Several Thoughts on Constructing an Innovation and Entrepreneurship Talent Training Model in the AI Era

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Abstract. This article constructs a new model for cultivating innovative and entrepreneurial talents--positive emotion-motivation intensity framework, which is based on broaden-and build theory, the central executive network, default mode network and salience network of brain nerves, and the mechanism of motivation generation, and elaborated on the detailed mechanism of this framework for stimulating imagination and driving creativity. Subsequently, we discussed in detail that under this framework, the role of teachers should shift from a traditional emphasis on knowledge training and process control as educators to a designer and servant of student emotional support and motivation reinforcement. Finally, from the perspectives of compressing credits, reforming subject basic courses, and encouraging errors, some repairs have been made to the innovation and entrepreneurship talent cultivation model of software engineering majors, in order to create a space for active exploration, cultivate student initiative, and accumulate psychological resources for students.

Keywords: AI; Innovation and entrepreneurship; Positive emotions; Motivational intensity; Teacher role.

1 Introduction

The general trend of the world is mighty and unstoppable. As Lenin said, "Sometimes nothing happens for decades, and sometimes decades of events happen in a few weeks". ChatGPT was launched on February 1, 2023, and its user base surpassed 100 million in two months, making it the fastest-growing app in human history in terms of user growth. GPT-4 was released on March 17, 2023. The SORA was released on February 15, 2024, and is expected to go online after October. "At the core of GPT lies the Transformer model, while SORA is powered by a combination of Diffusion model and Transformer model. ProGen algorithm based on Transformer model developed by AI startup Salesforce Research was trained on the amino acid sequences of 2.81 billion proteins from 19,000 protein families in the Protein Data Bank, generating 1 million entirely new proteins. From this pool, 100 proteins with the most promising antibacterial potential were selected for further testing. Remarkably, 66 of these artificial

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proteins exhibited antibacterial activity, with two matching the bactericidal efficacy of the natural protein lysozyme [1]. As early as 2020, researchers at MIT utilized AI to identify a novel antibiotic named Halicin from a pool of 61,000 molecules. Interestingly, the chemical properties of Halicin eluded comprehension by human scientists [2]. In 2022, DeepMind researchers bypassed traditional methods of determining plasma shapes by either experimentation or numerical simulation. Instead, they trained an AI using a simulator to directly generate the desired plasma shape by controlling the coils in a controlled nuclear fusion device [3]. KoBold Metals utilized a multidisciplinary data set encompassing geology, physics, and geography from 60 mining projects worldwide to train an AI mineral exploration model. This model led to the discovery of the Mwinduga copper mine in Zambia, the largest copper deposit found in the country in a century [4]. Just as 1666 was Newton's annus mirabilis, or 'miracle year,' and 1905 was Einstein's, 2023 could be considered AI's annus mirabilis. Moving forward, most technological advancements will be intertwined with neural networks, either leveraging related algorithms or employing corresponding tools.

AI represents not only a technological revolution but also a paradigm shift. As AI rapidly integrates and advances across various domains, software engineering is undergoing a profound transformation. AI serves as a powerful tool for software development, while also reshaping the way software is designed, implemented, and maintained. However, this aspect is not the focus of this discussion. Computer scientist and Turing Award laureate Frederick Brooks famously asserted, 'The fundamental problem of software engineering is that it is essentially an information-transfer problem, and information transfer is a people problem' [5]. In the era of AI, we need to rethink education and the methods and models for cultivating innovative and entrepreneurial talent. Traditionally, schools and teachers have been the active agents in education, while students have been passive recipients. Drawing parallels with the history of AI development, traditional education, which defines the scope of learning, accurately labels learning materials, and evaluates learning outcomes, is akin to supervised learning, the most fundamental form of training AI models. In contrast, GPT employs unsupervised learning, operating without a predefined scope or labeled data, instead discovering patterns on its own. The evident gap between traditional education and GPT, and so, a call for paradigm shift in talent cultivation. Li Deyi, academician of the Chinese Academy of Engineering, believes that education will transform from 'teaching' and 'learning' to 'educate', evolving from imparting and utilizing knowledge to creating knowledge. Education will place a greater emphasis on nurturing students' imagination and creativity" [6]. Early innovation and entrepreneurship education (IE) research exhibited three main tendency areas. The first is to define IE as educational activities aimed at cultivating talents with innovative and entrepreneurial consciousness, spirit, thinking, ability, personality and other qualities or personality characteristics, thereby deriving concepts such as critical thinking, innovative thinking and creative thinking, and understanding innovation and creation as a free spirit without constraints. Second, pay too much attention to the goal of "innovation and entrepreneurship", and pay little attention to the process of "educating people"; Third, IE is regarded as an important content or specific quality education in quality education practice. This paper has no intention to deduce the above concepts, but only attempts to make a

panoramic jigsaw puzzle of IE focusing on the cultivation of imagination and creativity based on scientific experimental evidence. Even if it is a blind person's feeling, I hope it is a real touch, rather than a conceptual imagination.

2 Positive Emotions and Imagination

Emotions, often categorized as basic and social, extend beyond mere sensations, profoundly influencing our behaviors and cognitive processes. As functional psychological states, emotions shift our brains into distinct operational modes, adjusting our goals, directing our attention, and altering the weight we assign to various factors during mental calculations [7]. Positive emotions encompass a spectrum, including pride, love, awe, amusement, gratitude, inspiration, desire, triumph, empathy, attachment, passion, interest, contentment, joy, and relief. Pride is usually considered as bad, but it can promote you to interact with others, share your achievements and experience, and strive for greater achievements. Awe can motivate you to be kind to others, prompt you to expand your attention from narrow personal interests to extensive group interests, and enhance your ability to integrate into society and seek benefits for the public. Interest will encourage you to actively explore, increase knowledge, accumulate experience, and improve your ability to cope with future challenges. Happiness makes people keep an open mind to new information, think flexibly and efficiently, actively explore, and be more willing to break through the original thinking framework and challenge their own limits. The above new understanding comes from the broaden-and-build theory put forward by Barbara Fredrickson, a professor of the University of North Carolina in 2001 [8]. In 2005, he and Christine Branigan, a professor from Michigan University, jointly confirmed this theory through experiments [9]. The broaden-and-build theory reasonably explains the evolutionary reasons for human positive emotions. In the face of risks, the brain must maintain a delicate balance. On the one hand, it induces our thinking mode, narrows our vision, helps avoid risks, pays attention to immediate threats, prevents us from exploring, and takes quick and decisive actions in the face of potential threats. On the other hand, the brain makes us curious about the outside world, encourages us to broaden our horizons, seize opportunities, and actively explore. Broadening one's horizons, curiosity makes you pay attention to details that you usually overlook, stimulates more active imagination, and facilitates the connection of new ideas, thus igniting your creativity, which is the intended meaning of broadening. At the same time, your positive emotions can influence the people around you, making them more willing to cooperate with you and establish new social relationships. The support and care you receive from others will accumulate as psychological resources, enabling you to be more courageous and resilient in facing challenges, setbacks, and misfortunes in the future. This is the essential meaning of building.

The goal of software engineering is to create a virtual world. A software that brings joy to users must be a fusion of technology, art, culture, mathematics, and philosophy, requiring perfect coordination in many aspects such as function realization, demand satisfaction, and user interaction. To achieve this, apart from the ability to handle

complexity, the key lies in details. It is obvious that this cannot be created by a student who only cares about grades and worries about failing exams. People in a negative emotional state tend to have a narrowed perspective, conservative thinking, and avoid exploration. Their imagination is suppressed, making it difficult to handle complexity and capture details. How can we even talk about broadening and building? Nowadays, society is in a negative emotional state of "involution". While we cannot influence the complex variable of social emotions, we can create a pure land of positive emotions for students in the localized environment of the campus. This will help students accumulate psychological resources and, after leaving school, become a beacon of light that counteracts the negative emotions of society through their creativity. First, reduce credit hours to create space for students to actively explore. The minimum graduation requirement for the software engineering major in our college is 200.5 credit hours, totaling 2,308 class hours. The heavy academic workload can induce students' thinking patterns, narrowing their horizons and avoiding risks. They tend to choose courses with high credit hours and easy grades, avoiding exploration. Compared with the 120 credit hours graduation requirement of related majors in the UK and the US, ours is obviously too much. According to Professor Yan Guangcai from the Department of Education at East China Normal University's calculation based on the principle of equality between freedom and responsibility, the total credit hours for undergraduate majors in research universities should not exceed 130. Structurally, the proportion of general education courses, subject-based foundation courses, and specialized courses should be roughly 30%, 20%-30%, and 40%-50% respectively [10].For computer science undergraduate majors, the ratio of theoretical courses to practical courses at Tsinghua University is 66%/34%, while that of MIT is almost 50%/50%. Moreover, MIT emphasizes more on the application of mathematics in the field of engineering [11]. The ratio of theoretical courses to practical courses in our institution is 69.8%/30.2%, which is obviously not very reasonable. Referring to the above research conclusions, with 130 credit hours as the upper limit, it is more reasonable to control the total credit hours of public basic courses and subject-based foundation courses within 60, and the total credit hours of specialized courses and practical courses above 70. Secondly, we should reform the subject-based foundation courses to cultivate students' initiative. The greatest difference between humans and AI lies in human initiative. Cultivating humans using the same methods for training AI in the AI era would be the greatest tragedy facing humanity. The design of subject-based foundation courses should be de-systematized and centered around the needs of specialized courses and practical courses. There should be no limitations in terms of semesters or class hours, and the number of elective courses should be increased without increasing the overall class hours. The goal is to achieve a curriculum that is small but refined, diverse yet comprehensive, realizing the vision of Academician Zhu Gaofeng for a "combination of theory and practice under the guidance of engineering practice" [12], and implementing the engineering education philosophy of CDIO, which states that "students learn engineering by actively finding organic connections between practice and courses through hands-on experience" [13]. This acquisition of initiative is conducive to students' development of positive emotions, imagination, and creativity. Third, encourage attempts that may lead to errors to con-

tinuously accumulate psychological resources for students. Frederick Brooks has a famous saying, "Good judgment comes from experience, and experience comes from bad judgment." On one hand, feeling the support and care of others after making mistakes helps students accumulate psychological resources and face future challenges bravely. On the other hand, encouraging attempts that may lead to errors contributes to creating an open and contingent informational and relational ecological network, mobilizing individual and collective wisdom to find beneficial answers from errors, stimulating students' imagination, and promoting the connection of existing ideas. As Steven Johnson said, "When someone comes up with a thought-provoking and useful idea, others can establish connections between that idea and other ideas in the organizational system, helping to form a complete concept. These ideas are stored in a public database, creating a kind of 'serendipity architecture' that provides new connection paths for good ideas" [14].

3 Motivation Intensity and Creativity

Creativity can be understood as the interaction between the central executive network(CN), the default mode network (DN) and the salience network (SN). The CN determines where your brain's attention is currently focused, what issues are being emphasized, and in the process of execution, once unexpected events occur, the brain's attention will shift, so it is also called the attention network. The DN constantly generates various ideas randomly, and human imagination comes from this. The SN is a switch between the CN and DN, constantly monitoring and evaluating the importance of the information currently being processed by the CN and DN. When the SN assesses that the information noticed by the CN is meaningless, it will turn on the DN. When the SN that the ideas generated by the DN are important, it will turn on the CN to pay attention to this information. The CN and DN operate in opposition, with one in an active state and the other closed. Creativity, from the perspective of brain neural mechanisms, refers to the simultaneous activation of the CN, DN, and SN, with the SN quickly identifying and evaluating valuable information, and the CN and DN switching rapidly. Brain neuroscience research has confirmed that the prerequisite for the simultaneous activation of the CN, DN, and SN is to activate the anterior cingulate cortex of the brain. Only when people feel relaxed, secure, and happy, can the anterior cingulate cortex be easily activated, stimulating imagination and creativity[15]. In addition to activating the anterior cingulate cortex in a relaxed, secure, and pleasant mood to simultaneously activate the CN, DN, and SN, expanding one's horizons to generate more and more distant ideas in the DN, maintaining leisure time, feeling lonely, and detaching oneself from current affairs are also conducive to activating the DN. Among them, the methods to achieve a good mood include gratitude practice, adjusting one's mindset to choose positive thoughts, regular exercise to reduce stress, and good rest. Gratitude practice refers to the positive emotion of "gratitude," and the ultimate goal of the other three methods is also to obtain positive emotions. Having free time and a sense of loneliness essentially refer to the freedom of time and space, which is the positive emotion of "relief." The above interaction

mechanism of the three brain neural networks related to imagination and creativity once again verifies the correctness of the broaden-and-build theory, proving that positive emotions are conducive to stimulating people's imagination and creativity. In the previous text, compressing credits is to allow students to have free time and reduce stress. Reforming basic academic courses is to allow for free time, reduce stress, and broaden students' horizons. Encouraging wrong attempts is to help students relax, feel secure, and activate the CN, DN, and SN of their brains, thus stimulating imagination and creativity.

However, in reality, having positive emotions and imagination does not naturally manifest creativity. Imagination needs motivation as an engine to truly unleash creativity. Motivation comes from the reward system of the brain and can be divided into drive, goals, and perseverance. Drive can be further classified into external drive and internal drive. External drive refers to incentives such as money and fame, which can sometimes become the source of negative emotions. Internal drive, including curiosity, enthusiasm, purpose, meaning, autonomy, and mastery, is the source of basic positive emotions. They form a positive feedback loop and are the core driving force for those who truly achieve great things and accomplishments. Curiosity is the beginning of a creative event. Once a valuable idea is found, the brain will secrete dopamine, making you more focused, generating new ideas, and deepening memory. Dopamine, as a reward substance, brings a sense of pleasure. At the same time, it fuels your curiosity and enhances your drive, making you determined to accomplish a task. This determined state is not merely about effort, but rather about passion. When you show passion, you are more willing to communicate with others and seek out those who share your aspirations. The positive feedback from these like-minded people will further stimulate the secretion of dopamine, and also oxytocin, which increases trust and love between you and others. Thus, curiosity and passion form a positive feedback loop, and the task you are working on begins to take shape.Purpose is not a goal, but the mission and meaning behind what you do. Under the influence of purpose and meaning, the right insular cortex of the brain will expand, enabling the brain to selectively receive information, thereby enhancing concentration, work motivation, productivity, and stress resistance. At the same time, purpose and meaning can also generate charisma, attracting others to join. To continue persevering in this task, the sense of control derived from autonomy (dopamine reward) is crucial. Autonomy leads to the pursuit of mastery, and the sense of mastery generated by each improvement can provide you with dopamine rewards, which is incomparable to doing things passively. The direction of acting autonomously is the goal. With autonomy and a goal system, you will encounter challenges in the process of pursuing mastery. At this point, you need perseverance, self-encouragement, and gratitude for the luck that has come your way [16]. Positive emotions allow people to diverge their attention and stimulate imagination, while motivation allows people to focus their attention and take action to achieve creativity. The level of creativity is related to the strength of motivation, and the stronger the motivation, the stronger the self-driving force. Harvard Business Review has published a series of empirical studies confirming that the strength of motivation is related to people's desires and emotional fluctuations [17], once again proving that there is a positive feedback loop between motivation strength

and positive emotions. Therefore, having both imagination inspired by positive emotions and creativity driven by high motivation intensity is what truly defines an innovative talent.

The above description is complicated and abstract. However, with a simple example, one can understand the role of the positive feedback loop between positive emotions and curiosity, enthusiasm, purpose, meaning, autonomy, and mastery in talent development, which is far more than just inspirational narratives in the news media. Wu Mingzhu, a melon breeding expert and academician, developed a keen interest in plant breeding after watching the documentary "Michurin" and feeling its magic. After graduating from high school, she enrolled in the Southwest Agricultural College to study horticulture and fruit and vegetable science. After graduation, she chose to research melon and watermelon breeding, but the best melon seeds were in Xinjiang, so she had to give up the opportunity to be assigned to a major institution in Beijing and went to Turpan instead. Starting in 1958, she traveled to over 300 production teams in Turpan to collect germplasm resources and sorted out 44 varieties. To accelerate the breeding process, she established a breeding base in Hainan. It was until 1984 that she cultivated a watermelon with better taste and sweetness from 24 groups of seeds, which is the widely consumed 8424 watermelon in China today.

Based on the psychology's broaden-and-build theory, three neural networks of brain neuroscience, and the generation mechanism of motivation, we have constructed a brand-new innovative and entrepreneurial talent cultivation model—the positive emotion-motivation intensity framework. Starting from the perspective of individual students and student groups, this framework utilizes the current understanding of human beings in psychology and brain science as its underlying logic and initial conditions to build an innovative and entrepreneurial talent cultivation model that differs from AI training methods. In this framework, all aspects such as educational goals, content, methods, curriculum, and evaluation are designed and constructed around creating positive emotions and enhancing students' motivation intensity, aiming to build a positive feedback loop for students' growth and hoping that they can spend a meaningful life in imagination and creation.

4 Role of Teachers in IE

Teachers need to play three roles simultaneously: designer, educator, and service provider. The role of the designer is to design teaching objectives, content, and methods. The educator fulfills five role behaviors: disciplining, preaching, modeling, consulting, and evangelizing. The role of the service provider is not only to serve the teaching objectives but also to serve the students in achieving those objectives. Disciplining involves directly setting learning objectives, conducting rigorous training, and then evaluating and assessing. Preaching involves persuading through instruction, with the core being to provide methods, feedback, and praise, showing students how to do something, understanding how well they have done, and giving timely praise. Modeling involves teaching through personal demonstration, with the core being "I'll show you how to do it; watch me." Consulting, as the name suggests, involves teach-

ers discussing with students on an equal footing or with lowered status, with the core being discussing together what to do and how to do it. Evangelizing involves transmitting meaning and values, focusing on human growth goals and significance, and cultivating people. Disciplining and preaching focus on teaching "knowledge," modeling and consulting focus on teaching "learning," and evangelizing focuses on teaching "education." Disciplining, preaching, and modeling are primarily driven by the teacher, similar to the supervised learning method of AI training, where the teacher's authority and process control can bring varying degrees of pressure to students, and the loss of student autonomy can weaken motivation. During the process of consulting and evangelizing, teachers and students are equal, but in traditional education modes, the teacher's role interventions are entirely based on personal experience and are difficult to trace.

Under the framework of positive emotion-motivation intensity, the design of teaching objectives, content, and methods should focus on creating positive emotions and activating the three neural networks related to imagination and creativity. The teaching process should assist students in evaluating and screening ideas, strengthening the attention of the CN, and enhancing their motivation intensity. Meanwhile, the service aspect should aim at cultivating students' imagination and creativity. For instance, when a student shows enthusiasm for an idea and needs to communicate with others to find like-minded individuals, teachers should timely play the role of a like-minded person, providing positive feedback to the student, helping them establish a positive feedback loop between curiosity and enthusiasm, and guiding them to put their ideas into action. When the student's work gains momentum, the teacher should join in and help them strengthen the meaning of their mission. When the student pursues mastery, the teacher should provide resources to assist them, remembering not to influence or deprive them of autonomy. When the student encounters setbacks, the teacher should offer encouragement and resilience. The role of teachers under the framework of positive emotion-motivation intensity has a certain improvisational aspect, emphasizing reinforcement and support at critical points in the student's internal drive positive feedback loop, with a greater focus on design and service. In traditional education models, teachers' roles are often concentrated on teaching, especially discipline, preaching, and modeling, which is not conducive to creating positive emotions, but may even foster negative emotions, making it difficult to cultivate students' imagination and creativity. The role of teachers as designers and service providers under the framework of positive emotion-motivation intensity can better motivate students to innovate, start businesses, and solve problems, which is the true essence of education and more conducive to students' growth. It can be seen that the positioning of teachers' roles under the framework of positive emotion-motivation intensity is a response to the above message of Li Deyi.

5 Conclusion

Without initiative, there is no personality, and without personality, there is no imagination and creativity. We cannot cultivate people in the same way as we train AI, or

else the "tool people" will be inferior to tools, and the displacement of tool people by tools will be the sorrow of humanity in the AI era. True innovative talents possess both imagination and creativity, motivated by positive emotions and high motivation intensity. The framework of positive emotion-motivation intensity is constructed based on the latest research results of broaden-and-build theory and brain neuroscience, aiming to establish an educational environment that combines positive emotions and motivation intensity for innovation and entrepreneurship education, rather than training and controlling people. Correspondingly, the role of teachers should also shift from educators emphasizing process control and knowledge training in traditional education models to designers and service providers providing emotional support and motivation enhancement. By doing so, we can transform classes, departments, and campuses into imaginative and creative learning organizations, enabling students to become the lights that brighten society's positive emotions after graduation and lead meaningful lives filled with imagination and creativity. Although I have graduated for many years and have no financial resources to contribute to the development of my alma mater, I offer these ideas in the hope of inspiring further discussions and contributions.

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