face to face contacting. For this measurement tool, collecting the requirements of users and improve the technology to create a better web-based learning experience. When teachers and students take online courses, they are inevitable to employ web-based learning tools, and unavoidable be subject to prior psychological state and living status.

According to positive psychology, a positive psychological state of an individual is often associated with good results and a high quality of life (Linley & Joseph, 2004). Mood disorders, like anxiety, depression, and stress, to the detriment of students' physical and mental health, may cause learning disorders (Bibi, Lin, Zhang, & Margraf, 2020). People with low self-efficacy always tend to avoid failure, to give up easily with suspicion of their capabilities induce poor performance, which as a part of positive psychology have had a significant effect to buffer against emotional disorders (Aspinwall & Staudinger, 2002). Thus, general health as a barometer to reflect the mental health, depression-anxiety-stress as a negative mood, self-efficacy, and family life quality act as healthy energy to promote a better way of learning. Under these complex circumstances of the pandemic, and without the supervision and inspector in the classroom, individuals' learning behavior and effects were hard to ascertain. As an auxiliary means to assist traditional teaching mode, online teaching has been a dominant learning approach to the novel coronavirus pandemic. The evaluation of web-based learning tool may be effected by self-efficacy, family quality of life, and depression-anxiety-stress. To make this relationship clear, the research was conducted to validate the relationship between them through a structural equation model.

Method

Participants

Data were collected between June 25 and July 21 in 2020. All of the investigators are 83 males and 194 females (N=277) with a different diploma and different professions. Among them, 253 are majority and 24 are ethnic (aging from 7 to 55), including 78 primary and secondary school students, 150 people hold a bachelor degree, 38 people master degree and 11 people doctoral degree from the eastern, central and western region of China, the geographic distribution features are also represented with random assigned.

Table 1 Demographic features of participants

Demographic variables	Frequency	Percent	Total
Gender			277
Male	83	30%	
Female	194	70%	
Race			
Majority	253	91.3%	
Ethnic	24	8.7%	
Ages			
7-12	7	2.5%	

13-17	58	20.9%
18-23	127	45.8%
24-33	53	19.1%
34-55	32	11.6%
Diploma		
High school and below	78	28.1%
Bachelor degree	150	54.2%
Master degree	38	13.7%
Doctoral degree	11	4.0%
Identity		
Teacher	42	15.2%
Primary school students	7	2.5%
Secondary school students	60	21.7%
College students	73	26.4%
Postgraduates	22	7.9%
PhD students	8	2.9%
Graduates	65	23.5%

Procedure

Participants were voluntary with random sampling, all of them were proficient in the Chinese language, all the questionnaires were translated into Chinese version to suit the features of respondents, it was organized by questionnaire website (www.wjx.cn) and send through WeChat communication and social platform. Participants were required to answer a set of questions, including demographic information, such as ages, gender, identity, the general health questionnaire, web-based learning tool scale, general self-efficacy scale, depression, anxiety and stress, family quality of life scale. It also included an open-ended question about collecting comments and suggestions. At the beginning and the end of the questionnaire, it was completed with an introduction, briefing, and acknowledgment.

Measures

Web-based learning tool scale

Web-based learning tool scale (WBLTs, Web-based learning tool scale) was developed and compiled by Kay & Knaack (2009) and revised by Kay (2009). Its purpose is to evaluate the structure and efficacy of web-based learning tools to promote ubiquitous learning. The WBLTs designed by Kay & Knaack (2009) can be used to identify the effectiveness and practicality of web-based learning tools, which aims to assess the structure and utility of technology to promote web-based learning and online teaching quality, it contains three parts of promoting learning, tools design and engagement. This tool has been extensively tested for more than 800 students in the United States. After verification and testing, the reliability of the questionnaire is 0.87. ~0.93, with high reliability, content validity, and structure validity. During the pandemic, learners' evaluation of web-based learning tools will affect learners' learning efficiency, learning results, learning motivation, learning attitude, etc. Given the special circumstances of the pandemic, the study uses WBLTs to explore learners' evaluation of web-based learning tools and their relationship between self-efficacy, general health, and family life quality. The internal consistency of WBLTs in this study is 0.9 (Cronbach's Alpha coefficient), which means that the scale tool has high reliability to be used.

General self-efficacy scale

Bandura (1977) put forward the theory of self-efficacy based on the theory of social cognition to describe the ability of an individual to complete a task or accomplish something under a specific situation. This theory has received extensive attention in the area of psychology and education, and its positive effects and influence have been tested. There are a lot of studies have paid attention to the application and effects of self-efficacy theory (Bandura et al., 2001; Schutte & Malouff, 2016). Self-efficacy directly affects learners' learning

cognition, learning motivation, and learning effect. It can be used to investigate and analyze learners' meta-cognition, feelings, and experience of web-based learning, and it also affected learners' learning motivation, preferences, and perception of web-based learning tools.

As the importance of self-efficacy and the particularity of the COVID-19 pandemic, learners' self-efficacy of web-based learning during the pandemic is unknown. Analyzing learners' web-based learning self-efficacy could be a benefit to understand learners' learning behavior, condition, and problems. Refer to the General self-efficacy scale (GSES, General self-efficacy scale) of Schwarzer & Jerusalem (1995). Zhang & Schwarzer (1995) modified and designed the Chinese version of the General Self-Efficacy Scale (GSES-C), which has been widely used and has shown good reliability and validity in the research field. Several studies have shown that the reliability of GSES-C is 0.76 (Cronbach's alpha coefficient) (Sun, Zhong, Xin & Kang, 2018), the first reliability is 0.83, and the second reliability is 0.91 (Wang et al., 2001). This study uses GSES-C to investigate learners' self-efficacy during the pandemic to figure out the effect of the external environment. The internal consistency of the questionnaire is 0.939 (Cronbach's alpha), which indicates that the scale tool has high reliability.

General health questionnaire

At the same time, to understand the mental health of learners during the pandemic, the study uses general health questionnaires to diagnose the mental health of online learners, and explore whether the new crown pandemic has an impact on the mental health of learners during web-based learning Or influence. Goldberg (1972) developed the General health questionnaire (GHQ, General health questionnaire) to help individuals discover their own psychological problems or mental illnesses in different situations. The scale includes 12 items, 20 items, 28 items, 30 Various versions of six projects or 60 projects, all of which show good internal consistency and reliability. At the same time, they have also been translated into 36 translations and have been used in many countries (Goldberg & Williams, 1988; Duncan-Jones & Hernderson, 1978; Ballinger, 1977; De Paulo et al., 1980; Sriram, Chandrashekar, Isaac & Shanmugham, 1989). Among them, the Cronbach's alpha of GHQ-20 is 0.894 (Penninkilampi-Kerola, Miettunen & Ebeling, 2006), and the Cronbach's alpha of GHQ-12 is 0.87 (Montazeri, Harirchi, Shariati, Garmaroudi, Ebadi & Fateh, 2003). This study explores the mental health status of learners during the pandemic and their relationship between web-based learning tool evaluation, self-efficacy, family life quality, etc. The internal consistency of GHQ is 0.702, which means that the reliability of the scale tool is average within the acceptable range.

Depression, Anxiety and Stress (DASS-21)

In addition to investigating the general health of the learner, it is also necessary to understand the emotional state of the learner and to investigate the emotional state and stress of the learner. Borrowing the Depression Anxiety Stress Scale (DASS) measurement tool, developed and designed by Lovibond & Lovibond (1995), to investigate the impact of the pandemic on the emotional state and stress of learners. DASS-21 involves 3 dimensions and contains 21 items. It has a wide range of applications in the field of mental illness measurement. It is mainly used to diagnose depression, anxiety, and stress. At present, DASS-21 has been translated into 42 versions of different countries. The reliability and validity of the questionnaire are relatively high and the reliability is high. The internal consistency is about 0.89 0.93 (Lovibond & Lovibond, 1995; Henry & Crawford, 2005), the internal consistency in the study of Bibi, Lin, Zhang & Margraf (2020) is 0.70 to 0.90. In other language versions of DASS-21, such as the Latin American version of DASS-21, the internal consistency is between 0.88 and 0.90 (González-Rivera, Pagán-Torres & Pérez-Torres, 2020), and in the Hispanic version of DASS The internal consistency of -21 is 0.96 and high construct validity (Daza, Novy, Stanley & Averill, 2002). It can be seen that the DASS-21 scale has high reliability and validity, and has been widely used and verified in a multicultural context. As a result, the study used the DASS-21 scale to investigate the emotional state of online learners during the pandemic and its interaction with web-based learning tool evaluation, self-efficacy, mental health, and family life quality, its reliability is 0.959.

Family quality of life scale

Besides, it is necessary to investigate and grasp the quality of learners' family life during the pandemic. The

quality of family life has an impact on learners' learning, psychological, emotional, and living conditions, and is related to learners' subjective well-being. In recent decades, the issue of family life quality has attracted widespread attention and great attention from the academic community. They have continuously tried to evaluate the family life quality, and have evaluated it from multiple dimensions in the past decades (Hoffman et al., 2006). Park et al., (2003) developed the Beach Center Family Life Quality Scale based on the preliminary research of Poston et al. (2003). The family quality life scale (FQLS, Family quality life scale) has an internal consistency of 0.80 0.85 (Hoffman et al., 2006), which has good reliability and validity, as well as in the circumstance of other researches. Application and promotion. FQLS expands on five aspects of family interaction, parenting, emotional well-being, material well-being, and disability-related support to evaluate whether the overall happiness and needs are met, and the evaluation of the quality of life (Summers et al., 2005; Hsiao, 2013).

Data analysis

Descriptive statistics and related analysis were conducted with the variables of web-based learning for the total sample. Bivariate correlations between key variables were acted to test the impact on the significant relationship between different variables. All statistical analyses were conducted in the software of SPSS 25.0 and Mplus 8.3. SEM, CFA, EFA, multiple linear regression model, and Hierarchical regression model was performed to test the hypothesis in this study. Hu & Bentler (1999) suggested that the criteria of indexes which was designed to examine the goodness of fit in a model are the value close to 0.95 for CFI (comparative fit index) and GFI, 0.06-0.08 for SRMR and 0.06 for RMSEA. This criterion was widely accepted in the field of psychology (Zadworna-Cieślak, 2020; Bacikova-sleskova & Bavolar, 2020).

Results

Descriptive statistics and related analysis

First of all, the data type data level variable uses the spearman correlation analysis method of correlation analysis, as shown in the Table 2. It can be seen that gender has a significant negative impact on self-efficacy ($p < 0.05$), and age and education have a significant positive impact on general health ($p < 0.05$).

Table 2 Descriptive Statistics and Correlation Matrix

	Mean	SD	1	2	3	4	5	6	7	8	9
1.Gender	1.70	0.459	-								
2.Age	3.16	0.970	.141*	-							
3.identity	3.84	0.947	.225**	.730**	-						
4.Identity	3.48	1.823	.155**	-.161**	.078	-					
5.WBLTs	11.0664	2.25492	-0.77	-0.010	0.006	0.025	0.954 ^α				
6.DASS	6.1661	2.53514	-0.095	-0.077	-0.035	-0.102	-0.319**	0.959 ^α			
7.GSES-C	6.9356	1.52425	-0.149*	0.029	0.002	-0.018	0.419**	-0.257**	0.939 ^α		
8.GHQ	5.7371	1.05760	-0.153	0.127*	0.140*	-0.106	0.195**	0.289**	0.312**	0.702 ^α	
9.FQLS	18.7977	3.55386	-0.065	0.038	0.002	0.040	0.478**	-0.373**	0.537**	0.221**	0.961 ^α

* $p < 0.05$, ** $p < 0.01$

WBLTs=Web-based learning tool; DASS=Depression-anxiety-stress; GSES-C=General Self-efficacy; GHQ=general health; FQLS=Family quality of life

^α=Cronbach's alpha coefficient

Reliability and validity test

The research conducted a reliability and validity analysis of the questionnaire in the study, using the Cronbach's Alpha coefficient to verify the reliability of the questionnaire and questions on SPSS25.0 software, and then using factor analysis to verify the content validity of the questionnaire tools and questions. Researchers

often use the Cronbach's alpha coefficient to examine the internal consistency of measurement tools (Kaplan, 2009), in consequence of the Cronbach's alpha was above 0.7, means the tools are acceptable, 0.8 means good reliability, and 0.9 means preferable (Kline, 2011; George & Mallery, 2003). Thus, if the reliability of the questionnaire item is greater than 0.8, it can be judged that the questionnaire tool has high reliability and stability. If the reliability of the questionnaire item is greater than 0.7, it can be judged that the reliability of the questionnaire is average and within the acceptable range.

Through internal consistency analysis, the Cronbach's Alpha coefficient of the web-based learning tool scale (13 items in WBLTs) is $0.954 > 0.9$, which is highly reliable. The Chinese version of the general self-efficacy scale (10 items in GSES-C) has Cronbach's The Alpha coefficient is $0.939 > 0.9$, which has a high reliability. The Cronbach's Alpha coefficient of the depression-anxiety-stress scale (21 items of DASS) is $0.959 > 0.9$, which has high reliability. The Cronbach's Alpha coefficient of the family quality of life scale (FQLS) (25 items) is $0.961 > 0.9$, which has high reliability. the Cronbach's Alpha coefficient of the general health questionnaire (12 items of GHQ) is $0.702 > 0.7$, and its reliability was within an acceptable range.

Also, factor analysis and Kaiser-Meyer-Olkin (KMO) test were always used to confirm the construct validity, and the content validity was examined by literature review and expert appraisal (Catalano, 2018). This study conducted an exploratory factor analysis on five questionnaires to test the structural validity of the questionnaire, selecting the maximum variance orthogonal rotation method, KMO and Bartlett's test, and principal component analysis (extract factor if the characteristic value is greater than 1, the absolute value of the factor load is greater than 0.5, and the results are shown in the table). Utilizing factor analysis, the KMO value of the web-based learning tool scale is $0.940 > 0.9$ ($p < 0.000$, satisfied with the Bartlett's test), the factor loading is between 0.647 0.848, and the cumulative variance contribution rate of three common factors is 79.046%. Its validity is relatively high. The KMO value of the Chinese version of the self-efficacy scale (10 items of GSES-C) is $0.928 > 0.9$ ($p < 0.000$, satisfied with the Bartlett's test), the factor loading is 0.487 0.795. The cumulative variance contribution rate of the co-factors is 73.502%, and its validity is very high. The KMO value of the depression, anxiety and stress scale (21 items of DASS) is $0.947 > 0.9$ ($p < 0.000$, satisfied with the Bartlett's test), the factor loading is 0.625 0.809, and the cumulative variance contribution rate of 3 common factors is 73.244%, and its validity is high. The KMO value of the Family Quality of Life Scale (FQLS 25 items) is $0.950 > 0.9$ ($p < 0.000$, satisfied with the Bartlett's test), the factor loading is 0.506 0.934, the cumulative variance contribution rate of 5 common factors is 79.334%, and its validity is high. The KMO value of general health scale (12 items on GHQ) is $0.917 > 0.9$ ($p < 0.000$, satisfied with the Bartlett's test), the factor loading is 0.660 0.832, and the cumulative variance contribution rate of extracting 2 common factors is 75.688%, and its validity is very high.

Finally, confirmatory factor analysis (CFA) was used to verify the reliability, convergence validity, and discriminate validity of each questionnaire. As shown in Table 3 and Table 4, four major measurement tools as follows: web-based learning tool scale, depression-anxiety-stress scale, general self-efficacy scale, and family life quality scale, are mainly used in confirmatory factor analysis. Firstly, after the test of the proposed model, the fitting index of the proposed model was very unsatisfactory. Therefore, the independent variable of the general health questionnaire was directly removed. Furthermore, during the process of confirmatory factor analysis and structural equation model construction, the general health questionnaire was excluded from the SEM. In addition, it can be seen from Table 3 and Table 4 that the reliability and validity of other questionnaires reached a good level excluding the general health questionnaire.

Table 3 Reliability and Convergence validity

Dimension	Item	Parameters of significant test Estimate	Parameters of significant test S.E.	Parameters of significant test Est./S.E.	Item P-V
W	WBLT1	0.858	0.021	41.045	***
	WBLT2	0.931	0.017	54.716	***
	WBLT3	0.796	0.026	30.643	***
D	DAS1	0.703	0.035	20.073	***

	DAS2	0.906	0.023	38.877	***
	DAS3	0.857	0.025	34.177	***
G	GSESC1	0.956	0.028	34.103	***
	GSESC2	0.881	0.029	30.698	***
F	FQLC1	0.834	0.020	41.446	***
	FQLC2	0.952	0.009	100.43	***
	FQLC3	0.911	0.013	71.168	***
	FQLC4	0.854	0.018	46.169	***
	FQLC5	0.377	0.053	7.098	***

W=Web-based learning tool; D=Depression-anxiety-stress; G=Self-efficacy; Q=general health; F=Family quality of life

***p<0.001

As shown in Table 3, reliability and convergence validity analysis, dimensions, all items, and standardized estimation coefficients are all greater than 0.6. The significance estimate is divided by the standard error to obtain the Z value (Est./SE) of the significance estimate. Z value>0.96 means significant, and all p values<0.001, which means that all items are significant. The item reliability is the square of the standardized estimated value. The R-square of the item is above 0.36 means acceptable, and above 0.5 means good. Item reliability (Square multiple correlations, SMC or R-square: the square of the standardized factor loading) refers to the explanatory ability of the dimension to the items, composite reliability is the internal consistency of the dimension topic, and AVE refers to the dimension to the items. The average explanatory ability of AVE is greater than 0.5, indicating that the dimension has a good explanatory ability, and the value of AVE was above 0.36 means acceptable. The convergence validity of all dimensional items reached the recommended level. Diagonal bold values are the root sign value of AVE, and the lower triangle is the Pearson correlation between the dimension according to the output table of Tech 4 in Mplus 8.3.

Table 4 Reliability and validity analysis

DIM	Item reliability STD.LOADING	Composite reliability CR	Convergence validity AVE	Discriminate validity W	Discriminate validity D	Discriminate validity G
W	0.796-0.931	0.897	0.746	0.864		
D	0.703-0.906	0.865	0.683	-0.200	0.826	
G	0.881-0.956	0.916	0.845	0.383	-0.135	0.959
F	0.377-0.952	0.901	0.661	0.419	-0.293	0.531

Mention: The bold font on the diagonal is the root value of AVE, and the lower triangle is the pearson correlation of the dimension.

W=Web-based learning tool; D=Depression-anxiety-stress; G=Self-efficacy; F=Family quality of life

According to Table 4, every dimension corresponds to its own corresponding items. The standardized load of all factors is between 0.417 and 0.959, the combined reliability CR is greater than 0.7, and the convergence validity AVE is greater than 0.5, all of which are within the acceptable desirable range. Within the range, the discriminate validity starts with the square root on the diagonal. According to the recommendations of Fornell and Larcker (1981), but the square root value of AVE on the diagonal, and the lower triangle is the Pearson correlation between the dimension. The comparison results show that the root value of the dimension is greater than the correlation of other related dimensions, so the dimension has discriminate validity.

In brief, the measurement tools used in the study have already shown good reliability, structural validity, convergence validity, and discriminate validity, and overall reliability and validity are at a high level. More-

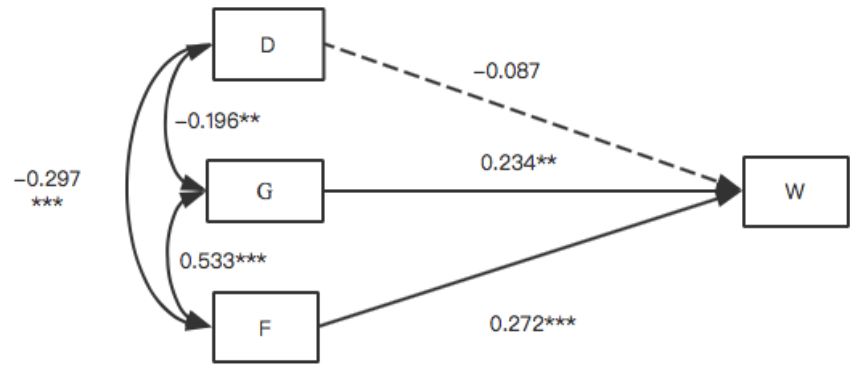
over, the measurement tools have been verified and used by researchers in different countries, regions, and different cultures, which shows that the quality of measurement tools is good enough. Based on the good quality of scale tools, the research uses a structural equation model, multiple regression model, and hierarchical regression model to further explore the influence relationship between the independent variables and dependent variables.

Structural equation model

As shown in Fig 1, there is a significant positive correlation between self-efficacy and family quality of life with a correlation coefficient of 0.533 ($p<0.001$). There is a significant negative correlation between self-efficacy and depression-anxiety-stress, the correlation coefficient is -0.196 ($p<0.01$). There is a significant negative correlation between family quality of life and depression-anxiety-stress, the correlation coefficient is -0.297 ($p<0.001$).

Self-efficacy scale have a direct positive impact on web-based learning tools, with a path coefficient of 0.234 ($p<0.01$). Family quality of life have a direct positive impact on web-based learning tools, with a path coefficient of 0.272 ($p<0.001$). Furthermore, depression-anxiety-stress has no significant impact on web-based learning tools. Among all the dependent variables, family quality of life have the greatest impact on the web-based learning tools, while the one that has the greatest impact on self-efficacy is the web-based learning tools.

Fig 1. Standardized structural equation model



W=Web-based learning tool; D=Depression-anxiety-stress; G=Self-efficacy; F=Family quality of life

*** $p<0.001$; ** $p<0.01$

Table 5 Fitness of Model

	Suggested standard	Model fit	Requirements
ML χ^2	smaller	140.116	
Df	bigger	59	
χ^2/df (Normed Chi-sqr)	$1<\chi^2/\text{df}<3$	2.375	meet
CFI	>0.95	0.968	meet
TLI	>0.9	0.958	meet
RMSEA	<0.08	0.071	meet
SRMR	<0.06	0.053	meet

Hu & Bentler (1999) proposed the goodness of model fit are: CFI (Comparative Fit Index) and GFI should be close to 0.95, SRMR close to 0.06 or 0.08, and RMSEA close to 0.06. As shown in Table 5, the model test

results show that the degree of freedom of the model is equal to 59, the chi-square value of the overall model fit is 140.116, the ratio of chi-square degrees of freedom is 2.375, and the significance probability value is $p < 0.000$, RMSEA=0.071 < 0.080, SRMR=0.053 < 0.06, CFI=0.968 > 0.950, TLI=0.958 > 0.950, all indicators are within the acceptable range and reach the model adaptation standard, so the model can be accepted.

It can be seen from Table 5 and Table 6, that part from the hypothesis of the research model has been verified ($p < 0.001$). Among them, the residual of the model has no negative value, and the correlation between the independent variables is less than 0.7, which means that there is no co-linearity. Therefore, according to the research hypothesis, except for the independent variable of general health, there is a significant influence relationship between web-based learning tools, self-efficacy and the quality of family life. Depression-anxiety-stress has no significant positive impact on web-based learning tool.

Table 6 Hypothesis analysis of model fit

DV	IV	Estimate	S.E.	Est./S.E.	P-value	R ²	Hypothesis
W	F	0.272	0.071	3.840	0.000***	0.225	Support
	G	0.234	0.070	3.348	0.001**		Support
	D	-0.087	0.063	-1.373	0.170		Not support

W=Web-based learning tool; D=Depression-anxiety-stress; G=Self-efficacy; F=Family quality of life

*** $p < 0.001$

Based on the structural equation model, the research explores the mediating effect on different independent variables, using the Bootstrap method to iterate 1000 times, and the 95% confidence interval CI = [0.130 0.383]. As shown in Table 7 and Fig 2, web-based learning tool has a significant effect on self-efficacy ($\beta = 0.243$, SE=0.064, $p < 0.000$), web-based learning tool has a significant effect on family quality life ($\beta = 0.503$, SE=0.110, $p < 0.000$), web-based learning tool has a significant effect on family quality life has a significant effect on self-efficacy ($\beta = 0.484$, SE=0.061, $p < 0.000$), family quality life as a mediator. The quality of life plays a mediating role of the two ($\beta = 0.243$, $t = 3.814$, $p = 0.000 < 0.001$), depression-anxiety-stress as a predictor has a significant indirect negative influence on self-efficacy.

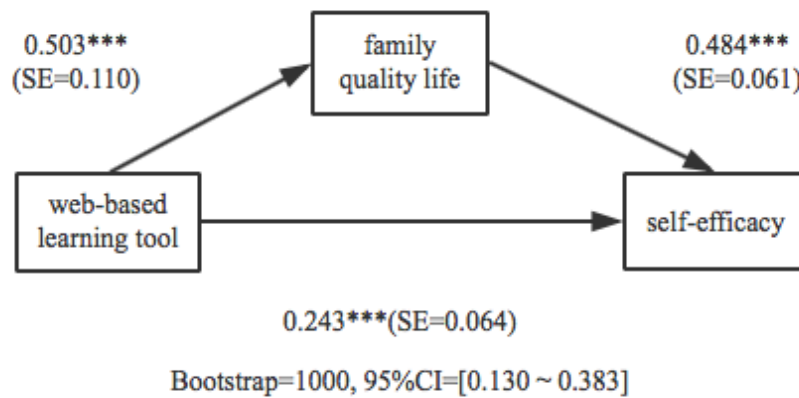
Table 7 Mediating effects of specific indirect effects

Specific indirect effects	β	Product of Coefficients		Product of Coefficients	P-Value	95% CI Bias corrected Lower
		S.E.	Est./S.E.			
W-F-G	0.243	0.064	3.814		0.000***	0.130

W=web-based learning tool; G=Self-efficacy; F=Family quality of life

*** $p < 0.001$

Fig 2. Indirect effects predicting self-efficacy, web-based learning tool as a predictor, family quality life as a mediator. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. CI=Confidence Interval



Multiple regression model

Based on data analysis, the study uses multiple linear regression equations to determine the quantitative correlation between multiple independent variables and dependent variables (see Table 8). All independent variables have significant predictive power for dependent variables. In the statistical data onto collinearity of all independent variables, the VIF value is less than 10 means that there is no collinearity between the respective variables, and the regression equation of the model is stable and reliable. The residual values of [-2, +2] can explain most of the predicted values and prove the validity of the regression equation. Among the four predictors, four variables have significant predictive power for family quality of life, followed by self-efficacy, web-based learning tools, depression-anxiety-stress and general health. The multiple correlation coefficient between the four predictors and the dependent variable family quality of life is 0.636, the coefficient of determination (R^2) is 0.405, and the F value of the regression model integrity test is 46.205 ($p=0.000<0.05$), so the four predictions The variables can effectively explain 40.5% of the variation to family quality of life.

From the perspective of the predictive power of each variable, the most predictive factor of family quality of life is the self-efficacy independent variable, with an explanatory variation of 29%; followed by the web-based learning tool, which explains the variation 34.9%; the predictive power of the remaining two independent variables depression-anxiety-stress and general health are 37.0% and 40.5% respectively. From the perspective of standardized regression coefficients, the β values of the four predictors in the regression model are 0.336, 0.209, -0.247, 0.222, where a positive number means that its influence on family quality of life is positive, and a negative number mean its It has a negative impact on family quality of life.

The non-standardized regression equation is as follows: family life quality = 7.577 + 0.783 * self-efficacy + 0.329 * web-based learning tools-0.346 * (depression-anxiety-stress) + 0.747 * general health

The standardized regression equation is as follows: family quality of life=0.336*self-efficacy+0.209*web-based learning tool-0.247*(depression-anxiety-stress) + 0.222* general health

Table 8 Results of multiple regression analysis

	coefficient	R^2	R^2	F value	F_{value}	B	Beta
Intercept						7.577	
G	.538	.290	.287	112.085***	112.085***	.783	.336
W	.591	.349	.344	73.362***	24.898***	.329	.209
D	.608	.370	.363	53.444***	9.211***	-.346	-.247
Q	.636	.405	.396	46.205***	15.797***	.747	.222

W=Web-based learning tool; D=Depression-anxiety-stress; G=Self-efficacy; Q=general health; F=Family quality of life

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Hierarchical regression model

From the results of the hierarchical regression analysis (see Table 9), it can be seen that the two independent variables of "depression-anxiety-stress" and "general health" in Model 1 can explain 24.8% of the variance of the dependent variable of family life quality. The F value is 45.060 ($p < 0.000$), reaching a significant level of 0.05. It shows that the regression coefficients of the two predictors of "depression-anxiety-stress" and "general health" are both significant, and the standardized regression coefficient β values of these two independent variables are -0.426 ($p < 0.000$) and 0.438 ($p < 0.000$), respectively, both reached a significant level. Among them, the influence of depression-anxiety-stress on the family life quality is negative, and the influence of general health on the family life quality is positive. If the two independent variables of web-based learning tools and self-efficacy are further invested, the overall explanatory variation increases by 15.7% (R^2), and the F value of the significant change is equal to 35.877 ($p < 0.000$), which means web-based learning tools and self-efficacy have significant effects on the quality of family life. The F value of the stratified binary linear regression overall test was 46.205 ($p < 0.000$), reaching a significant level of 0.05. It represents

Table 9 Hierarchical linear regression results

	Predictor variables	Model 1	Model 1	Model 2	Model 2
		β	t value	β	t value
Psychological states	D	-.426	-7.658***	-.247	-4.576***
	Q	.438	7.862***	.222	3.975***
Learning experience	W			.209	4.037***
	G			.336	6.096***
	F value	45.060***	45.060***	46.205***	46.205***
	R^2	.248	.248	.405	.405
	F value	45.060***	45.060***	35.877***	35.877***
	R^2	.248	.248	.157	.157

W=Web-based learning tool; D=Depression-anxiety-stress; G=Self-efficacy; Q=General health; F=Family quality of life

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Conclusions and reflections

Research conclusion

Firstly, to promoting web-based learning, learning during the pandemic is mainly affected by self-efficacy, web-based learning tools, and family life quality. Depression-anxiety-stress may have a little adverse effect. There are correlations effects of self-efficacy, depression-anxiety-stress, and family life quality. Learners' negative emotions in depression-anxiety-stress may affect their self-efficacy and family life quality, or maybe the use of web-based learning tools, but the effect was not significant. Thus depression-anxiety-stress emotions will be harmful to learners' learning. Family life quality and self-efficacy have a positive impact on web-based learning tools. This shows that high family life quality and self-efficacy maybe benefit learners to use web-learning tools to promote learning quality. Besides, the negative emotions such as depression-anxiety-stress during the pandemic are adverse to improve the quality of family life and self-efficacy. Thus, negative emotions should be to take care of mental health to prevent the low efficiency of learning. The use of web-based learning tools could promote study at home, family life quality, and self-efficacy, and family life quality can promote self-efficacy. A higher level of self-efficacy and family life quality help learners to better use web-based learning tools to promote learning effectively. At the same time, there is a positive correlation

between self-efficacy and family life quality, as a privilege to promote the use of web-based learning tools, which means that learners with high self-efficacy may have a better family life quality.

Secondly, from the point of the factors affecting web-based learning during the pandemic. Family life quality during the pandemic was not only affected by the individual's psychological states of depression, anxiety, and stress, but also the general health, use of web-based learning tools, family environment, etc., it will also affect the quality of learners' web-based learning directly and indirectly. There are interactive influences among various factors. Based on the results of the multiple regression model, it can be seen that self-efficacy, web-based learning tools, general health, depression-anxiety-stress as independent variables have a significant impact on the family quality of life of the dependent variable. Among them, depression-anxiety-stress as a kind of negative emotion has had a negative and significant impact on the quality of family life. The results of the hierarchical regression model further proved this conclusion. After incorporating the web-based learning tools and self-efficacy into the model, the model's predictive ability on the dependent variable was significantly enhanced.

Countermeasures and suggestions

Based on the research results and conclusions, the study believes that learning during the pandemic period needs to fully consider learners' individual factors, especially mental health and depression-anxiety-stress will greatly affect learners' use of web-based learning tools. Although web-based learning tool is a convenient instrument for learners to get access to knowledge and skills, the isolation between teachers and students was uncertain to make assurance about this kind of benefits with high dropout rate (Davidson-Shivers, Rasmussen, & Lowenthal, 2018; Hew & Cheung, 2014; Allen & Seaman, 2013). Paying attention to these problems and guiding the learners to overcome these mental health problems to quickly getting rid of the negative emotions of depression-anxiety-stress, is very important for individual control, which will help learners improve their concentration and quality of learning in web-based learning. On the other hand, family life quality is also very important to the self-efficacy of online learners. During the pandemic, it is necessary to ensure a high quality of family life, a relaxed family atmosphere with love, trust and faith, communication, and nurturing could promote learners' web-based learning. As a mediator between web-based learning tool and self-efficacy, family life quality could reduce learners' negative emotions in depression-anxiety-stress, and enhancing self-efficacy, and promoting learners' use of web-based learning tool. Secondly, the study also designed a multiple-choice question on the investigation of the reasons for the use of web-based learning tools. Among them, 70.87% and 20.71% of learners used web-based learning tools to study mainly due to regulations and requirements, while 53.72% and 49.51% of learners use web-based learning tools for autonomous learning and self-improvement reasons. Therefore, although the reasons why learners use web-based learning tools are diversified, regulations and requirements have been predominant effect, and autonomy learning of an individual was left behind. It can be seen that web-based learning tools have been widely used during the pandemic. Finally, the use and improvement of web-based learning tools are also very important for web-based learning during the pandemic. Learners' evaluation and opinions on web-based learning tools must be worth attention. The development and improvement of web-based learning tools as a technical problem has been further improved. However, existing research pays little attention to the evaluation of learners' use of web-based learning tools. In addition, there are some limitations in this study. For example, there are not enough investigation samples.

Compliance with Ethical Standards

Conflict of interest The authors declared no conflicts of interest with respect to the authorship or the publication of this article.

Ethical Approval All processes performed in studies involving individual participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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