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An Investigation on Learning Motivation and Learning Strategies of Face-to-Face and Distance Learners

—Taking the Course of SPSS Data Analysis and Quantitative Research as an Example

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Abstract

This paper aims to compare the characteristics of learners' motivation and learning strategies and their differences between face-to-face and distance learning environments. The study takes SPSS Data Analysis and Quantitative Research offered by Beijing Normal University as the object of research and surveys 159 learners using questionnaires. According to the different modes of delivery, the learners were categorized into live listening, remote synchronous live class and remote asynchronous video class (MOOC mode). The results show that: the external motivation of the learners in the live lecture group and the remote synchronous live lecture group is significantly higher than that of the learners in the remote asynchronous video lecture group; there is no significant difference in the level of the learners' learning strategies between the different modes of delivery; and the correlation coefficients of the dimensions of the learning motivation and learning strategies have reached the level of significance for the majority of the dimensions, especially the self-efficacy and internal motivation. And based on the results, some suggestions are made for the provision of the course.

Keywords

Face-to-Face Teaching, Distance Learning, Learning Motivation, Learning Strategies

1. Research Background and Issues

1.1. Background of the Study

The quality of distance education has consistently been a highly scrutinized and

actively explored subject in distance learning, as it is considered pivotal to the sustainability of distance education (Li, 2023). As a crucial determinant of distance education quality, numerous domestic and international scholars have conducted valuable investigations and initiatives regarding the motivation and learning strategies of distance learners. Key areas of study include the stimulation of distance learners' motivation (Lee et al., 2022), the investigation of the use of learning strategies (Neroni et al., 2019), the exploration of the relevant strategies to stimulate and maintain the motivation to learn (Karabulut Coskun & Çetin, 2022); and language learning strategies for distance students in asynchronous and synchronous environments (Chen & Rodway, 2023).

Among them, Gumasing et al. found that physical, cognitive, and macroergonomic factors significantly affected motivation and academic attention in online learning for high school students by examining motivation and academic attention in distance learners (Gumasing et al., 2023). Karaoglan Yilmaz and Yilmaz found a significant effect on motivation and academic attention in online learning for high school students by examining learning analytics (LA) as a metacognitive tool on learners' transactional distance and motivation in online learning environments, found that providing LA-based feedback support was effective in reducing transactional distance and increasing learners' motivation (Karaoglan Yilmaz & Yilmaz, 2021). Some scholars have also studied the learning strategies of junior high school students in the process of learning statistics and probability through structural equation modeling, revealing that motivation, learning anxiety, and self-efficacy mediate learning strategies through self-concept, and found that motivation, learning anxiety, self-efficacy and self-concept have a significant effect on the use of learning strategies (Wang, 2021).

In summary, most existing studies discuss one of the factors of motivation and learning strategies individually, so it is not easy to compare and synthesize the conclusions obtained, which is not conducive to a comprehensive and detailed analysis of distance learners to guide the better development of distance teaching. Most subjects are learners in distance learning environments and the findings of the studies. However, they specifically reference distance learning and lack a comparative study between distance education and face-to-face education. The comparative study of distance education and face-to-face education needs to be improved (Sun et al., 2017). Distance learning must accept more challenges than traditional teaching due to its characteristics (Wu & Peng, 2021). A comparison of the two can present a more precise and more accurate picture of the differences between the learning characteristics of learners in traditional teaching and distance learning, which is of great significance for guiding the design of teaching and learning (Ma et al., 2016a); in addition, distance education is divided into live distance learning and recorded distance learning, but few scholars have explored the connection and difference between the two, and the study about the different distance learning modes has been conducted. In addition, distance education is divided into live and recorded distance learning, but

only some scholars have explored the connection and difference between the two. Therefore, it is necessary to analyze learners' learning motivation and learning strategies in different modes of delivery to formulate effective measures to improve the quality of distance learning.

1.2. Research Content and Key Questions

This study takes the course "SPSS Data Analysis and Quantitative Research" as the object of research, not only because it includes three modes of delivery: live listening, remote synchronous live streaming, and remote asynchronous video recording (MOOC mode) but also because the course theme is in line with the needs of contemporary talent training. In the era of big data, the methods and strategies of data processing and analysis are an essential part of computational thinking, which significantly impacts learners' scientific research ability and ability to adapt to society. With the advent of the significant data era, quantitative research based on social surveys and project evaluation is increasing and has a critical position in fields such as pedagogy (Wang & Wang, 2024a). However, it is undeniable that in many research projects, there are a large number of problems of misuse of data analysis methods and confusion of statistical test indicators, which lead to a lack of confidence in the research conclusions and seriously affect the quality of the research (Li, 2023). Therefore, a course to enhance student's ability to conduct quantitative research based on data has emerged. The course "SPSS Data Analysis and Quantitative Research," offered by teachers such as Associate Professor Ma Xiulin of the School of Educational Technology at Beijing Normal University, explores the techniques of data normalization and statistical analysis using the SPSS and Excel environments from the perspectives of quantitative research specification and statistical analysis of data. The course is delivered in three modes: live listening, remote synchronous live streaming class, and remote asynchronous video class (MOOC mode). What are the characteristics and differences of learners' motivation in different delivery modes? What kind of learning strategies do they adopt? What is the relationship between motivation and learning strategies? Sorting out these questions can help the teaching team of this course to carry out the course in a more targeted way, to develop students' ability to conduct quantitative research more efficiently, and then to improve their research ability; on the other hand, this is of great significance to teacher education and talent cultivation in the digital era.

Therefore, this study aims to investigate the learning characteristics of the learners of this course, to explore the characteristics of learners' motivation and the use of learning strategies in the on-site teaching and distance learning environments, as well as the correlation between the two, and to study the differences in learners' motivation and learning strategies between genders and between different modes of delivery, to explore the problems that need to be paid attention to in the development of this course, to provide suggestions for the development and further improvement of the SPSS course.

2. Research Design and Programme

2.1. Research Framework and Methods

1) Research framework

This article aims to explore the differences in learning motivation and strategies among learners in the teaching practice of the same course "SPSS Data Analysis and Quantitative Research" using three different teaching methods: live listening, remote synchronous live streaming class, and remote asynchronous video class. On the premise of ensuring consistency in the course content, teaching progress, and class schedule accepted by learners, this study distributed a survey questionnaire after the course to quantify the learning effectiveness of learners under different teaching modes. The focus is on exploring the impact of gender differences on the intensity of learner motivation and learning strategy level, the differences in learner motivation and learning strategies under different teaching modes, and the correlation between learner motivation and learning strategies under the same teaching mode. The aim is to draw conclusions on the learning effectiveness of students under different teaching modes. The specific process is shown in Figure 1.

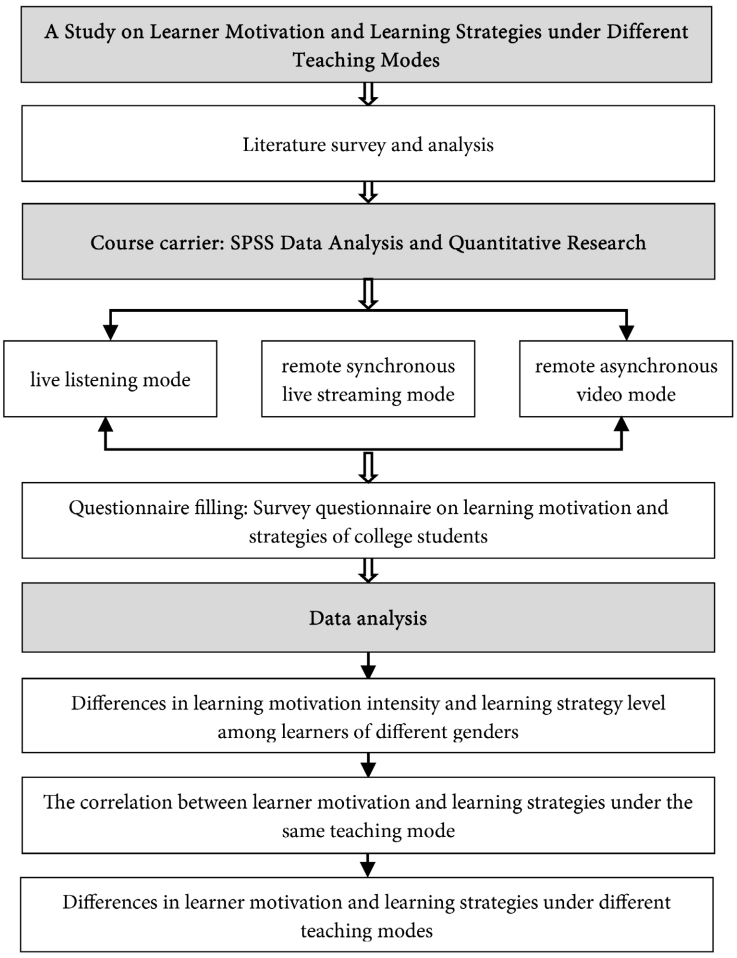

Figure 1. Research framework diagram.

2) Research methods

a) Questionnaire survey method

The questionnaire survey method is a survey method in which surveyors use a uniformly designed questionnaire to inquire about the situation or seek opinions from the selected survey subjects. In order to measure the differences in learning motivation and strategies among students in this study, it is necessary to use different scales and survey questionnaires to conduct multiple measurements on students under different teaching methods, in order to obtain the changes in their motivation and learning strategies under different teaching methods, and to analyze the teaching effectiveness.

b) Interview method

Interview method refers to a type of survey in which researchers directly obtain information and data through face-to-face and oral conversations with the respondents. In this study, individual interviews were conducted with students who exhibited significant differences in learning behavior and had issues with questionnaire presentation. Through face-to-face conversations, students were able to gain a deeper understanding of their true thoughts, needs, and improvement suggestions under different teaching modes.

c) Comparative research method

Comparative research method refers to researchers identifying and explaining differences between different groups by collecting and analyzing data. This study mainly compares the differences in learning motivation and strategies among learners under three teaching methods: live listening, remote synchronous live streaming class, and remote asynchronous video class.

2.2. Sample Selection and Its Characteristics

The course "SPSS Data Analysis and Quantitative Research" was selected as the research vehicle for this study, and this course is listened to in three forms: live listening, remote synchronous live streaming, and remote asynchronous video recording (MOOC method). As this course is a cross-campus public elective, learners in the first two ways of listening to lectures are required to select the lectures in the teaching platform and attend the lectures on time, and they can get the credits of this course after passing the examination without paying; whereas, the teaching based on the MOOC mode is open to the public, and the learners are required to pay for the lectures in order to watch the teaching videos of the course, and they can not get the credits. From the overall status of learners participating in this course, all three types of learners are highly interested in it, and their intrinsic motivation for learning is relatively high. Therefore, the three types of learners who took the course were used as the study population.

The course "SPSS Data Analysis and Quantitative Research" lasted for one semester. At the end of the semester, a questionnaire was administered to all the students who attended the course. In this study, the questionnaire was released and collected using the Questionnaire Star platform, 159 questionnaires were

collected, and 159 valid questionnaires were obtained based on the reverse questions to eliminate invalid questionnaires, with a validity rate of 100 percent. It was statistically derived that there were 38 male students (24%) and 121 female students (76%); there were 27 students (17%) who listened to the lectures on-site, 115 students (72%) who listened to the remote synchronous live lectures, and 17 students (11%) in the group of remote asynchronous video lectures (MOOC mode). The specific distribution of the learners among them is shown in Table 1.

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2.3. Learning Effectiveness Evaluation Tool—College Student Learning Motivation and Strategy Survey Questionnaire

The research method used in this study is questionnaire survey, which evaluates learning effectiveness through the "College Student Learning Motivation and Strategy Survey Questionnaire".

The survey questionnaire is divided into three parts, with a total of 82 questions. The first part is a survey of students' basic situation, consisting of 7 items, which respectively investigate students' gender, identity type, listening methods, course selection motivation, understanding of quantitative research, frequency of listening, and extracurricular investment time; The second part is the Learning Motivation Scale, which uses the Motivated Strategies for Learning Questionnaire (MSLQ) designed by Pinrich to measure the items related to learning motivation, including five dimensions: internal motivation, external motivation, task value, control beliefs, and self-efficacy (Pintrich & Degroot, 1990). There are a total of 25 questions. The third part is the Learning Strategy Scale, which consists of items related to learning strategies in MSLQ, including nine dimensions: retelling, fine processing, organization, critical thinking, metacognition and self-regulation, management of learning time and environment, effort regulation, cooperative learning, and seeking help. There are a total of 50 items, including 8 reverse questions. All items are presented in the form of a Likert five point scale (1 - 5 represents completely disagree, somewhat disagree, half agree, half disagree,

Table 1. Distribution of learners' identity types.

Mode of delivery	Live listening	Remote synchronous livestreaming class	Remote asynchronous video class (MOOC mode)
Number of people	27	115	17
Percentage (%)	17	81	12

somewhat agree, and completely agree).

To ensure the quality of the survey, the validity of the survey questionnaire is mainly ensured through expert structural validity. The author invited three associate professors in the Education Technology major of Beijing Normal University to review this survey questionnaire. At the same time, factor analysis was conducted based on small-scale survey data, and it was found that KMO = 0.782 > 0.60, and the significance of Bartlett's sphericity test was 0.000 < 0.05, confirming that the data has a good structure and is suitable for factor analysis. The results of factor analysis are basically consistent with the primary dimension of the survey indicators, confirming that the survey questionnaire has good structural validity. Reliability is mainly tested based on the test term and Cronbach's coefficient. After reliability score testing, the consistency between the Learning Motivation Scale and the Learning Strategy Scale α The coefficients are 0.943 and 0.969 respectively, and the consistency reliability of the total scale is 0.977, both greater than 0.70, indicating that its reliability meets the research needs. In addition, the high positive correlation between the verification item and the verified item indirectly confirms the reliability of the data.

3. Data Distribution and Discussion

3.1. Gender Differences in Learning Motivation

Because most of the participants in this course are teachers and students from regular universities, there is a phenomenon of fewer male students and more female students in terms of gender distribution among the learners of this course. Among them, boys account for 24% (n = 38) and girls account for 76% (n = 121). Using gender as the grouping variable, independent sample t-tests were conducted on each dimension and overall learning motivation, and the results are shown in Table 2.

As seen from Table 2, in internal motivation, external motivation, task value, control beliefs, and the overall mean of learning motivation, girls' learning motivation is higher than that of boys. Only self-efficacy is slightly lower than that of boys, indicating that female students are more strongly motivated to learn the course and eager to improve their learning power through the course.

Table 2. Gender differences in learners' motivation characteristics.

Dimension	Mean		Standard deviation		T-test
	Male	Female	Male	Female	
Internal motivation	3.809	3.849	0.635	0.752	0.768
External motivation	3.125	3.241	0.628	0.675	0.346
Task values	3.763	3.884	0.681	0.759	0.355
Control beliefs	3.763	3.765	0.660	0.636	0.991
Self-efficacy	3.549	3.525	0.600	0.695	0.851
Overall	3.602	3.653	0.506	0.592	0.632

In the T-test results with gender as a grouping variable, the Sig values of the dimensions of learning motivation and the whole range from 0.346 to 0.991, and the P-values are above the significance level of 0.05. Therefore, it can be determined that there is no significant difference in learning motivation between learners of different genders in the learning of the course.

3.2. Characteristics of Learners' Motivation in Different Modes of Instruction

1) Mean value analysis of the correlation between the intensity of learning motivation and the mode of instruction

This cross-school public elective course is not only an intercollegiate elective course offered to schools but also an online broadcast course recorded on the MOOC platform. Therefore, it is necessary to explore the learning motivation characteristics of learners under different teaching methods to provide a reference for better offering this course. The learning motivation characteristics of learners under three different teaching methods are shown in Table 3.

As can be seen from Table 3, although both learned remotely, the learners in the remote asynchronous video group had a much lower external motivation score (M = 2.765) than those in the remote synchronous live streaming group (M = 3.290). In comparison, their score on the task value dimension (M = 4.147) was higher than that of the learners in the remote synchronous live streaming group (M = 3.810). This result is because learners in the remote asynchronous video group watched the course out of interest in the course content and paid to watch the course rather than for credit or reward. Also, most of the learners who watched the video were primary and secondary school teachers who took the course independently and found the course content critical and valuable. Overall, the remote asynchronous video group learners had the highest motivation scores, except for the external motivation dimension. The reason for this is that "their learning needs are more internally motivated from their development, and their goal of participating in distance learning comes from their inner strength (Wang & Wang, 2024b). In addition, Table 3 also shows that during the learning process, the control beliefs of the live listening group were the strongest (M = 3.833), while the self-efficacy of the remote asynchronous video recording was the strongest (M = 3.681). These conclusions are enlightening for effectively organizing online learning and teaching and learning activities.

Table 3. Mean value analysis of learners' motivation under different modes of delivery.

Mode of delivery	Internal motivation	External motivation	Task values	Control beliefs	Self-efficacy	Overall
Live listening class	3.880	3.176	3.864	3.833	3.529	3.656
Remote asynchronous live streaming class	3.813	3.290	3.810	3.743	3.510	3.633
Remote asynchronous video class	3.956	2.765	4.147	3.794	3.681	3.669

2) Significance test of differences in learning motivation in different modes of delivery

In order to further explore the differences in the various dimensions of learning motivation among these three modes of delivery, one-way ANOVA found a significant difference between learners under different modes of delivery only in the dimension of external motivation ($p < 0.05$). At the same time, there is no significant difference in other dimensions of learning motivation, and the F-value and probability of significance values are shown in **Table 4**.

Post hoc comparisons found that learners in the remote asynchronous video group were significantly less externally motivated than those in the live listening group and the remote synchronous live streaming group. Since learners who watched the remote asynchronous video class (MOOC mode) did not have external pressure from other factors such as credits, they were more interested in the course content, and interest in learning can significantly stimulate students' internal motivation to learn (Sun & Feng, 2022). Therefore, they have stronger internal and weaker external motivation for learning motivation. In contrast, learners' internal and external motivation in the live listening group and the remote synchronous live streaming group were flat, indicating that their learning process was affected not only by the course content but also by many external factors such as credits, rewards, and even assessment and roll call.

3.3. Gender Differences in Learning Strategy Levels

From the nine dimensions of learning strategies as well as the overall situation, the differences in learning strategies of learners of different genders were obtained through independent samples t-test as shown in **Table 5**.

As can be seen from **Table 5**, girls' use of retelling, fine processing, cooperative learning, and help-seeking strategies is higher than that of boys. In comparison, boys' use of six strategies, namely, organization, critical thinking, metacognitive self-regulation, management of study time and environment, and effort regulation, is slightly higher than that of girls and in terms of the overall use of learning strategies, girls' use of these strategies is slightly higher than that of boys. This phenomenon is in line with the conclusion of the research on gender differences among college students that female students tend to be more attentive

Table 4. One-way ANOVA on learners' motivation based on delivery mode.

		Sum of squares	df	Mean square	F	Significance	Post hoc comparisons
External motivation	Between groups	4.120	2	2.060	4.898	0.009	Remote asynchronous video class < live listening and remote synchronous live streaming class
	Within group	65.610	156	0.421			
	Total	69.730	158				

Table 5. Learning strategy differences of learners of different genders.

Dimension	Mean		Standard deviation		T-test
	Male	Female	Male	Female	
Repetition	3.401	3.454	0.574	0.709	0.674
Fine processing	3.570	3.656	0.607	0.706	0.503
Organisation	3.546	3.504	0.721	0.857	0.786
Critical thinking	3.663	3.456	0.588	0.787	0.137
Metacognitive self-regulation	3.342	3.321	0.486	0.552	0.838
Management of study time and environment	3.234	3.229	0.449	0.390	0.955
Effort regulation	3.191	3.160	0.521	0.504	0.738
Co-operative learning	3.351	3.534	0.702	0.748	0.183
Seeking help	3.178	3.349	0.529	0.674	0.713
Overall	3.386	3.407	0.484	0.551	0.946

than male students, and that they tend to be more serious and disciplined in their studies, as well as being able to organize their studies better by taking advantage of their excellent memory and observation (Jin, 1999).

Meanwhile, after one-way ANOVA, it was found that there was no significant difference in the use of learning strategies among learners of different genders in the course.

3.4. Learners' Learning Strategy Levels in Different Delivery Modes

The learners' learning strategy dimensions and their overall use of learning strategies in the three different delivery modes, namely, live listening, remote synchronous live streaming, and remote asynchronous video group, are shown in Table 6.

Table 6 shows that compared with the learners in the live listening group, the learners in the remote synchronous live streaming group generally have lower learning strategy use. The learners in the remote asynchronous video group scored the highest in all learning strategy indicators, except for a slightly lower score in the management of learning time and environment dimension.

Previous analysis found that learners in remote asynchronous video groups have the highest learning motivation. They are more proactive learners who engage in the course with clear learning objectives (Ma et al., 2016b). Therefore, they will actively adopt various learning strategies to assist their learning; that is, the use of learning strategies is generally higher (Zhao, 2021). However, compared to the on-site group, their use of help-seeking strategies could be more robust due to the lack of timely and practical guidance and feedback from teachers and peers when watching videos. The learners in the remote synchronous live streaming group needed more communication and interaction with the live teacher and peers, and the learning atmosphere needed to be more active to

Table 6. Learners' use of learning strategies under different delivery modes.

Mode of delivery	Repetition	Refinement Processing	Organisation	Critical thinking	Metacognitive self-regulation	Management of learning time and environment	Effort regulation	Cooperative learning	Help-seeking	Overall
Live listening group	3.463	3.667	3.472	3.593	3.315	3.218	3.232	3.481	3.574	3.446
Remote synchronous live streaming group	3.402	3.575	3.476	3.459	3.298	3.222	3.126	3.490	3.463	3.390
Remote asynchronous video group	3.677	3.990	3.838	3.682	3.539	3.309	3.338	3.510	3.515	3.600

motivate them to adopt active learning strategies (Wan & Shu, 2022).

Meanwhile, after one-way ANOVA, it was found that there was no significant difference in learning strategies among learners with different modes of delivery in this course.

3.5. Correlation Analysis between Learning Motivation and Learning Strategies

In order to explore the correlation between learning motivation and learning strategies, the four dimensions of learning motivation and the nine dimensions of learning strategies were respectively subjected to Spearmen's correlation analysis, and the results are shown in Table 7.

Table 7 shows that the correlation coefficients between motivation and the dimensions of learning strategies overwhelmingly reached the significance level (except for external motivation and management of learning time and environment, help-seeking, control beliefs, and effort regulation). In the table, self-efficacy has higher correlation coefficients with the dimensions of learning strategies than other motives. Self-efficacy in this questionnaire refers to the learners' speculation and judgment on their ability to complete the learning tasks, which shows that those learners who are confident to learn well will actively and positively use various learning strategies, make learning plans, and make timely adjustments.

Meanwhile, Table 7 shows that the correlation coefficients between internal motivation and the dimensions of learning strategies are generally high and positively correlated. In the questionnaire survey on the essential learning situation, 61% of the learners said that they chose this course to improve their scientific research ability, which shows that most learners have strong internal motivation. Learners with high internal motivation will actively use various learning strategies to improve their learning efficiency (Cui & Zhao, 2018). In addition,

Table 7. Spearmen correlation coefficients of the dimensions of learning motivation and learning strategies.

Mode of delivery	Repetition	Refinement Processing	Organisation	Critical thinking	Metacognitive self-regulation	Management of learning time and environment	Effort regulation	Cooperative learning	Help-seeking
Internal motivation	0.569**	0.670**	0.593**	0.622**	0.568**	0.426**	0.183*	0.417**	0.417**
External Motivation	0.290**	0.235**	0.316**	0.342**	0.264**	0.099	−0.177*	0.315**	0.148
Task values	0.561**	0.713**	0.583**	0.528**	0.559**	0.464**	0.319**	0.386**	0.378**
Control beliefs	0.405**	0.522**	0.415**	0.426**	0.404**	0.268**	0.110	0.348**	0.246**
Self-efficacy	0.0.669**	0.740**	0.706**	0.721**	0.743**	0.606**	0.334**	0.512**	0.395**

Note: * represents $p < 0.05$, ** represents $p < 0.01$ (two-tailed test).

the correlation coefficient between task value and the dimensions of learning strategies is relatively high, and learners are highly interested in the learning content of the course, so they will actively participate in the learning of the course (Shi et al., 2023). On the other hand, the correlation coefficients between external motivation and the dimensions of learning strategies are generally low and even harmful, which indicates that external motivation sometimes inhibits the use of learners' learning strategies.

4. Research Conclusion and Reflection

4.1. Conclusion of the Study

Taking the learners who took the course "SPSS Data Analysis and Quantitative Research" as the research object, this study investigated the learning motivation and learning strategies of learners of different genders and modes of instruction using questionnaires distributed through the network and analyzed the relationship between them. The main conclusions drawn are as follows.

1) Factors affecting learners' motivation include five dimensions: internal motivation, external motivation, task value, control beliefs, and self-efficacy, among which the three dimensions of internal motivation, task value, and control beliefs have a more significant impact on learners' motivation, while external motivation has a lower impact. Female students' motivation level was slightly higher than that of male students, and there was no significant difference in the level of motivation of learners of different genders. Among the three delivery modes, learners in the remote synchronous live streaming group had the weakest learning motivation. In contrast, learners in the remote asynchronous video group had the highest level of internal motivation. However, their external motivation was significantly lower than that of learners in the live listening and remote synchronous live streaming groups. This phenomenon is because distance learners hope to learn more knowledge, enrich themselves through learning, and

satisfy their desire for knowledge and interest. This relatively long-lasting and stable internal motivation is the source of sustaining learning motivation (Liu, 2022).

2) The learning strategies often used by learners include nine dimensions: retelling, fine processing, organization, critical thinking, metacognition and self-regulation, management of learning time and environment, effort regulation, cooperative learning, and help-seeking, among which learners use four strategies, namely, retelling, fine processing, organization, and critical thinking, more frequently than the other dimensions of learning strategies. There is a slight difference in the preferences for learning strategies among learners of different genders; learners in the remote synchronous live streaming group generally scored lower on learning strategies than learners in other delivery modes.

3) The correlation coefficients of the dimensions of learning motivation and learning strategies overwhelmingly reached significance. Among them, the correlation coefficients of self-efficacy, internal motivation, and task value with the dimensions of learning strategies are generally high and positively correlated. In contrast, the correlation coefficients of external motivation with the dimensions of learning strategies are generally low or even negatively correlated.

In general, the quality of distance education is influenced by a combination of factors, including the rationality of the curriculum structure and the relevance of the teaching content to the individual development of students and the needs of the times, as well as the students' own self-driven learning ability and time management skills.

4.2. Research Implications

As one of the quantitative research courses offered by universities in China, the teaching team of this course has a long way to go. The challenges faced by the enhancement of distance learning effectiveness primarily stem from the absence of teaching interaction and collaborative learning, as well as maintaining a favorable learning atmosphere and motivation. Therefore, to improve the teaching quality of the course and the students' learning effect, in conjunction with this study, the author puts forward the following suggestions.

1) Strengthening learners' internal motivation

There are many constituent dimensions of learning motivation, but internal motivation has a crucial influence on learners' learning. Therefore, teachers should use various strategies to stimulate and maintain learners' internal motivation to learn and strengthen the sense of self in learning to enhance self-efficacy and promote deep learning (Xia, 2023). For example, teachers can firstly encourage students to take the initiative to participate in practice based on group discussion, project-based learning, inquiry-based learning, and other methods (Shang, 2017); secondly, they can provide students with actual teaching cases and research projects of quantitative research in response to their nearest developmental zones, to enable them to obtain the successful experience of achieving

their goals, and to enhance their self-efficacy and the motivation to continue to learn.

2) Improve the participation of remote learners

Under the network learning environment, learners in different geographical areas can share high-quality teaching resources. However, remote learners' lack of a sense of belonging could make their learning effect less satisfactory. For this reason, it is necessary to mobilize teachers and students to interact actively, improve communication methods and encourage teachers and students to participate in discussions, and update the teaching content in real-time to improve the efficiency of teaching interaction (Liu & Han, 2023), so that the teachers can ensure the quality of face-to-face courses while trying to improve the learning effect of remote learners. For example, learners of the remote synchronous live streaming in the course can collaborate and share under the organization of the remote teachers, and when appropriate, they can also communicate and interact with the teachers and students at the front end; learners watching the MOOC videos can communicate with each other in the online learning community, and at the same time, they should also arrange for the teachers to give timely feedback and summaries of the problems in the learning community (Bai et al., 2016).

3) Strengthen the management of learners and reinforce their external motivation

Due to the lack of necessary guidance and management, learners in the MOOC learning environment are prone to the problem of insufficient external motivation, which leads to irregular time investment and the phenomenon of "failing to keep up with the class and dropping out." (Tian et al., 2020) Constructivist learning theory emphasizes the critical role of learner initiative, i.e., intrinsic motivation. However, the author's research found that in the absence of external pressure and strict management of MOOC learning, a large number of learners, although highly motivated at the beginning of the course and able to log in to the learning platform frequently, as the course progresses, some learners gradually reduce the frequency of visiting the learning platform, and even fail to complete the course eventually, resulting in a lack of external motivation. The result is that the completion rate of MOOC-based learning is low. Based on this, necessary measures need to be taken. On the one hand, it is possible to set appropriate entry thresholds for learners in online learning (Kan, 2021), strengthen guidance and management during their learning process, and subject their learning activities to certain constraints, so that their learning motivation can be maintained at a high level, thereby ensuring the quality of learning at each stage of their learning, improving the completion rate of courses, and ultimately ensuring the quality of MOOC learning (Zhou & Yang, 2021). On the other hand, teachers can add interactive links to the course content to enhance students' learning enthusiasm, provide after-class question-and-answer services to promptly answer students' questions encountered during the learning process, and main-

tain their learning motivation.

4.3. Research Shortcomings

1) Since most of the learners participating in the course are students of teacher training colleges and universities, and there is a phenomenon that there are fewer men than women, there are limitations in analyzing the characteristics of learning motivation and the use of learning strategies of learners of different genders, which will have a particular impact on the results of the study.

2) The study was conducted mainly by distributing questionnaires through the Internet, which lacked face-to-face communication with the learners, thus failing to analyze in depth the differences in the learners' motivation and learning strategies and the reasons for such differences in different modes of instruction.

5. Summary

With the increasing popularity of data analysis and data mining technology, research methods built based on data analysis and computational science have gradually penetrated multiple disciplines. More and more researchers have recognized the value of computational science in fundamental theoretical research, social development, and talent cultivation. Cultivating computational thinking ability has been formally incorporated into the basic computer teaching plan of domestic colleges and universities and has become the core content of talent cultivation in the 21st century. Therefore, higher education schools must be committed to cultivating students' computational thinking skills and equipping them with data literacy for scientific exploration and meaning construction using complex data sets (Hui, 2023). However, in actual teaching, it is found that there are significant individual differences in students' computational thinking abilities, and students are blind in improving their own computational thinking abilities, resulting in limited ability to apply computational thinking to solve problems in non-computer professional contexts. In the context of the significant data era, generating a series of data analysis software such as SPSS and SAS has further lowered the threshold of data analysis and data. Students can achieve professional-level quantitative analysis based on the data analysis software, including effective screening of data, analysis of data, and processing of data, digging into the potential correlations behind the data, and then quantifying the phenomena, predicting the trends, and ultimately revealing the universal laws and conclusions (Li, 2023). At the same time, improving data analysis ability will further change students' thinking habits and problem-solving methods, especially in the rigor of argumentation and methods of applying data, which changes students' thinking and promotes the integration of disciplines. Based on teaching practice, this paper explores the differences in learners' motivation and strategies under different delivery modes. It uses this as a basis to promote teaching improvement, effectively cultivate students' ability to analyze and re-

search data, acquire and apply knowledge, think computationally and solve problems, and enable them to engage in scientific research and better adapt to social development requirements.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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