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Learning attitude, motivation, and ability among chemistry students in China

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Abstract

The study investigates the relationships among learning attitude, motivation, and ability of chemistry students, aiming to enhance these aspects through a proposed program. Addressing a gap in understanding the current learning state of chemistry students, this research focuses on profiling respondents based on sex, origin, and year level, and assessing their learning attitude, motivation, and ability. Utilizing a quantitative research design, 425 chemistry students from a university in China were surveyed using adapted and validated questionnaires. Results indicate a positive overall learning attitude among students, although cognitive engagement and interest in class are lacking, alongside underutilization of online resources. Learning motivation is generally high, with professional skill development being a key motivator. While learning ability is positively assessed, there is room for improvement in self-adjustment and learning methods. Significant differences were found in responses based on sex, and a strong correlation among learning attitude, motivation, and ability was established. The study proposes a program to enhance these factors and suggests practical actions, such as collaboration with industry for internships and integrating online resources into teaching. This research contributes to the knowledge base by highlighting the interconnectedness of attitude, motivation, and ability in chemistry learning and offers actionable recommendations for educational improvement.

Keywords: learning attitude, learning motivation, learning ability, chemistry students, educational improvement

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1. Introduction

Scientific knowledge plays a crucial role in the pursuit of national prosperity and rejuvenation, thus garnering increasing attention from the government. In Document No. 6 on Deepening the Reform of Undergraduate Education and Teaching and Comprehensively Improving the Quality of Talent Training issued by the Ministry of Education (2019), it emphasizes the significance of upholding moral education, deepening reforms in undergraduate education and teaching with a focus on students, teachers, management, and outcomes. Learning attitude refers to a stable mental state, which directly or indirectly affects the learner's effect or attitude towards the learning object(Chen, 2023). If a student can have a good learning attitude, then he will take the initiative to learn, love learning, and will get good grades. On the contrary, if the students' attitude to learning is negative, it will make students tired of learning, then the results of the exam will be not optimistic. Different learning attitudes affect students' academic performance and determine whether they can successfully complete their studies. Good learning attitude affects students' vocational ability level and future career development.

College students are the front group of social development. However, in the actual teaching, it is not difficult to find that many students have incorrect learning attitude, loose learning state and low enthusiasm for learning. To sum up, it is of great significance to study the current situation of students' learning attitude and make students have a positive learning attitude. Li et. al.,(2022) define learning attitude as a stable choice tendency towards learning. Ma (2022) believes that under the influence of the environment, learners' persistent and consistent mental state and action tendency towards learning objects form their own learning methods and habits, which is called learning attitude. By summarizing the previous studies, this study believes that, generally speaking, learning attitude is the student's learning habit state, and a student's mental intention to the learning situation. Learning attitude can be analyzed and studied from the aspects of students' attention to learning, students' emotions to learning, and students' willpower to learning.

Learning motivation is the psychological motivation for students to change their learning desire into learning behavior, and it is the internal power to initiate and maintain students' learning activities(Yang, 2022). It reflects students' needs and wishes, and is reflected in the process of volitional behavior. Students' learning motivation has the functions of activating, guiding and strengthening students' learning activities. The level and strength of learning motivation directly affect the state and permanence of students' learning. College students are in a specific age and life stage, their outlook on life, values, ideal and ambition level and personality psychological characteristics are different, determine the source of their motivation, content and constant persistence are also different. Understanding and mastering the characteristics of current college students' learning motivation, correctly mobilizing students' learning enthusiasm, training and stimulating students' learning motivation is not only an important theoretical problem, but also a practical problem to be solved urgently in the reform of education and teaching.

Learning motivation is usually divided into two categories, one is internal motivation and the other is external motivation. Internal motivation refers to the motivation mainly generated by students' own psychological factors. For example, they are curious about knowledge and eager to learn more. External motivation is a motivation mainly caused by the influence of external environment. For example, the desire to get the approval of parents, the reward of teachers, and the achievement of a classmate (Li,2021). Research shows that both kinds of motivation can promote students' learning. But there are still some students who lack the motivation to study. The main manifestations are absenteeism, lack of learning interest, low learning efficiency, unsatisfactory academic performance and so on(Wang et. al.,2018).

Chemistry is a subject based on experiment. The creation of experiment-oriented scientific inquiry activities

in teaching is helpful to stimulate students' interest in science, guide students to learn chemistry knowledge through observation, experiment and communication and discussion, and improve students' scientific inquiry ability. However, sometimes when teachers give lessons, they give priority to teaching, delete the parts of scientific inquiry and cooperative learning, and ignore the subject status of students. These make the rich and colorful chemical experiments lose their own charm, boring chemistry classes can not arouse students' curiosity, and even lose their interest in learning chemistry. Due to the above reasons, in the student group, students have a serious phenomenon of weariness, showing the characteristics of unclear learning purpose and bad learning habits. Students lack confidence in learning chemistry well, lack motivation for chemistry learning (Fang,2019). Therefore, with the emphasis on educational reform and innovative development, learning motivation is the first driving force for students to participate in learning activities. Through studying the differences of learning motivation among college students in different factors, it is of key significance to improve teaching, enhance teaching quality and enhance teaching effect.

Learning ability refers to the ability of learners to manage their own learning, specifically, learners can determine the learning objectives and content, adjust the learning progress, choose learning methods and skills, monitor the learning process, and self-evaluate the learning effect (Niu, 2019). Learning ability referred to in this study is a comprehensive ability, which requires learners to manage their own learning methods, learning content and learning state in the learning process, proactively discover, explore and solve problems, and be able to self-evaluate and self-reflect on their own learning (Xu,2018). Relevant investigation and research found that college students currently have some problems such as low awareness of independent learning, lack of independent learning methods and strategies, and can not diagnose and adjust the learning state in time. However, for college students, cultivating their learning ability, enabling them to realize self-development, and integrating classroom learning methods into actual production and life, can lay a solid foundation for their lifelong learning and the development of core qualities. (Wang, 2020).

Therefore, this study aims to investigate the status and differences of college students' learning attitude, motivation and ability, analyze the factors that affect these problems, and at the same time propose strategies to enhance learning attitude, motivation and ability. These can not only help students establish correct learning goals in the learning process, formulate reasonable learning plans, acquire knowledge efficiently and enhance the professional skills of students in chemistry, but also guide teachers to carry out education and teaching plans, master the characteristics of students' physical and mental development, so as to teach students in accordance with their aptitude and improve the teaching quality in the teaching process. It may provides value for high-quality training of professionals and provides reference for promoting academic development.

Objectives of the Study - This study aimed to determine the relationships among learning attitude, motivation, and ability of chemistry students to propose a program on enhancing their learning attitude, motivation, and ability in chemistry based on the results of the study. More specifically, it assess their learning attitude as to cognitive level, emotional experience, and behavioral tendency; identify their learning motivation in terms of learning interest, thirst for knowledge, and personal achievement; determine their learning ability as to learning method, self-supervision and diagnosis, and self-adjustment; determine the significant relationships among key variables; and propose a program on enhancing learning attitude, motivation, and ability in chemistry among students in China.

2. Methods

Research Design - This study intended to use the method of quantitative research to investigate the learning attitude, motivation and learning ability of chemistry students, which is the process of collecting and analyzing numerical data of respondents. The purpose is to truly understand the current learning state of chemistry students, and to conduct a systematic and comprehensive research on the above problems. In order to do a good job in the questionnaire survey, the researcher will consult the books and literature related to learning attitude, learning motivation and learning ability before making the questionnaire. Then, after analysis and collation, combined

with the content and purpose of this research, the questionnaire of this paper will be formed after modification. This paper hopes to have a comprehensive and real understanding of the current situation of chemistry students in our university through questionnaire survey. On this basis, relevant analysis and research are carried out, in order to put forward relevant suggestions conducive to improving students' learning attitude, learning motivation and learning ability, so as to promote students' better development in the future, and provide references for relevant researchers.

Participants of the Study - The study involved a wide range of students, including freshmen, sophomores and juniors. The form of the instrument is anonymous to ensure that the survey results are scientific and reasonable, so as to understand the true feedback of students on relevant questions more objectively and comprehensively. According to the Raosoft calculator, 425 college students majoring in chemistry will be selected from a university in China to conduct a questionnaire survey. In order to fully obtain the research data, so as to ensure the smooth progress of the research.

Instrument of the Study - The students' learning attitude questionnaire to be used in this study is adapted from Huiyuan Tian's (2023) master's dissertation "Development of assessment tools for High School students' Learning Attitude in Chemistry". The questionnaire contains three dimensions - cognitive level, emotional experience and behavioral habits. Originally contains 20 items, but later increased to 26 items. In addition, the learning motivation questionnaire will be adapted from Jianguo Li's (2019) study on the relationship between high school students' chemistry learning motivation, learning efficacy and academic performance. This part of the questionnaire contains three dimensions - learning interest, thirst for knowledge and personal achievement. It originally contained 20 items, later increased to 27 items. The questionnaire of learning ability will be adapted from Qi Bao's (2020)doctoral dissertation on strategies to improve high school students' autonomous learning ability in chemistry in the post-epidemic era. It includes three dimensions: learning methods, self-supervision and self-diagnosis, and self-regulation. Originally containing 20 items, later increased to 29 items. After measurement, it was found that the reliability of the questionnaire was very high, and the overall Alpha value was close to 0.9. This indicates a high degree of consistency between the different dimensions, ensuring the reliability and trustworthiness of the results.

Data Gathering Procedure - After the questionnaire is finalized, it will be sent to the respondents to collect relevant information needed for the research. Data collection was carried out through electronic questionnaires distributed by the wechat team, using electronic links. In order to eliminate ineffective questionnaires, researchers will provide accurate guidance on the distribution of questionnaires. The survey will be conducted anonymously for academic purposes and data obtained are used exclusively for statistical research and analysis.

Date Analysis - The information collected will be classified and tabulated in order to analyze and interpret the research. Through computer application, SPSS statistical tool will be used to answer the questions in this study. The average value is mainly used to analyze the central tendency of the data. The mean here refers to the arithmetic mean, which has an important place in statistics as the most important measure of trend. It is the value that best represents the entire distribution. In this study, it will be used to determine mean values and respondents' assessments of learning attitudes, learning motivation, and learning ability.

Ethical Considerations - In the research work of this paper, it will be guaranteed to respect human will and freedom, and not to conduct forced research against the will of others. Give respondents the respect and protection they deserve, and do not conduct unethical and unfair research. In addition, it will ensure that participants fully understand the purpose, procedures, risks, etc. of the study and voluntarily agree to participate in the study. During the course of the study, care will be taken to protect the privacy of the participants and ensure the security of the collected data, which can only be accessed by those who have obtained permission. In addition, the participants will remain anonymous at the time of the research report to ensure their privacy.

3. Results and discussion

Table 1 summarizes students' attitude performance in three aspects: cognitive level, emotional experience and behavioral disposition, with a comprehensive average value of 3.13. The results show that the respondents have a more positive attitude towards learning. Among them, behavioral tendency (3.21) ranks first, emotional experience (3.11) ranks second, and cognitive level (3.06) ranks third.

Table 1

Summary Table on Learning Attitude

Indicators	Weighted Mean	Verbal Interpretation	Rank
Cognitive Level	3.06	Agree	3
Emotional Experience	3.11	Agree	2
Behavior Disposition	3.21	Agree	1
Composite Mean	3.13	Agree	

Legend: 3.50 – 4.00 = Strongly Agree; 2.50 – 3.49 = Agree; 1.50 – 2.49 = Disagree; 1.00 - 1.49 = Strongly Disagree

The results showed that respondents showed the strongest positive tendencies in behavior. There was little difference in average scores for Cognitive Level and Emotional Experience, both lower than behavioral tendencies. This means that students' learning attitude can be further enhanced by improving their cognitive level and emotional experience in the future. Lin (2020) found that class participation had a great impact on students' learning attitude through a survey of 8th grade students. There is a positive correlation between the emotional experience of classroom environment and learning attitude to some extent, among which "student responsibility" and "class participation" have a greater impact on students' learning attitude. The better the students' perception of the English classroom environment, the more positive their attitude towards learning.

Table 2

Summary Table on Learning Motivation

Indicators	Weighted Mean	Verbal Interpretation	Rank
Learning Interest	3.18	Agree	1
Thirst for Knowledge	3.08	Agree	3
Personal Achievement	3.13	Agree	2
Composite Mean	3.13	Agree	

Legend: 3.50 – 4.00 = Strongly Agree; 2.50 – 3.49 = Agree; 1.50 – 2.49 = Disagree; 1.00 - 1.49 = Strongly Disagree

Table 2 summarizes the performance of students' learning motivation in three aspects: learning interest, thirst for knowledge and personal achievement, with a comprehensive average value of 3.13. The results show that the interviewees have higher learning motivation. Among them, interest in learning (3.18) ranked first, personal achievement (3.13) ranked second, and thirst for knowledge (3.08) ranked third.

The results show that learning interest is the most prominent motivation factor among the interviewees, which may be related to the intrinsic satisfaction brought by learning itself. The average of personal achievement was similar to the desire for knowledge, but the average of personal achievement was slightly higher, which may be related to the pursuit of personal goals and fulfillment. On the whole, the respondents' learning motivation showed a relatively balanced but dominated by learning interest among the three subvariables. This means that students' learning motivation can be further increased by enhancing their learning interest in the future.

Through research, Qi(2018) pointed out that teachers can arrange teaching according to learners' learning interests in future teaching, and construct teaching content and teaching objectives to cultivate students' enthusiasm for learning. Let students learn in a pleasant learning environment, so that students can be more motivated to learn. The new curriculum standard closely combines learning interest with learning motivation. Li (2023) pointed out that teachers should change the traditional teaching mode and teaching concept to stimulate students' learning interest to the maximum extent and enhance students' learning motivation.

Table 3

Summary Table on Learning Ability

Indicators	Weighted Mean	Verbal Interpretation	Rank
Learning Method	3.12	Agree	2
Self-supervision and Self-diagnosis	3.10	Agree	3
Self-adjustment	3.15	Agree	1
Composite Mean	3.12	Agree	

Legend: 3.50 – 4.00 = Strongly Agree; 2.50 – 3.49 = Agree; 1.50 – 2.49 = Disagree; 1.00 - 1.49 = Strongly Disagree

Table 3 summarizes students' performance in learning methods, self-supervision, diagnosis and self-adjustment, with a comprehensive average value of 3.12. This showed that participants generally held positive attitudes towards these measures of learning ability. Among them, self-adjustment (3.15) ranked first, learning methods (3.12) ranked second, and self-supervision and self-diagnosis (3.10) ranked third. The results show that these three indicators are generally recognized by the respondents, indicating their importance in learning ability.

Self-adjustment leads in both mean and ranking, which may indicate that among participants, the ability to self-adjust is considered the most important or has the most effect in practical applications. Therefore, in the process of improving learning ability, we should pay more attention to the improvement of self-adjustment ability. Because it can have a direct impact on learning. At the same time, learning method is also an important factor to improve learning ability.

Zhu (2024) said in his article that cultivating students' learning ability will be of great benefit to students' future work and study. When teachers carry out teaching activities, they should pay attention to the establishment of learning thinking, and guide students to reflect on what they have learned in time. Teachers should lay emphasis on teaching students how to learn. Although this process is long, but for the long-term development of students, teachers must persist for a long time. Teachers should take students' all-round development as the ultimate teaching goal, gradually cultivate students' learning habits, and improve students' autonomous learning ability.

Table 4

Relationship Between Learning Attitude and Learning Motivation

Cognitive Level	r-value	p-value	Interpretation
Learning Interest	.906**	0.000	Highly Significant
Thirst for Knowledge	.886**	0.000	Highly Significant
Personal Achievement	.838**	0.000	Highly Significant
Emotional Experience			
Learning Interest	.913**	0.000	Highly Significant
Thirst for Knowledge	.862**	0.000	Highly Significant
Personal Achievement	.832**	0.000	Highly Significant
Behavior Disposition			
Learning Interest	.892**	0.000	Highly Significant
Thirst for Knowledge	.850**	0.000	Highly Significant
Personal Achievement	.820**	0.000	Highly Significant

Legend: Significant at p-value < 0.01

Table 4 shows the correlation between learning attitude and learning motivation. The calculated R-value indicates a very strong direct correlation, and the resulting p-value is less than the alpha level.

As can be seen from the table, the three dimensions of learning attitude (cognitive level, emotional experience, behavioral disposition) are highly positively correlated with learning motivation. High positive correlation means that there is a strong positive correlation between each dimension of learning attitude and learning motivation. In other words, the improvement of students' cognitive level of learning, emotional experience and behavioral disposition may significantly enhance their learning motivation. These results suggest that positive learning attitudes can be an effective way to enhance learning motivation. Educators can improve

learning motivation by strengthening the cognitive level of students and elevating emotional experiences. In addition, since behavioral disposition is also significantly related to learning motivation, it is possible to improve students' learning motivation by cultivating their positive behavioral habits.

Chen et. al.,(2022) confirmed through empirical research that the learning motivation of students in higher vocational colleges is influenced by a variety of factors such as attitude, subjective norms and behavioral control cognition, and the effects are different. The change of learning motivation is the internal factor of continuous motor skill learning. The change of individual motivation will make them in different emotional experience, and when the individual's emotion changes, it will react on the motivation, prompting the motivation to reverse. The motivational function of emotion indicates that emotion can be used as a motivation to continuously stimulate individual behavior. When the individual motivation needs can not be satisfied in the objective things, it will produce negative emotions (frustration) that hinder the efficiency of learning and work, which acts as a condition for the reversal of motivation. In the teaching practice of skill learning, people often get frustrated because of cognitive bias, which is used to change their motivation(Qi et. al.,2023).

Table 5

Relationship Between Learning Attitude and Learning Ability

Cognitive Level	r-value	p-value	Interpretation
Learning Method	.866**	0.000	Highly Significant
Self-supervision and Self-diagnosis	.920**	0.000	Highly Significant
Self-adjustment	.875**	0.000	Highly Significant
Emotional Experience			
Learning Method	.865**	0.000	Highly Significant
Self-supervision and Self-diagnosis	.908**	0.000	Highly Significant
Self-adjustment	.870**	0.000	Highly Significant
Behavior Disposition			
Learning Method	.856**	0.000	Highly Significant
Self-supervision and Self-diagnosis	.884**	0.000	Highly Significant
Self-adjustment	.865**	0.000	Highly Significant

Legend: Significant at p-value < 0.01

Table 5 shows the correlation between learning attitude and learning ability. It can be see that the correlation between learning attitudes and learning ability is assessed through different dimensions. These dimensions include cognitive levels, emotional experiences, and behavioral disposition. Each dimension is subdivided into three sub-dimensions: learning methods, self-supervision and self-diagnosis, and self-adjustment. The calculated R-value indicates a very strong direct correlation, and the resulting p-value is less than the alpha level. These data show that all aspects of learning attitude, including cognitive level, emotional experience and behavioral disposition, have a very strong positive correlation with learning ability. This means that a positive learning attitude may significantly improve an individual's learning ability.

Zhang(2023) through exploration and analysis found that math learning attitude affects math learning ability through the mediating role of math self-efficacy. Zhang (2024) conducted a survey on 132 students of an English major by means of a combination of questionnaire survey and interview, and investigated students' learning attitude and critical thinking ability and the relationship between them. The results show that both learning attitude and critical thinking ability of English majors are higher, and there is a significant positive correlation between them.

Table 6 shows the correlation between learning motivation and learning ability through a series of statistical data. These data include the correlation coefficient (r-value) and significance level (p-value) between different dimensions of learning motivation (learning interest, thirst for knowledge, and personal achievement) and three sub-dimensions of learning ability (learning methods, self-supervision and self-diagnosis, and self-adjustment). The calculated R-value indicates a very strong direct correlation, and the resulting p-value is less than the alpha level. These data show that students with higher learning motivation are more likely to adopt effective learning methods, self-supervise and self-diagnose, and self-adjust, which in turn can further enhance learning motivation,

forming a positive cycle. To sum up, there is a significant positive correlation between learning motivation and learning ability, which means that improving students' learning motivation may help improve their learning ability and learning effect.

Table 6

Relationship Between Learning Motivation and Learning Ability

Learning Interest	r-value	p-value	Interpretation
Learning Method	.841**	0.000	Highly Significant
Self-supervision and Self-diagnosis	.900**	0.000	Highly Significant
Self-adjustment	.868**	0.000	Highly Significant
Thirst for Knowledge			
Learning Method	.814**	0.000	Highly Significant
Self-supervision and Self-diagnosis	.867**	0.000	Highly Significant
Self-adjustment	.833**	0.000	Highly Significant
Personal Achievement			
Learning Method	.768**	0.000	Highly Significant
Self-supervision and Self-diagnosis	.847**	0.000	Highly Significant
Self-adjustment	.792**	0.000	Highly Significant

Legend: Significant at p-value < 0.01

Li(2023) pointed out in the article that lifelong learning ability is also affected by learning motivation, learning characteristics and other factors. To this end, she studied the corresponding observed variables and the relationship between variables, and the results proved that learning motivation has a direct effect on learning ability. Jia(2024) pointed out in his article that forming study groups and participating in online discussions on social media enables students to share resources and learning strategies, thereby improving learning motivation and effectiveness. Self-monitoring and evaluation also play a crucial role in autonomous learning. New media tools such as online testing and progress tracking applications can help students monitor their learning progress and evaluate their learning results, and have a positive effect on learning motivation.

Table 7

A Proposed Program on Enhancing Learning Attitude,Motivation and Ability of Chemistry Students

Key Result Areas/Objectives	Activities	Success Indicators	Persons Involved
I.Learning Attitude 1.Name of Activity: To enhance students' understanding of the role of chemistry in the social sciences.	Develop courses that intersect chemistry with other social science disciplines show how chemistry can be integrated with the social sciences.	More than 95% of students will be able to recognize the scientific contributions of chemistry.	School administratorsschool heads, chemistry teachers，chemistry students
2.Name of Activity: Organize chemical-related career development seminars, inviting professionals in the field of chemistry to share their experiences and insights.To enhance students' understanding of the importance of learning chemistry.	Regular career development talks are held to introduce the importance and application of chemistry in different industries. Show how chemistry knowledge can provide an advantage in different career fields, including non-traditional chemistry careers.	More than 95% of students will increase their understanding of the importance of learning chemistry.	School administratorsschool heads, chemistry teachers，chemistry students
II.Learning Motivation 1.Name of Activity: Help students regularly evaluate their learning strategies and make adjustments based on feedback.	(1)Teach students effective learning strategies, such as memory skills, concept maps, problem solving skills, etc. (2)Students are encouraged to develop a personalized study plan based on their learning style and needs (3)Provide personalized learning counseling to help students identify learning methods that are right for them.	More than 95% of students have been inspired to use different learning strategies through student sharing and discussion	School administratorsschool heads, chemistry teachers，chemistry students

Name of Activity: Through lectures or seminars, students are made aware of the importance of effective study time. Introduce and practice efficient learning methods, such as active learning, spread learning and alternate learning, to help students use their learning time more effectively and improve the quality and effect of chemistry learning.	(1)Encourage students to find more efficient learning methods to reduce ineffective learning time (2)Teach students how to properly plan their study time, including setting study goals and priorities. (3)Help students overcome the habit of procrastination and motivate them by setting short-term goals and reward mechanisms.	More than 95% of students will improve their learning efficiency through learning	School administrators, school heads, chemistry teachers，chemistry students
III. Learning Ability 1.Name of Activity: Students are encouraged to self-reflect after the test, identify their strengths and weaknesses, and improve their self-assessment ability	(1)Teachers should provide specific and timely feedback to help students understand the test results and identify areas for improvement. (2)Teach students how to use test results to identify gaps in knowledge and misunderstandings.	More than 90% of the students have self-assessment ability, which effectively increases the students' self-assessment ability.	School administratorsschool heads, chemistry teachers，chemistry students
2.Name of Activity: Students are encouraged to regularly evaluate their own study plan, identify weaknesses in their learning, and make necessary adjustments based on feedback. To help students make progress in rigorously implementing the plan and scientifically planning their own learning.	(1)Teach students how to make a realistic study plan, including time scheduling and task breakdown. (2)Regular learning strategy workshops are organized for students to share and discuss different learning methods and adjustment techniques. (3)Establish learning support systems, such as learning advisor services, to provide individualized guidance and support to students.	Ensure that more than 95% of students receive guidance on adjusting their study plan	School administratorsschool heads, chemistry teachers，chemistry students

4. Conclusions and recommendations

Most respondents were males, with slightly more from urban than rural places. Chemistry students have a agreed positive learning attitude, but the students have a weak cognition of their major and do not feel interested in class. There is also a lack of full use of online resources. Students generally have positive agree motivation. The promotion of professional skills plays a very important role in the minds of students. At the same time, increasing students' interest is an important factor to enhance learning motivation. Respondents agreed and practice of learning ability, but there is still room for improvement. Students should pay attention to the improvement of self-adjustment ability. Because it can have a direct impact on learning. At the same time, learning method is also an important factor to improve learning ability. Sex has a significant impact on learning attitude, and it also significantly affects learning motivation and learning ability. There is a highly significant correlation among the three variables, indicating that the better the learning attitude, the more positive the learning motivation, the stronger the learning ability. A program has been proposed to improve students' learning attitude, learning motivation and learning ability in Chemistry.

Schools may collaborate with companies in the field of chemistry to provide internship opportunities for students, so that they can experience the practical application of chemical knowledge in their careers. Teachers may use online resources to improve their digital information learning ability, to guide students to make better use of online resources. At the same time, teachers may introduce online learning platforms in the teaching process to provide review materials and self-testing tools to help students self-assess and improve. Students may also be encouraged to participate in chemical-related research projects to enhance their professional skills and market competitiveness. School supervisors and teachers may evaluate the proposed program for implementation. Future researcher may investigate further on Association between the students' learning abilities and their career development.

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