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Influence of Thinking Patterns on Learning Stress among Science and Engineering Students

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Abstract:

With the popularity of higher education, especially in the field of science and technology, students are under increasing academic pressure. The content of S&E programmes is usually highly academically challenging, and students not only have to master complex theoretical knowledge but also need to solve practical problems, which leads to the enormous pressure they face in their academic careers. According to the survey, polytechnic students often feel anxious and nervous, and even doubt their abilities when facing heavy academic tasks, experimental work, and project progress. This kind of stress not only affects academic performance, but may also have a long-term negative impact on students' physical and mental health.

Keywords: science and engineering students, thinking patterns, learning stress, cognitive style, psychology

1. introductory

With the increasing demand for high-quality talents in modern society, college students in science and engineering face great academic pressure in the learning process. As an important factor influencing individual behaviour, emotion and cognition, thinking mode plays a key role in the perception and coping of learning pressure. In this paper, we analyse the characteristics of thinking patterns of polytechnic college students and explore how they affect the generation and regulation of academic stress. The study shows that the thinking style of science and engineering students is generally more logical and systematic, but if they focus too much on result-orientation or lack the ability to be flexible and adaptive, it may lead to greater psychological pressure. On the contrary, cultivating a positive way of thinking and the ability to regulate emotions can help reduce academic burden and improve learning efficiency.

This paper looks at the mindset of science and engineering students and examines its impact on academic stress and will answer the following questions:

1.1 How are thought patterns categorised?

1.2 How do different modes of thinking differ in their impact on academic stress among science and engineering students?

1.3 How to relieve study stress by optimis-

ing your mindset

2. Mindset

Mindsets of intelligence are individuals' implicit beliefs about how intelligence is formed and whether it is malleable (Dweck, 2006). Dweck, an American psychologist, categorises individuals' mindsets into growth mindset, which believes that people's intelligence can be improved through effort, also known as the growth mindset, and fixed mindset, which tends to view intelligence as a fixed psychological trait, also known as the solid mindset (Dweck, 2000). 2000). In the early stages of their research, Dweck et al. referred to this belief in the plasticity of intelligence as implicit theories of intelligence; later, it was more commonly referred to as growth mindset theories or mindset theories for ease of intervention research and theory dissemination (Dweck, 2006).[1]

3. Characteristics of thinking patterns of science and engineering students

2.1 Logical and systematic

Science and engineering students are inclined to use a scientific way of thinking in their studies, focusing on analysing the nature of the problem and possessing strong logical reasoning skills. They tend to solve problems by means of quantitative analyses and formulae derivation, and habitually look for verifiable answers.

2.2Strong goal-orientation

Science and engineering programmes often have clear learning objectives and evaluation criteria, and students generally show a strong goal-orientation in the learning process. They tend to focus on achieving predetermined academic goals, neglecting emotional regulation and self-care in the process.

2.3 Result-oriented perfectionist tendency

Science and engineering students tend to pursue a high degree of perfection when facing academic tasks, especially in experimental or project tasks, and often expect to achieve error-free results. This perfectionist tendency may increase their psychological burden in the learning process.

2.4 Less emotional regulation

Compared to arts students, science and engineering students have less training in emotional regulation and self-reflection, which leads to the possibility that they may feel more anxious and frustrated in the face of failure or stress.

4. Learning Stress

4.1 Difficulty aspects of the programme

4.1.1 Depth and Breadth of Knowledge

Science and engineering programmes require a great deal of theoretical knowledge, and students must not only understand these abstract concepts of physics, mathematics, electricity and electronics, but must also be able to use mathematical tools to perform derivations and calculations in a proficient manner.

4.1.2 High course articulation requirements

Science and engineering courses often have a close logical connection between them, if a subject is not understood and learnt in place, it will affect another course related to it.

4.2 Practical aspects

4.2.1 High requirements for experimental operation

The experimental courses in science and engineering are an important part of learning, and students need to be skilled in a variety of mastery of experimental operation skills, and chemical experiments also involve the use of some hazardous chemicals, which requires students to strictly abide by the experimental safety norms in the operation process.

4.2.2 High pressure of engineering practice projects

For some engineering students, they have to participate in software development projects, from requirements analysis, system design, coding implementation to testing and maintenance, the whole process requires students to have a solid programming foundation and teamwork ability. Civil engineering students have to participate in building structural design and construction practice projects. In the structural design stage, students have to design safe, economical and reasonable building structures according to the requirements of building design. In the construction practice, students have to go to the construction site to understand the construction process and procedure, which not only needs the support of theoretical knowledge, but also requires students to be able to adapt to the complex construction site environment, communicate effectively with the construction personnel, and ensure that the construction process is in line with the design requirements.

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4.3 Aspects of pressure for further education and employment

4.3.1 Intense competition for further studies

For many students of science and engineering, the examination is an important way to continue their studies. The examination subjects for science and engineering majors usually include mathematics and professional subjects. The difficulty of the maths part has already been mentioned, and the revision of professional courses is also a difficult task. Moreover, the competition for the examination is very fierce. Every year, a large number of students apply for popular colleges and majors, such as Computer Science and Technology at Tsinghua University and Mechanical Engineering at Shanghai Jiaotong University, with relatively low acceptance rate, which brings great psychological pressure to students.

4.3.2 High employment pressure

Although the job market of science and engineering majors is relatively stable, they are also facing some challenges. On the one hand, some traditional science and engineering industries, such as the manufacturing industry, have been affected by the economic situation and industrial upgrading, and the structure of the demand for talents has changed. For example, in some traditional machinery manufacturing enterprises, due to the development of automation technology, the demand for ordinary machining workers has decreased, while the demand for high-end talents mastering intelligent manufacturing technology has increased. On the other hand, emerging fields of science and technology, such as artificial intelligence and big data, have a broad development prospect, but the competition is also very fierce. These fields require students to have not only solid professional knowledge, but also the ability to innovate and practical experience. Moreover, in the process of job hunting, science and technology students often need to face numerous competitors, including excellent graduates from domestic and foreign universities, which makes them face greater pressure in employment, and they need to continuously improve their comprehensive quality in order to obtain ideal job opportunities.[6]

5. Methodology

5.1 Objects

The survey was conducted in Jiangsu Province, Zhejiang Province, Liaoning Province and other areas. This study uses questionnaire star to distribute questionnaires, a total of 450 copies, after the recovery of the questionnaire data will be based on the response to the population and the scope of the questionnaire data will be excluded, the final recovery of valid questionnaires 411 copies. The average education of the survey respondents is bachelor's degree, and master's degree accounts for the second. The average age is 21.22 years old.

5.2 Tools

5.2.1 Mode of Intellectual Thinking Scale (MIS)

The original scale was developed by Dweck (2000) and consisted of 6 entries, including 3 entries measuring fixed-type thinking (FM)
"My level of intelligence is fixed and difficult to change"; "My intelligence is my basic trait and it is difficult for me to change it"; "I can learn new things, but it is difficult to change my true basic intelligence ".3 Entries measuring Growth Mindset (GM): "With effort, I can significantly change my level of intelligence"; "I am able to change my level of cleverness";" I can change a lot regardless of my current level of intelligence". The scale is scored on a 6-point scale with options distributed from 1 (strongly disagree) to 6 (strongly agree).

5.2.2 Learning Stress Incident Questionnaire

Based on the 85 life events that college students may face as listed in the Psychological Stress Scale for Chinese College Students compiled by Bao-Yong Liang and Zhi-Hong Hao, 16 life events, all of which are directly related to studying, were selected to form the Study Stress Events Questionnaire used in this study[5] .

6. Conclusion

6.1 Prevalence of stressful learning events

From the findings of questions 4-19, it is clear that incidents of academic stress faced by science and engineering students are more prevalent:
- Stressful study schedules: 60.8 per cent of students identified this as a source of stress.
- Failure in examinations: 56.0 per cent of students identified this as a source of stress.
- Deepening of learning content: 42.8 per cent of students identified this as a source of stress.
- Changes in the learning environment: 41.8 per cent of students identified this as a source of stress.
- Preparation for examinations: 37.7 per cent of students identified this as a source of stress.
These data suggest that science and engineering students face multiple sources of academic stress, and that these sources of stress are closely related to the difficulty of the learning tasks, time management, and future planning.

6.2 Distribution of intellectual thought patterns

From questions 20-25 on the Intellectual Thinking Patterns Scale, there were significant differences in the students' perceptions of intelligence:
- Intelligence level fixed and difficult to change (Question 20): 74.2% of students disagreed or somewhat disagreed.
- Intelligence is a fundamental characteristic that is difficult to change (Question 21): 72.7% of students disagreed or somewhat disagreed.
- It is possible to learn new things but it is difficult to change the basic intelligence (question 22): 73.5 per cent of the students disagreed or somewhat disagreed.
- The level of intelligence can be significantly changed by making an effort (question 23): 74.7 per cent of students disagreed or somewhat disagreed.
- Being able to change one's level of intelligence (Question 24): 74.2% of students disagreed or somewhat disagreed.
- Much can be changed regardless of the current level of intelligence (Q25): 72.3% of students disagreed or somewhat disagreed.

6.3 Influence of Thinking Patterns on Stress in Learning

The following conclusions can be drawn by comparing data on learning stressful events and intellectual thinking patterns:

6.3.1 Fixed Views of Intelligence and Stress in Learning

- Intelligence levels are fixed and hard to change (Question 20) and intelligence is a fundamental characteristic and hard to change (Question 21):
- A higher percentage of students agreed or strongly agreed with these two questions (25.8 per cent and 27.3 per cent respectively). These students may be more inclined to believe that their intelligence is unchangeable, and thus may feel helpless and anxious when facing academic pressure as they believe that they are unable to improve their academic performance through hard work.
- CONCLUSION: Students with a fixed view of intelligence may be more likely to feel academic stress because they believe they cannot change their situation through effort.

6.3.2 Growth-oriented view of intelligence and learning stress[2]

- It is possible to significantly change the level of intelligence through hard work (Q23) and It is possible to change a lot regardless of the current level of intelligence (Q25):
- The proportion of students who agreed or strongly agreed was also higher in these two questions (25.3 per cent and 27.7 per cent respectively). These students were more inclined to believe that intelligence could be changed through hard work, and thus might be more motivated to find solutions rather than feel helpless when facing academic pressure.
- CONCLUSION: Students with a growth-oriented view of intelligence may be better able to cope with academic stress because they believe that academic performance can be improved through hard work.

6.3.3 Associations between learning stress and perceptions of intelligence

- Learning time constraints (Q6) and deepening of learning (Q13):
- These two items are among the main sources of learning stress. For students who hold a fixed view of intelligence, the intense learning time and deepening content may further exacerbate their anxiety, as they believe that they will not be able to adapt to these changes through their endeavours.
- For students who hold a growth-oriented view of intelligence, they may be more motivated to adapt their approach to learning to meet these challenges.
- CONCLUSION: The perception of academic stress is closely related to students' intellectual outlook. Students with a fixed intellectual outlook may be more likely to perceive stress, whereas students with a growth intellectual outlook may be more able to cope with stress.

1、Not liking the specially studied

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**218**	**53.0**	**53.0**	**53.0**
	be	**193**	**47.0**	**47.0**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

ISSN 2959-6149

2、Change in learning style

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**178**	**43.3**	**43.3**	**43.3**
	be	**233**	**56.7**	**56.7**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

3、Study time constraints

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**250**	**60.8**	**60.8**	**60.8**
	be	**161**	**39.2**	**39.2**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

4、Examination failure

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**181**	**44.0**	**44.0**	**44.0**
	be	**230**	**56.0**	**56.0**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

5、Repeat or retake(course)

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**263**	**64.0**	**64.0**	**64.0**
	be	**148**	**36.0**	**36.0**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

6、Transfers

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**199**	**48.4**	**48.4**	**48.4**
	be	**212**	**51.6**	**51.6**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

7、Preparation for final exams

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**215**	**52.3**	**52.3**	**52.3**
	be	**196**	**47.7**	**47.7**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

8、Working while studying

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**208**	**50.6**	**50.6**	**50.6**
	be	**203**	**49.4**	**49.4**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

9、Classes must be held on time every day

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**154**	**37.5**	**37.5**	**37.5**
	be	**257**	**62.5**	**62.5**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

10、Deepening learning

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**235**	**57.2**	**57.2**	**57.2**
	be	**176**	**42.8**	**42.8**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

11、Changes in the learning environment

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**239**	**58.2**	**58.2**	**58.2**
	be	**172**	**41.8**	**41.8**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

12、Preparation for graduate school

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**256**	**62.3**	**62.3**	**62.3**
	be	**155**	**37.7**	**37.7**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

13、Preparation for foreign language examinations abroad

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**237**	**57.7**	**57.7**	**57.7**
	be	**174**	**42.3**	**42.3**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

ISSN 2959-6149

14、Monotonous or stale learning content

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**225**	**54.7**	**54.7**	**54.7**
	be	**186**	**45.3**	**45.3**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

15、Learning difficulties

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**199**	**48.4**	**48.4**	**48.4**
	be	**212**	**51.6**	**51.6**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

16、Caught cheating on exams

		frequency	percentage	Effective percentage	Cumulative percentage
validity	**clogged**	**248**	**60.3**	**60.3**	**60.3**
	be	**163**	**39.7**	**39.7**	**100.0**
	(grand) total	**411**	**100.0**	**100.0**	

17、My level of intelligence is fixed and difficult to change

		frequency	percentage	Effective percentage	Cumulative percentage
validity	disagree	**38**	**9.2**	**9.2**	**9.2**
	Strongly disagree	**25**	**6.1**	**6.1**	**15.3**
	Couldn’t agree more	**91**	**22.1**	**22.1**	**37.5**
	Agree with	**96**	**23.4**	**23.4**	**60.8**
	I don’t agree with that	**55**	**13.4**	**13.4**	**74.2**
	Kind of agree	**106**	**25.8**	**25.8**	**100.0**
	(grand)total	**411**	**100.0**	**100.0**	

18、My intelligence is a fundamental characteristic of me,and it is difficult for me to change it

		frequency	percentage	Effective percentage	Cumulative percentage
validity	disagree	30	7.3	7.3	7.3
	Strongly disagree	29	7.1	7.1	14.4
	Couldn't agree more	90	21.9	21.9	36.3
	Agree with	94	22.9	22.9	59.1
	I don't agree with that	56	13.6	13.6	72.7
	Kind of agree	112	27.3	27.3	100.0
	(grand)total	411	100.0	100.0	

19、I can learn new things,but it is hard to change my true basic intelligence

		frequency	percentage	Effective percentage	Cumulative percentage
validity	disagree	37	9.0	9.0	9.0
	Strongly disagree	21	5.1	5.1	14.1
	Couldn't agree more	97	23.6	23.6	37.7
	Agree with	101	24.6	24.6	62.3
	I don't agree with that	46	11.2	11.2	73.5
	Kind of agree	109	26.5	26.5	100.0
	(grand)total	411	100.0	100.0	

20、Through hard work,I can significantly change my level of intelligence

		frequency	percentage	Effective percentage	Cumulative percentage
validity	disagree	21	5.1	5.1	5.1
	Strongly disagree	33	8.0	8.0	13.1
	Couldn't agree more	97	23.6	23.6	36.7
	Agree with	91	22.1	22.1	58.9
	I don't agree with that	65	15.8	15.8	74.7
	Kind of agree	104	25.3	25.3	100.0
	(grand)total	411	100.0	100.0	

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21、I was able to change my level of intelligence

		frequency	percentage	Effective percentage	Cumulative percentage
validity	disagree	19	4.6	4.6	4.6
	Strongly disagree	41	10.0	10.0	14.6
	Couldn't agree more	95	23.1	23.1	37.7
	Agree with	94	22.9	22.9	60.6
	I don't agree with that	56	13.6	13.6	74.2
	Kind of agree	106	25.8	25.8	100.0
	(grand)total	411	100.0	100.0	

22、Regardless of my current level of intelligence,I can change many

		frequency	percentage	Effective percentage	Cumulative percentage
validity	disagree	20	4.9	4.9	4.9
	Strongly disagree	36	8.8	8.8	13.6
	Couldn't agree more	107	26.0	26.0	39.7
	Agree with	78	19.0	19.0	58.6
	I don't agree with that	56	13.6	13.6	72.3
	Kind of agree	114	27.7	27.7	100.0
	(grand)total	411	100.0	100.0	

Synthesis of conclusions

- Students with a fixed view of intelligence: are more inclined to believe that intelligence is unchangeable, and therefore may feel helpless and anxious in the face of academic pressure. They may be more vulnerable to academic stress because of a lack of confidence in their own abilities.

- Students with a growth-oriented view of intelligence: are more inclined to believe that intelligence can be changed through effort, and therefore may be more motivated to find solutions when faced with academic stress. They may be more able to cope with academic stress because of the belief that they can improve their academic performance through effort .

7.Problems in the introduction

7.1.1 How are thought patterns categorised?

Thinking patterns are mainly categorised into growth mindset and fixed mindset, a classification based on the research of American psychologist Dweck (Dweck, 2000; Dweck, 2006)

7.1.2 What are the differences in the impact of different mindsets on academic stress among science and engineering students?

Fixed-thinking students: greater stress perception. Fixed-thinking students are more inclined to believe that intelligence is unchangeable, and thus may feel helpless and anxious when faced with academic stress. For example, when faced with a tight study schedule or deepening of study content, they may believe that they are unable to adapt to these changes through their efforts, and thus feel more stress. (As mentioned in the article, a higher proportion of students agreed with the statements "Intelligence level is fixed and unchangeable" and "Intelligence is a

basic characteristic and unchangeable". The percentage of students who agree with "intelligence level is fixed and difficult to change" and "intelligence is a basic characteristic that is difficult to change" is higher, and these students are more likely to be troubled by academic stress); weaker coping ability: due to the lack of confidence in their own ability. Fixed-minded students may be more likely to give up when faced with a challenge than to actively seek a solution.

Growth mindset students: weaker stress perception. Growth mindset students are more likely to believe that intelligence can be changed through effort, and therefore may be more motivated to find solutions rather than feel helpless when faced with academic stress. For example, they may cope with study pressure by adjusting their study methods and increasing their study time. (As mentioned in the text, a higher proportion of students agreed that "Intelligence level can be significantly changed through effort" and "Much can be changed regardless of the current level of intelligence. ", and that these students are more able to cope with academic stress). Greater ability to cope: Growth mindset students believe they can improve their academic performance through hard work and are therefore more likely to adopt positive coping strategies when faced with challenges, thus reducing academic stress.

7.1.3 How can learning stress be relieved by optimising thinking patterns?

Developing a growth mindset: educational guidance. Teachers and parents can help students develop a growth mindset through educational guidance. For example, emphasising the importance of effort rather than focusing solely on grades or talent; positive feedback: giving positive feedback when students make progress, emphasising the results of effort rather than simply praising talent or ability; setting an example: motivating students to believe that they, too, can make a difference through effort by telling stories of successful people who have achieved success through their efforts; and enhancing emotional regulation skills: emotional management training . Science and engineering students tend to have less training in emotion regulation, and can be helped to learn to cope with failure and stress through specialised emotion management courses or training; Self-care: encouraging students to pay attention to the emotional experience of the learning process and engage in self-care, for example, by relieving stress through exercise, meditation, etc.; Optimisation of learning methods: Goal decomposition. Break down learning goals into multiple small goals and achieve them step by step to avoid the stress of aiming too high; Time management: help students learn to organise their study time appropriately to avoid anxiety due to time constraints; Creating a supportive environment: school support. Schools can help students cope with learning pressure by providing support services such as psychological counselling and study tutorials; Peer support: encourage students to set up study groups to support and encourage each other to face learning challenges together.

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