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A Study of The Effects of Feedback on College Students' Self-Regulated Learning in an Online Learning Environment

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ABSTRACT

Background: Effective feedback positively affects the learning process of students, and its role is manifested in the fact that it can stimulate learning motivation and promote cognition. In self-regulated learning as a learning mode, feedback is also an essential key factor in the process of its activities. Based on the requirements of an online learning environment for college students' self-regulated learning as well as the current situation that the overall level of Chinese college students' self-regulated learning ability is only in the middle, this study hopes to provide feedback based on the process of self-regulated learning, implement feedback for college students using online learning, and explore the impact of feedback on college self-regulated learning to test the utility of feedback. **Methods**: This study combines literature analysis, experimental research, and a questionnaire to conduct an in-depth study of the impact of feedback on undergraduate self-regulated learning in an online learning environment. Sample: 37 students' final grade point average in the previous semester is taken as the pre-test score. Based on this data, the study subjects are divided into two groups that are not statistically different. A teaching experiment lasting one semester is conducted on two groups of students: one receiving feedback and the other not, serving as the experimental and control groups. **Results**: (1) Feedback has a positive impact on college students' self-regulated learning level; (2) Feedback does not have a significant impact on college students' academic performance in the short term. **Conclusion**: This study investigates three aspects of model construction, feedback design, and empirical evidence to provide feedback based on learners' self-regulated learning processes in online learning environments to improve college students' self-regulated learning.

Keywords : Feedback; Online Learning; Self-Regulated Learning; Students' Performance

Background

With the rapid change in network technology, online learning is favored by many teachers and learners and has become an important mode of teaching practice at all levels and in all types of schools. However, learners and teachers face many challenges in an online learning environment. Most learners are already

accustomed to teacher-centered learning, so they have difficulty coping with self-directed learning in an online learning environment. Research has shown that self-regulated learning ability is the key to determining the success of online learning, and self-regulated learning ability has a significant impact on students' online learning outcomes (Wang, Zhang, & Chen, 2021). Self-regulated learning is the process of learners' self-motivation, active and flexible use of learning strategies, self-observation, self-judgment, and self-response to learning behaviors, which is considered to be one of the most important skills needed for lifelong learning (Boekaerts, 1999). Due to its critical importance for measuring success in online educational environments, self-regulated learning is considered one of the success factors in online learning. Therefore, developing university students to become self-regulated learners is important for enhancing learning outcomes.

The number of empirical studies on the level of self-regulated learning ability of college students is relatively small. Some scholars in the empirical study of improving the effectiveness of network self-regulated learning, in order to understand the current situation and characteristics of college students' network self-regulated learning, surveyed 260 college students by OSRL questionnaire, and the results of the survey showed that survey respondents' network self-regulated learning was generally at a medium level (Wang, Zhang, & Chen, 2021). The psychology of learning suggests that feedback plays an integral role in student learning. Effective feedback has a positive impact on students' learning processes in terms of motivation and cognition (Hattie & Timperley, 2007). Self-regulated learning is a learning style, and feedback is also an essential factor in the process of its activities. In order to improve college students' self-regulated learning, this study provides an external intervention on college students' self-regulated learning process by designing feedback. The effect of feedback on self-regulated learning is explored empirically.

The psychology of learning suggests that feedback plays an integral role in student learning. Effective feedback has a positive impact on students' learning processes, which can manifest in two aspects: stimulating motivation and promoting cognition. Self-regulated learning as a learning style, feedback is also an essential key factor in the process of its activities (Paulina, Mutiah & Panaemalae, 2023). Regarding the research on feedback and self-regulated learning, (Narciss, Proske & Koerndle, 2007) researchers have shown in their publications that providing learners with timely feedback interventions on their learning behaviors can promote self-regulated learning in web-based learning environments, which is conducive to improving learning performance (Narciss, Proske & Koerndle, 2007). In the process model proposed by Butler and Winne, the role of feedback in the process of self-directed learning is elaborated theoretically. Regarding the study of the relationship between feedback and the elements of self-regulation, feedback increases the level of motivation of learners, and positive feedback increases their internal motivation (Butler. & Winne.,1995). There are no consistent findings regarding the effect of feedback on learners' self-efficacy. It has also been found that feedback optimises learners' choice and use of strategies. Compared to the no-feedback condition, learners are more likely to use strategies that are riskier but exert less cognitive effort in decision-making tasks in the feedback condition (Rieskamp & Otto, 2006). Regarding the research on the relationship between feedback and various elements of self-regulation, explored the effects of three forms of feedback—individual feedback, social feedback, and task feedback—on college students' motivation, and the results showed that task feedback (i.e., values giving the results of students' scores on a task) had a boosting effect on college students' motivation. The remaining two forms of feedback, on the other hand, reduce learning motivation. The role of external feedback has also been mentioned in several papers in the context of competence development strategies for self-regulated learning, but there are not many empirical studies on the self-regulation process of feedback on learning, especially on online learning by Chinese university students. In order to improve college students' self-regulated learning, the overall goal of this study is to design feedback for students learning online in an online learning environment so as to investigate the effect of feedback on students' self-regulated learning.

The specific research objectives are as follows: (1) To construct a relationship model between self-regulated learning and feedback. (2) To design feedback based on the process of self-regulated learning. (3) To test the effect of feedback on self-regulated learning in an online learning environment.

Methods

Research Question

Aiming at the requirements of the online learning environment for college students' self-regulated learning and the fact that the overall level of Chinese college students' self-regulated learning ability is only moderate, this study provides feedback on the process of self-regulated learning and explores the impact of feedback on college self-regulated learning. Feedback was implemented for university students who adopted an online learning approach to test the utility of feedback. Therefore, this study poses the following research questions:

1. How can feedback be designed for self-regulated learning processes in university students?
2. What should be implemented as feedback for self-regulated learning processes in online learning?
3. What influence does feedback have on university students' self-regulated learning in online learning?

Model Construction

Nicol constructed a model of the relationship between self-regulated learning and feedback based on the self-regulated learning model proposed by Butler, which argues that in higher education, formative assessment and feedback should be used to help students become self-regulated learners (Nicol & Macfarlane, 2006). The shortcoming of this model is that external feedback is only provided after learners have obtained externally detectable outcomes after self-regulated learning, so this study adopts the self-regulated learning process model proposed by Zimmerman and adds an internal feedback role to this model (Zimmerman, & Schunk, 2011). The external feedback in this study involves three stages of feedback: feed-forward, learning feedback, and outcome feedback. First, feed-forward was conducted in the planning stage: students were provided with issues to be aware of in the completion of learning tasks in order to help learning to build self-confidence, motivate the engine, and complete the goal setting. Secondly, feedback in the behavioral phase: providing students with feedback on their learning performance online and in tests to help them self-observe and self-monitor. Thirdly, the self-reflection stage provides feedback on the results; it helps students to self-evaluate and self-react and provides motivation for the next stage of motivation. Therefore, a model of the relationship between self-regulated learning and feedback was constructed. As shown in Figure 2.1.

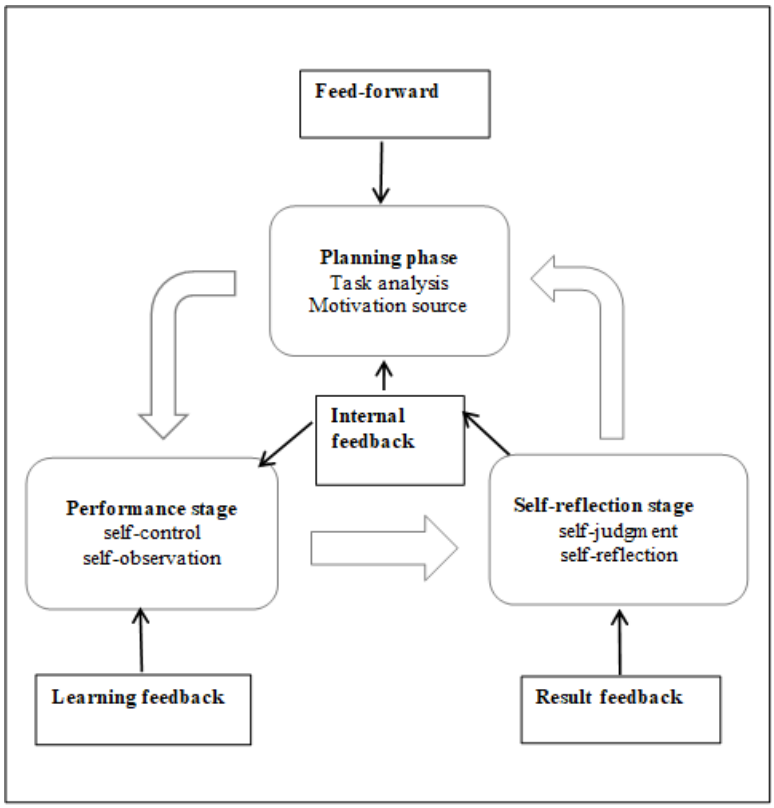

Figure 2.1 Model of Self-Regulated Learning and Feedback Relationship

This study combines literature analysis, experimental research, and a questionnaire to conduct an in-depth study of the impact of feedback on undergraduate students' self-regulated learning in an online learning environment.

37 sophomore students in the course Graphic Design, which is conducted using online learning, are selected as the study participants, and the final grade point average of the study participants in the previous semester is used as the pre-test score. Based on this data, the study subjects are divided into two groups, which are not statistically different. 37 students is this specific class size, so the number of experimental and control groups is not equal. The 19-student group is the experimental group, and the 18-student group is the control group. The experimental group receives feedback on their learning as the semester-long course progresses, while the control group receives no feedback.

In the early stages of the experiment, a questionnaire is used to obtain data on students' online self-regulated learning level in order to understand the current status of learners' self-regulated learning ability level. At the end of the experiment, a post-test questionnaire was distributed, and the data collected from the pre- and post-tests were analyzed using SPSS to find out whether there was a significant difference in the level of self-regulated learning ability of the study participants before and after the experiment and to test the impact of the feedback design on the self-regulated learning of the learners in the online learning environment.

Feedback Design

The feedback design in this study refers to the design of external feedback, which involves three stages of feedback: feed-forward, learning feedback, and result feedback. Feedback for all three stages is learning feedback, which refers to the information provided based on learning content, learning process, and learning results. Regarding the types of feedback, four types are designed: descriptive feedback, prompting feedback, evaluative feedback, and suggestive feedback. Among them, the feed-forward uses descriptive feedback. Learning feedback adopts descriptive feedback and suggestive feedback. Descriptive feedback mainly provides objective descriptions of learners' learning process and status, such

as online learning time, number of discussions, completion of assignments, etc.; suggestive feedback provides hints on learning strategies according to learners' learning performance. The resultant feedback adopts evaluative feedback and suggestive feedback. Evaluative feedback is a kind of direct judgment on learners' learning results based on certain evaluation criteria, and suggestive feedback refers to the relevant improvement suggestions given to the learners for the deficiencies of the learning process and results. Feedback for the planning stage of the feed-forward is mainly in the form of text. Learning feedback is in the form of tables. Outcome feedback is given in the form of a combination of graphics and text.

Table 2.2 Types and Forms of Feedback

Stage of Feedback	Type of Feedback	Form of Feedback	Content of Feedback
Feed-forward	Descriptive Feedback	Text	It provides students with information about the learning task and prompts them to read the assignment evaluation criteria before undertaking the learning program.
Learning feedback	Descriptive feedback, suggestive feedback	Forms	Students' motivation in online learning; download of learning materials; interaction; and completion of online assignments.
Result feedback	Evaluative Feedback, Suggestive Feedback	Combination of graphics and text	Provide students with the results and grades of their learning; give suggestions on the results of their learning; in the suggestions, the teacher gives encouraging words.

Self-Regulated Learning Questionnaire

The Self-Regulated Learning Questionnaire (SRLQ) consists of two parts, one of which adopts the OSLQ, a scale developed by (Barnard *et al*., 2009) for online learning environments (Barnard L., Paton V., & Lan W., 2008). The other part was selected from the MSLQ items on learning motivation and cognitive strategies, and in this study, time management, environment construction, and cognitive strategies were united into the self-regulated learning strategies dimension (Pintrich *et al*., 1993). Therefore, the Self-Regulated Learning Questionnaire was divided into four research dimensions, namely, the goal setting dimension, the learning motivation dimension, the self-regulated learning strategies dimension, and the self-evaluation dimension.

The reliability of the scales was examined using the Cronbach's coefficient method, and the total alpha coefficients and subscale alpha coefficients of the scales used for the measurement of the present study were at a good level. The alpha coefficient of the goal-setting dimension is 0.819, the alpha coefficient of the learning motivation dimension is 0.670, the alpha coefficient of the self-regulation learning strategy dimension is 0.737, and the alpha coefficient of the self-assessment dimension is 0.709. The questions on this scale are based on the direct translation of the foreign questionnaires and are determined after discussion among the relevant experts, so the scale has high content validity. The KMO (Kaiser-Meyer-Olkin) value of 0.677 indicates that the items in the scale are sufficiently interrelated for factor analysis. It's positive that this value is greater than 0.5, suggesting acceptable sampling adequacy.

Results and Discussion

Differences in Self-Regulated Learning Levels between the Experimental Group and the Control Group in the Pre-Test Analysis.

Firstly, the self-regulation learning level (SRL) of the two groups is analyzed for differences. Through the independent samples t-test, the mean values of the two groups are 61 and 59.33 respectively. Table 3.1 shows the independent samples t-test, and the results show that F=0.048, P(sig)=0.827>0.05, which indicates that the two samples are homogeneous. Therefore, we refer to the test results of Equal variances assumed. The result shows that the sample t=0.383 and P value (two-sided) is 0.704>0.05 between the different groups, indicating that there is no significant difference in the overall level of self-regulation learning between the experimental and control groups.

Table 3.1 SRL Pre-test Independent Samples t-Test

							95% Confidence Interval of the Difference	
DV		**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**Lower**	**Upper**
SRL Pre-test	Equal variances assumed	0.383	35	0.704	1.667	4.354	-7.173	10.506

Post-Test Data Analysis

Analysis of the Difference between the Experimental Group and the Control Group in Self-Regulation Learning Level

The mean values of post-test self-regulated learning water in the experimental and control groups were 67.16 and 60.67 respectively. The results of the independent samples t-test are shown in Table 3.2. The results show a two-sample chi-square. p-value (two-sided) is 0.046<0.05, indicating that there is a significant difference in the level of post-test self-regulation learning between the experimental group and the control group.

Table 3.2 SRL Post-Test Independent Samples t-Test

								95% Confidence Interval of the Difference	
Group			**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**Lower**	**Upper**
SRL Post-test	Equal variances assumed		2.072	35	0.046	6.493	3.133	0.132	12.854

Analysis of the Difference between the Pre- and Post-Test Self-Regulation Learning Levels of the Experimental Group

The descriptive statistics of paired samples t-test shows that the mean value of the experimental group is 61 before the experiment and 67.16 after the experiment, and the mean value of the post-test is higher than that of the pre-test. Table 3.3 shows the results of paired samples t-test for the experimental group, which lists the mean difference, standard deviation of the difference, and standard error of the mean of the difference of the pre- and post-test self-regulation learning levels of the experimental group. t=3.114, P(two-sided)=0.005<0.05, which indicates that there is a significant difference between the pre- and post-test self-regulation learning levels of the subjects in the experimental group.

Table 3.3 The Paired t-Test Between the Pre-test and the Post-test Performed on the Experimental Group

Group	**Mean Difference**	**Standard Deviation**	**Std. Error Difference**	**t**	**df**	**Sig. (2-tailed)**
E Group	6.160	9.890	1.978	3.114	18	0.005

Analysis of the Difference between the Pre- and Post-Test Self-Regulation Learning Levels of the Control Group

The descriptive statistics of the paired samples t-test showed that the mean value of the control group was 59.33 before the experiment and 60.67 after the experiment, and the mean value of the post-test was slightly higher than that of the pre-test. The paired samples correlation coefficient test showed that the correlation coefficient of the self-regulation learning level of the control group learners before and after the experiment was 0.963 with sig < 0.05, which is significant. Table 3.4 shows the results of the paired samples t-test for the control group, p (two-sided) = 0.223 > 0.05, indicating that there is no significant difference between the pre- and post-test self-regulated learning levels of the control subjects.

Table3.4 The Paired t-Test Between the Pre-test and the Post-test Performed on the Control Group

Group	Mean Difference	Standard Deviation	Std. Error Difference	t	df	Sig. (2-tailed)
C Group	1.333	3.576	1.032	1.292	17	0.223

Analysis of the Difference between the Experimental Group and the Control Group in the Post-Test Scores

Table 3.5 shows the descriptive statistics of the post-test scores of the experimental group and the control group, with the mean, standard deviation and standard error of the scores of the two groups respectively.

Table 3.5 The Post-Test Score Descriptive Statistics

Group	N	Mean Difference	Standard Deviation	Std. Error Difference
C Group	18	81.12	7.769	1.554
E Group	17	79.25	9.006	2.600

The results of the independent samples t-test analysis are shown in Table 4.6. The results show that F=0.010, P (sig)=0.919>0.05, which indicates that the two samples are in agreement. Therefore, referring to the test results of Equal variances assumed, the results show that the sample t=0.651 and P value (two-sided) is 0.519>0.05 between different groups, indicating that there is no significant difference between the post-test scores between the experimental group and the control group.

Table 3.6 Score Post-Test Independent Samples t-Test

							95% Confidence Interval of the Difference	
Group		*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Score Post-Test	Equal variances assumed	0.651	35	0.519	1,870	2.872	-3.961	7.701

Discussion

Feedback Has a Facilitating Effect on the Improvement of College Students' Self-Regulation Learning Level

Through the statistics of the experimental group and the control group post-test self-regulation learning questionnaire data, it is concluded that there is a significant difference between the control group and the experimental group post-test self-regulation learning level. There is no statistically significant difference between the control group and the experimental group, while there is a statistically significant difference between the control group and the experimental group. Although the conclusion of the experiment shows that feedback has a positive effect on the improvement of college students' self-regulation learning ability, it does not mean that there is no change in the self-regulation learning level of the learners who did not receive feedback. Through the pre- and post-test analyses of the self-regulation learning level of the students in the control group, although there is no statistically significant difference, the mean value has also increased, and the reason for the increase may be due to other factors, which is evident in the fact that the feedback is not given in the control group. The reason for the increase may be due to other factors, which can be seen, probably because with the accumulation of time and the increase in learning experience, the learners' self-regulation learning level will be improved.

Feedback Does not Have a Positive Effect on College Students' Performance

By standardizing the scores of the homework items for the two groups of subjects and conducting an independent sample t-test, The results show that there is no significant difference between the scores of the two groups. It is possible that, due to the short experimental period, teaching feedback did not have a positive impact on academic performance. In conclusion, although feedback does not have a positive effect on students' academic performance in the short term, it has a partially positive effect on college students' self-regulated learning.

Conclusion

Self-regulated learning can play an important role in online learning environments and is crucial in determining the success of online learning. Feedback, as one of the key factors influencing learning, has a positive effect on motivating learners and promoting cognitive aspects. This study aims to investigate the impact of feedback on self-regulated learning. Based on this research purpose, the study is carried out in three aspects: model construction, feedback design, and empirical evidence. The research idea of combining theory and practice is adopted to analyze in depth the effect of feedback on self-regulated learning in an online learning environment. The research conclusions of this study are as follows: (1) the construction of the model of the relationship between self-regulated learning and feedback can be carried out in three stages: feed-forward for the planning stage, learning feedback for the behavioral performance stage, and result feedback for the self-reflection stage; (2) feedback has a facilitating effect on the improvement of the level of self-regulated learning of college students; and (3) feedback has not had a positive effect on the performance of college students.

Declarations

Ethics Approval and Consent to Participate: Informed consent was obtained from participants prior to data collection, detailing the study's purpose, the nature of the data, and any potential risks or benefits. The confidentiality and security of participants' private data, protecting their identities and preventing unauthorized access has been ensured.

Conflict of Interest: Not applicable.

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