Abstract—Self-efficacy for self-regulated learning (SESRL) is a protective factor for academic performance. However, there are few studies have explored its impact on online learning during the Covid-19. This study investigated (a) the mediating roles of perceived usefulness (PU) and perceived ease of use (PEOU) in the relationship between SESRL and use intention (UI) and (b) the moderating role of gender in the indirect relationship between SESRL and UI. Four hundred Chinese college students entered this study and completed the measurements of SESRL, PEOU, PU and UI. The results showed that SESRL, PEOU, PU and UI were positively correlated with each other. Mediating analysis showed that PEOU and PU mediated the relationship between SESRL and UI. By comparison, the single mediating effect of PEOU was stronger than the single mediating effect of PU and the multiple mediation of them together, which showed the robust effect of PEOU. Moderation analysis showed that the effects of SESRL on PU and PEOU in females were stronger than in males. A high level of SESRL is more conducive to improving the PU and PEOU of female students, which further influenced their intention to use online learning.

Index Terms—Self-efficacy for self-regulated learning, perceived ease of use, perceived usefulness, use intention.

I. INTRODUCTION

In order to reduce the spread of Covid-19, many countries formulated policies to control interpersonal distance, and schools adopted online learning to protect the health of students and teachers [1], [2]. Teachers could conduct synchronous teaching at a specific time through specific media or record videos in advance, and students completed the courses according to their situation [3], [4]. In China, colleges replaced face-to-face courses with online courses to keep education sustainable during the epidemic with tools like Teams, Zoom, and MOOC.

The flexible communication and digital learning resources of online learning make learners experience a particular way of learning and change the traditional relationship between teachers and students. Scholars have found the positive impact of online learning during the epidemic. The constraint of Covid-19 positively influenced students’ performance and efficiency in online learning by changing their learning strategies and making learning sustainable [5], [6].

Although online learning has been widely used in colleges, the real impact of online learning depends mainly on whether and to what extent students accept it. Some studies have found that college students are not very willing to study in online classes, and many of them propose that they do not want to continue learning online in the future if there is a choice, and they prefer face to face learning [7], [8]. Students experience pressures and difficulties from attitude, emotion, motivation and self-regulation in online learning. Due to the autonomy and self-regulation of online courses, scholars believe that self-regulated learning (SRL) is crucial for successful education during the outbreak of Covid-19 [9]. The effectiveness of online learning depends on students’ attitude or personality of autonomous learning rather than the ability to use technical equipment [10]. Students who think they are capable tend to use SRL strategies frequently, such as making plans and managing time and have more intrinsic motivation and less procrastination [11]. Effective learning strategies are helpful to improve academic performance and adapt to learning in an emergency.

Although many studies have discussed the impact of SRL on online learning in Covid-19, few of them considered the role of self-efficacy for self-regulated learning (SESRL). At present, the world is still under the shadow of the epidemic, and it is crucial to find the factors that affect students’ willingness to use online learning. This study contributes to the study of online learning during the epidemic period and tries to put forward suggestions on improving students’ willingness to use online learning from the perspective of self-regulated learning.

II. LITERATURE REVIEW

A. Technology Acceptance Model (TAM)

Davis (1985) proposed the TAM model based on rational behavior theory and used it to predict and interpret the acceptance and usage in technology applications [12]. The TAM model in Fig. 1 uses perceived usefulness (PU) and perceived ease of use (PEOU) as independent variables, which could influence the behavior of user technology adoption. In addition, TAM uses behavior intention or actual use of the information system as a dependent variable.

PEOU reflects the extent to which users believe that using a particular system would be free of effort, and PU reflects the extent to which users believe that using a system will improve their performance [13]. PEOU and PU are influenced by external factors in the TAM model, including subjective norms, experience, perceived enjoyment, computer anxiety, and self-efficacy [14]. Behavior intention refers to the subjective possibility of a person performing a
particular act, such as use intention (UI), which is the crucial factor to the success of a system [15], [16]. In the original TAM model, behavior intention was influenced by attitudes, PU, and PEOU.

In online learning, PEOU reflects the extent to which users believe that using online learning systems will be free of effort, and PU reflects the degree to which users believe that using online learning systems will improve their learning performance [17]. Previous studies have confirmed the significant effects of PEOU and PU on use intention and the significant effect of PEOU on PU in online learning among college students [18]–[21]. When students believe the technology is easy to use, they may think that the technology is useful and consider using it.

Many researchers have used TAM to predict and explain the use behavior of online learning. Some of them have tested students’ acceptance of online learning in Covid-19 with TAM and demonstrated the influences of internal factors, institutional factors, external factors, PU and PEOU on students’ use intention [22]–[25].

### B. Self-efficacy for Self-regulated Learning (SESRL)

Self-regulated learning refers to self-generated thoughts, feelings, and actions planned and systematically adapted as needed to affect one’s learning and motivation [26]. It involves the formulation of learning goals, the monitoring of achieving goals, and the reflection on the usefulness of strategies. Scholars have confirmed the significant prediction of self-regulated learning on students’ satisfaction with online education and the moderation effect of self-regulated learning on basic need satisfaction, positive emotion, and intrinsic learning motivation [27], [28]. Learners with a higher level of SRL are positive about their learning effectiveness and have more intrinsic motivation and less procrastination [11], [29].

Understanding self-regulation strategies does not mean that users can use them efficiently. Learners’ belief in self-regulation ability is a determinant factor of successful self-regulation, which means that a high level of self-efficacy for self-regulated learning (SESRL) is necessary [30], [31]. Previous studies have noted that SESRL positively affects students’ learning [32], [33]. As a belief of self-efficacy, SESRL is positively correlated with students’ academic performance and is a predictor of achievement goals [32]. Students who know how to learn and actively participate in learning are not willing to actively cheat [33].

Students with good performance often use many self-regulated learning strategies (e.g., organizing, transforming, and seeking information), which predicts the score of standardized performance tests [34], [35]. Compared with traditional learning methods, online learning needs more self-management and self-efficacy for self-regulated learning. Students who are confident in their learning ability will have more motivation to participate in the learning process and persist in accomplishing arduous academic tasks, which will make them more successful in online learning [36], [37]. Students with a high level of learning self-efficacy tend to use online learning, while those who do not believe their abilities to use technology will avoid using it [38].

In this new era, the construction of knowledge is increasingly dependent on the electronic network. In online learning research, students with a high level of SESRL are prone to use online education and show great strategic flexibility in seeking solutions [39]. They tend to think that using online learning is easy and useful. Therefore, SESRL may positively influence use intention through PEOU and PU.

### C. Gender

There are gender differences in SESRL, and female students have higher self-efficacy in self-regulation than male students [40], [41]. Female students expressed a high degree of confidence in their ability to make homework plans, retrieve information provided in classes or textbooks, and participate in class discussions [40]. Scholars investigated the gender differences in academic self-regulation behaviors and found that female students showed more goal’s setting, planning and self-monitoring than male students [42]. The effects of SESRL on PU and PEOU in females may be stronger than those in males.

### III. THE PRESENT STUDY

Based on previous studies, SESRL may affect users’ practical evaluation and intention to use online learning. People with a high level of SESRL are prone to think online learning is easy and useful, improving their intention to use it. Therefore, this study explored the Chinese college students’ intention to use online learning during the epidemic by taking SESRL as the external influencing factor, PU and PROU as the mediating variables, and gender as a moderating variable (as shown in Fig. 2).

![Fig. 1. TAM model.](image)

![Fig. 2. Structural model.](image)

This study proposed the following assumptions:

H1: Perceived usefulness and perceived ease of use could mediate the relationship between SESRL and use intention.

H2: Gender could moderate the effects of SESRL on perceived usefulness and perceived ease of use.
IV. METHOD

A. Participants

This study was conducted from April to June 2020, and the participants were Chinese college students who studied in online courses during Covid-19. This research was introduced on the campus social platform of universities in Macau, and students were invited to participate. Since the students were at home, this study sent the questionnaires to them through the Internet. Four hundred and forty-two participants voluntarily entered and completed the questionnaires online. After eliminating the invalid data, the number of valid questionnaires was four hundred, with an effective rate of 90%. There were one hundred and fifty-four males, and two hundred and forty-six females, with an average age of 21.15 years (SD=1.58).

B. Measure

Demographic information. It included age, gender, and other information. It also asked participants if they were participating in the school’s online courses. Only the questionnaire with a “Yes” answer was valid.

Self-efficacy for self-regulated learning. The scale of SESRL was compiled by Zimmerman, Bandura and Martinez-Pons (1992) and revised by Wang and Qian (2015) with 11 items [43], [44]. The scale used a 7-Likert scale with 1 representing “extremely bad” and 7 representing “extremely good”. The Cronbach’s α of scale is 0.83, indicating excellent reliability.

Perceived usefulness, perceived ease of use and use intention. This study adapted the measures of Venkatesh and Davis (2000) to form three scales to measure PU, PEOU and use intention. This study adapted the measures of Venkatesh and Davis (2000) to form three scales to measure PU, PEOU and use intention. Each scale contained three items with a 5-scoring system with 1 representing "extremely disagree" and 5 representing "extremely agree".

C. Procedure

Firstly, this study verified the reliability and validity of the measurements. Secondly, all variables were standardized, and the Process macro invented by Hayes (2013) was used to test the mediating effect. Thirdly, this study encoded gender and used Process macro to test whether the mediating process was moderated by gender. In addition, the bootstrapping method with 5000 data resampling tested the significance of mediating effects with the 95% bias-corrected confidence interval.

V. RESULT

A. Reliability and Validity Analysis

Table I and Table II presented the results of validity and reliability. Cronbach’s α coefficient of reliability was equal to or greater than 0.7, indicating good reliability. Convergent validity could be measured by standardized factor loading, Average Variance Extracted (AVE) and Composite Reliability (CR). Standardized factor loadings of all items were greater than 0.6, the values of AVE were greater than 0.5, and the values of CR were greater than 0.7, which indicated the good convergence validity of scales. For each variable, the square root of AVE was greater than the correlation coefficient, showing good discriminant validity.

B. Testing for Mediation Effect

Table II listed the mean, standard deviation and correlation of each variable. As expected, there were positive relationships between SESRL, PEOU, PU, and use intention. This study standardized the average score of all variables and used Process macro (Model 6) to analyze the mediating effects of PEOU and PU on the relationship between SESRL and use intention. Fig. 3 showed the test results of mediation. First, the overall effect of SESRL on use intention was significant (β=0.62, p<0.001). Second, the effects of SESRL on PEOU and PU were significant (β=0.65, p<0.001; β=0.22, P<0.001). The PEO, as the first mediator, significantly affected PU that was the second mediator (β=0.53, p<0.001). Third, PEOU and PU had significant direct effects on use intention (β=0.48, P<0.001; β=0.24, P<0.001). Fourth, when PEOU and PU entered the equation simultaneously, the significant relationship between SESRL and use intention decreased (β=0.16, p<0.01).
the 95% confidence interval did not contain 0 (CI$_{95\%}$ [0.35, 0.56]). The mediation effects of PEOU and PU were statistically significant. The single mediation effects of PEOU and PU were significant (CI$_{95\%}$ [0.23, 0.42], CI$_{95\%}$ [0.02, 0.09]), and multiple mediation effects of them together were also significant (CI$_{95\%}$ [0.04, 0.13]). In order to find out the differences between single mediation and multiple mediation, this study compared the indirect effects. The results shown in Table III showed that the single mediating effect of PEOU was stronger than the single mediating effect of PU (CI$_{95\%}$ [0.23, 0.42], CI$_{95\%}$ [0.02, 0.09]), and the multiple mediation effect of them together was also significant (CI$_{95\%}$ [0.04, 0.13]).

C. Testing for Moderated Mediation

This study coded gender with “0” representing males and “1” representing females. Process macro (Model 84) was used to analyze the moderation effect of gender between SESRL and use intention.

In Table IV, Model 1 showed that gender moderated the relationship between SESRL and PEOU ($\beta=0.21$, $p<0.01$). Model 2 showed that gender moderated the relationship between SESRL and PU ($\beta=0.19$, $p<0.05$).

This study mapped the chart of PEOU and PU predicted by SESRL in males and females, respectively (Fig. 4 and Fig. 5). The simple slope test in Fig. 4 showed that for female students, SESRL was positively correlated with PEOU ($\beta_{simple}=0.71$, $p<0.001$). For male students, SESRL was positively correlated with PEOU ($\beta_{simple}=0.50$, $p<0.001$), but the correlation was weaker compared to female students.

The simple slope test in Fig. 5 showed that for female students, SESRL was positively correlated with PU ($\beta_{simple}=0.28$, $p<0.001$). For male students, SESRL was not related to PU ($\beta_{simple}=0.09$, $p>0.05$).

VI. DISCUSSION

Based on the TAM model, this study established a moderated mediation model to test whether SESRL could affect college students’ intention to use online learning through PU and PEOU and whether this indirect relationship could be moderated by gender.

This study verified the positive effect of SESRL on college
students’ intention to use online learning. The results showed that students with a high level of SESRL were more likely to use online learning. Scholars have found the protective effect of SESRL on learning and achievements [32], [33]. Students with a high level of SESRL tend to make good use of online learning with self-regulated learning strategies, such as organizing, transforming, and seeking information [34]. Therefore, it is suggested that teachers improve students’ SESRL and cultivate their strategies for self-regulated learning, such as search contests and use training, which could encourage them to actively use the convenient resources of online learning and increase their use intention.

The results of mediation analysis showed that PEOU and PU mediated the effect of SESRL on use intention. Students with a high level of SESRL often have flexible strategies in finding solutions, such as planning and managing academic work, establishing an efficient learning environment, and getting rid of distractions [35], [39]. A high degree of confidence and awareness of self-ability could affect students’ utilization and mastery of online learning. When students think it is easy to use online learning, they are more likely to believe that it is useful and then prefer to use it.

The comparison of mediation effects showed that the single mediation effect of PEOU was stronger than the single mediation effect of PU and the multiple mediation of them together, which means that the mediation effect of PEOU on SESRL and use intention was greater than that of PU. PEOU was an essential influencing factor in the relationship between SESRL and use intention.

The results of moderating effect analysis showed that gender played a moderating role in the first stage of the mediation model. The positive effect of SESRL on PEOU was moderated by gender, and the effect was stronger in females than in males. The positive effect of SESRL on PU was significant in females but not significant in males. Previous studies have shown that female students have higher confidence in self-regulation than male students [40]. Female students expressed a high degree of confidence in their ability to make homework plans, retrieve information provided in classes or textbooks, and participate in class discussions. Female students showed more goal setting, planning and self-monitoring than male students in academic self-regulation behaviors [42]. These behavioral strategies may improve their evaluation of the usefulness and ease of use in online learning. Therefore, SESRL has a more significant impact on PEOU and PU in female students than male students.

VII. CONCLUSION

The results showed that perceived usefulness and perceived ease of use could mediate the effect of self-efficacy for self-regulated learning on students’ intention to use online learning. In other words, self-efficacy for self-regulated learning positively affected students’ perceived usefulness and perceived ease of use, which further increases their intention to use online learning. In addition, the first stage of the mediation model (from self-efficacy for self-regulated learning to perceived usefulness and perceived ease of use) was moderated by gender. For college students, the effects of self-efficacy for self-regulated learning on perceived usefulness and perceived ease of use were more robust in female students than in male students.

CONFLICT OF INTEREST

The author declares no conflict of interest.

AUTHOR CONTRIBUTIONS

The author’s contribution to this work includes: conducting research, analyzing data and writing the paper.

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