Humanities education for engineers: Status & Practice

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Abstract: The level of humanistic quality of science and engineering students is related to the rise and fall of a nation. This paper conducts a questionnaire survey on the current status of humanistic quality education for science and engineering students in five science and engineering universities in Shaanxi Province. From the perspective of students' cognition, it analyzes the existing problems in humanistic quality education and students' evaluations of current humanistic quality education, and proposes targeted implementation strategies for humanistic quality education, which has important practical significance for improving humanistic quality education in science and engineering institutions.

Keywords: humanistic quality, science and engineering students, current status of humanistic quality education, implementation strategies

1. Introduction

In recent years, scholars in the education field have extensively discussed the topic of humanistic quality education. However, many scholars engaged in exploring humanistic quality education have failed to clearly define and delineate its meaning. After reviewing numerous scholarly definitions, the author presents a clear conceptualization of humanistic quality education. The author argues that to understand what humanistic quality education entails, one must first clarify what humanistic quality means. The Implementation Plan for the Outline of the National Action Plan for Scientific Literacy (2016–2020) issued by the General Office of the State Council in March 2016 states: "Basic scientific literacy generally refers to understanding necessary scientific and technological knowledge, mastering basic scientific methods, establishing scientific thinking, advocating scientific spirit, and possessing certain capabilities to apply science in handling practical problems and participating in public affairs."[1] In this paper, humanistic quality is positioned as the counterpart to scientific quality. Humanistic quality is an organic whole composed of three elements: humanistic knowledge, humanistic spirit, and humanistic practical ability. Accordingly, humanistic quality education refers to education concerning an individual's humanistic knowledge, humanistic spirit, and humanistic practical ability, standing in contrast to scientific quality education. "For science and engineering students, merely mastering professional knowledge is far from sufficient; they should also continuously learn rich humanistic knowledge and improve their humanistic quality. College students must learn not only how to do things but also how to be human, using the 'Way' (Dao) of humanities to guide the 'Instrument' (Qi) of science."[2]

2. Survey on humanities education for STEM students

2.1. Questionnaire survey

2.1.1. The questionnaire

The questionnaire used in this study consisted of 37 items in total (36 multiple-choice questions and 1 open-ended optional question). The main contents of the questionnaire were as follows: Part I covered basic demographic information; Part II examined respondents' basic understanding of humanistic quality education; Part III investigated the current status of humanistic quality education for science and engineering students, covering four dimensions—students' overall perception of humanistic quality status, humanistic knowledge status, humanistic spirit status, and humanistic practice status; Part IV assessed

https://doi.org/10.62852/cahr/2026/216

students' evaluation of current humanistic quality education, examining three dimensions: humanities courses offered by the university, support provided by the university, and humanities instructors. A total of 500 questionnaires were distributed in this study. After excluding invalid questionnaires (including incomplete responses and unreturned forms), 465 valid questionnaires were collected, yielding an effective response rate of 93%.

2.1.2. Respondents and sampling method

From March to May 2016, a survey was conducted among five universities in Shaanxi Province, including one "985 Project" university—Northwestern Polytechnical University (152 respondents); one "211 Project" university—Xidian University (143 respondents); and three ordinary undergraduate universities (200 respondents)—Xi'an University of Science and Technology, Xi'an Shiyou University, and Xi'an University of Technology. A random sampling method was employed. After all questionnaires were collected, the relevant data were entered into Excel spreadsheets in a unified format. Upon completion of data entry, the Excel files were converted into a format recognizable by SPSS software, and the raw data were then imported into SPSS 20.0 for analysis.

2.1.3. Basic information of the sample

Grade distribution. Among all surveyed students, there were 208 first-year students, accounting for approximately 44.7% of the total; 120 second-year students, accounting for approximately 25.8%; 92 third-year students, accounting for approximately 19.8%; and 45 fourth-year students, accounting for approximately 9.7%. The sample size for first-year students was relatively large, while that for fourth-year students was relatively small.

Gender distribution. Among all surveyed students, there were 329 male students, accounting for approximately 71% of the total, and 136 female students, accounting for approximately 29%. The sample contained more male students than female students, a distribution consistent with the characteristics of science and engineering institutions.

University and major distribution. (See Table 1 for details)

2.2. Survey analysis and discussion

Table 1 Distribution of Respondents by University and Major

School	Major
Northwestern Polytechnical University (NPU)	Mechanical Manufacturing, Aircraft Design, Software Engineering, Detection, Guidance and Control Technology, Computer Science and Technology, Traffic Engineering, Electronic Information Engineering, Energy and Power Engineering, etc.
Xi Dian University	Network and Information Security, Information Engineering, Communication Engineering, Integrated Circuits, Mathematics, Optoelectronic Information Science and Engineering, Biomedical Engineering, Electronic Science and Technology, etc.
Xi'an Shiyou University	Civil Engineering, Geology, Materials Science and Engineering, Mathematics and Applied Mathematics, Electrical Engineering and Automation, Mining Engineering, Information Science and Technology, Exploration Engineering, etc.
Xi'an University of Science and Technology (XUST)	Materials Science, Energy Chemical Engineering, Civil Engineering, Physical Geography and Resource Environment, Internet of Things, Resource Exploration Engineering, Automation, Microelectronics Science and Engineering, etc.
Xi'an University of Technology (XUT)	Internet of Things Engineering, Electrical Engineering and Automation, Integrated Circuit Design and Integrated Systems, Digital Media, Mechanical Design, Manufacturing and Automation, Materials Science, Applied Physics, etc.

2.2.1. Students' basic understanding of and attitudes toward humanistic quality education

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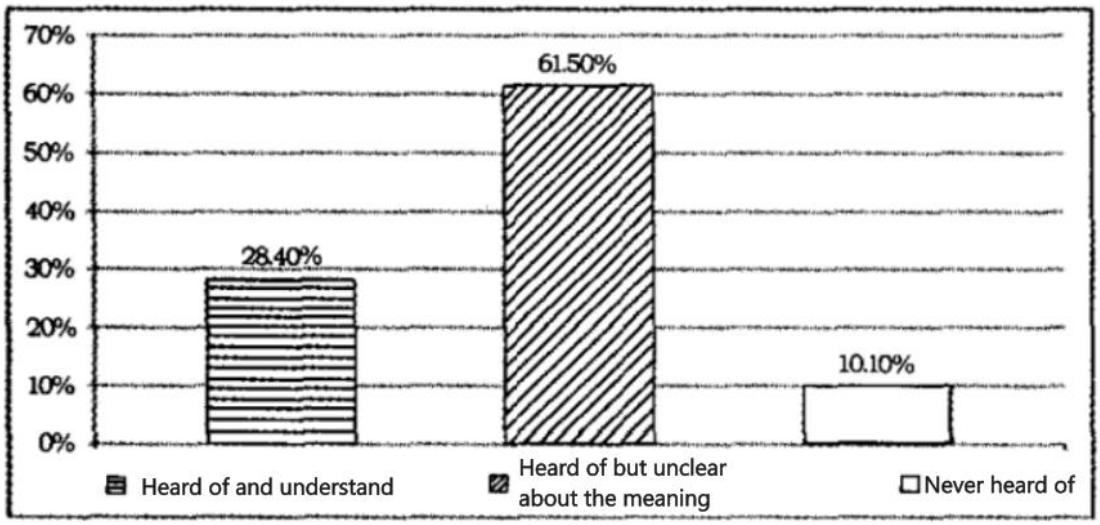

Figure 1 Survey Results: "Have You Heard of Humanistic Quality Education?"

Figure 1 presents the survey results for the question "Have you heard of humanistic quality education?" It can be seen that only a small number of students have heard of it and understand its meaning, while the majority have heard of it but are unclear about its meaning. When asked about their evaluation of their own humanistic knowledge and literacy, 14.2% of students were "very satisfied" with their humanistic quality, 64.7% considered their humanistic quality "average," 18.5% believed it was "relatively deficient," and 2.6% considered their humanistic quality "very deficient." Evidently, most students generally rated their own humanistic quality rather low. Students have a clear understanding of the importance of humanistic quality, yet they are not very satisfied with their own humanistic quality, indicating a discrepancy between perception and reality. This also indirectly reflects that students themselves attach great importance to humanistic quality education; however, possibly due to various external factors such as problems with the university, faculty, and environment, students' own humanistic quality remains relatively low.

2.2.2. Current status of humanistic quality education for science and engineering students

2.2.2.1. Status of humanistic knowledge

When students were surveyed with the question "Do you actively explore humanities and social science knowledge beyond your major?" as many as 68.4% selected "sometimes, but often lack time and energy," 26% selected "often," and only 5.2% selected "have never thought about it" (see Figure 2). Figure 2 also presents the responses to the question "Have you read philosophical works by famous figures such as Marx, Engels, and Lenin?" Furthermore, when investigating students' understanding of the Asian Infrastructure Investment Bank (AIIB), only 2.2% indicated they were "very familiar with it," 38.9% stated they had "never heard of it at all," and the majority selected "have heard of it but do not understand it." The survey reveals that most students have a strong desire to acquire humanistic knowledge; however, due to constraints of time and energy, their humanistic knowledge remains relatively deficient. The underlying reasons may include limitations arising from academic workload, access to resources, time availability, and various other factors.

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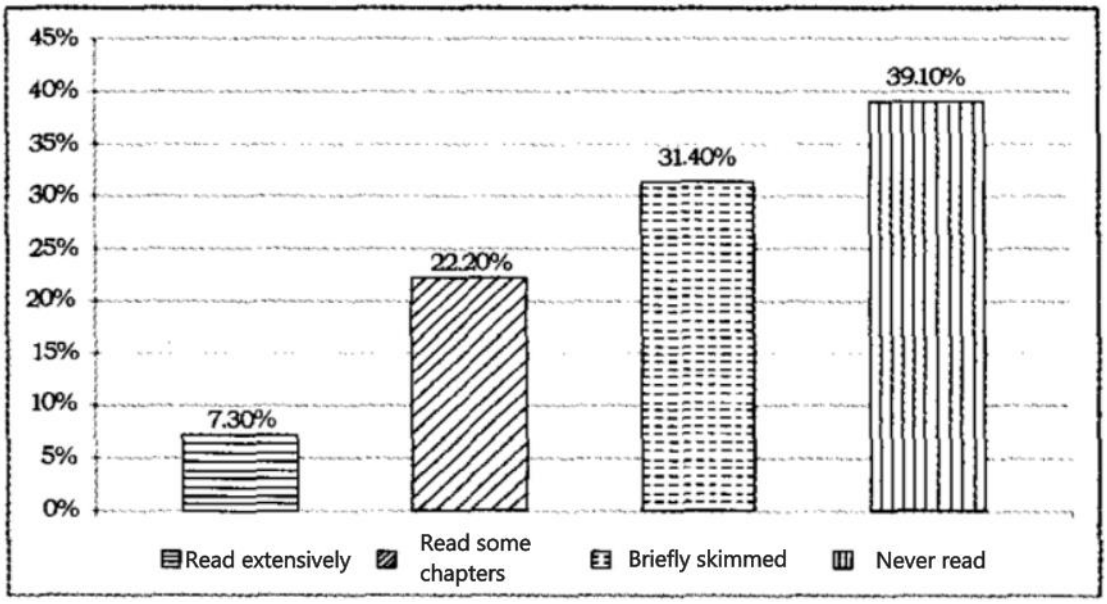

Figure 2 Survey Results: "Do You Explore Humanities Knowledge Beyond Your Major?"

2.2.2.2. Status of humanistic spirit

When asked the question "What kind of relationship do you think exists between people nowadays?" students' responses are shown in Figure 3. Through the survey question "How do you generally react when encountering setbacks?" it was found that the majority of students selected "handle calmly"; however, a small number of students, such as 5.2%, selected "lose one's temper," and 4.7% selected "depressed and desperate." This indicates that students can basically correctly understand the relationship between people, and most students hold positive views on this matter, though a small number still hold negative views. This reflects that the humanistic spirit of science and engineering students is still lacking to a certain extent; to fundamentally change this situation requires joint efforts from all parties.

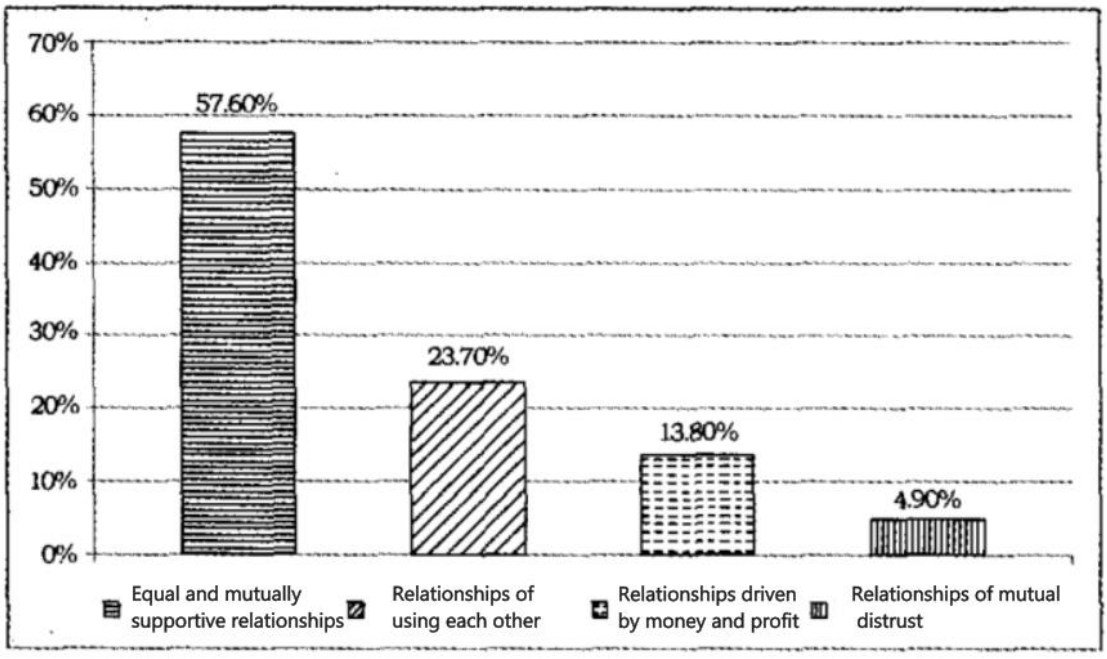

Figure 3 Survey Results: "What Is the Relationship Between People Today?"

2.2.2.3. Status of humanistic practice

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Figure 4 presents the responses to the question "Are you able to write documents such as notices, requests for instructions, summaries, and reports relatively smoothly?" When surveying the question "What is your opinion on various campus cultural activities?" nearly half of the students indicated that they "can both develop abilities and broaden horizons," while only 4.3% of students expressed "no interest in the activities."

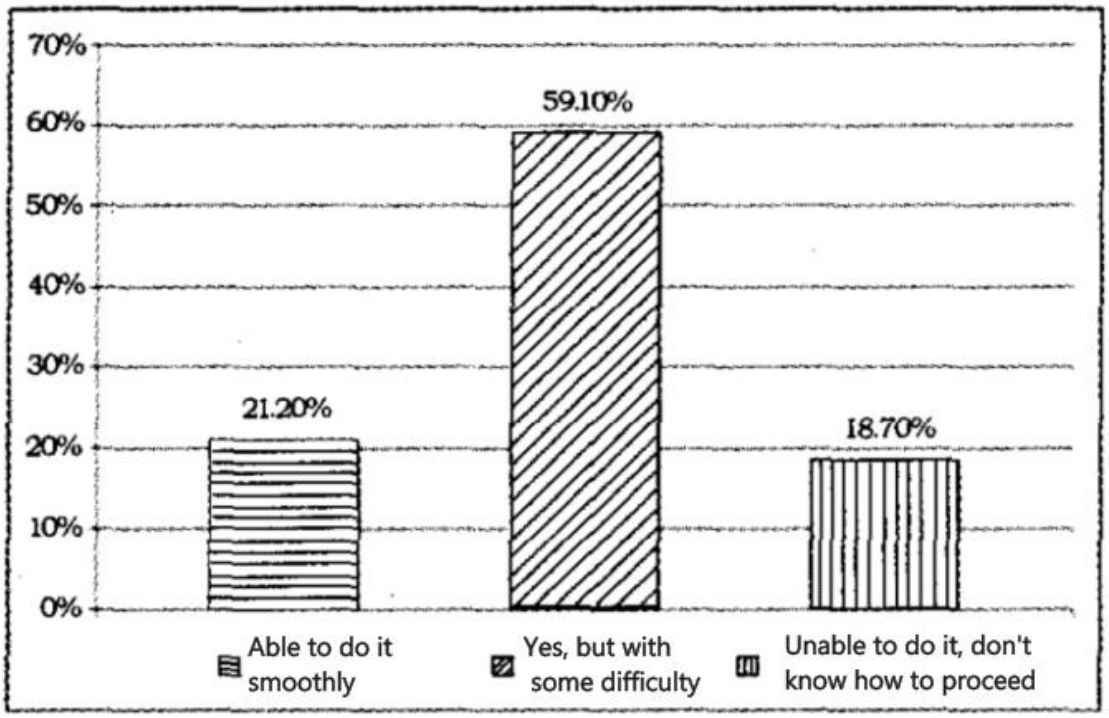

Figure 4 Survey Results: "Can You Write Official Documents Smoothly?"

2.2.3. Students' evaluation of current humanistic quality education

2.2.3.1. Humanities courses offered by the university

Through the survey question "What is your attitude toward the general humanities courses offered by the university (such as Ideological and Moral Cultivation and Legal Basis, Modern Chinese History, Military Theory, etc.)?" it was found that 44.5% of students believed that "the lectures are interesting and one can learn a lot," while 23.9% of students believed that "they are not taken seriously, and the purpose of learning is merely to pass exams." Evidently, whether regarding the teaching content or teaching effectiveness of humanities courses, approximately one-third of students expressed dissatisfaction; the effectiveness of the courses has far failed to meet students' psychological expectations. Moreover, although most students believe that humanities quality courses are very useful, a portion of students still consider the purpose of learning to be merely passing exams, or even reading other books in humanities classes or skipping classes. This may be influenced by various factors such as students' own attitudes and the effectiveness of the courses. Furthermore, "Chinese universities have long formed unified enrollment, unified academic systems, unified teaching plans and syllabi, especially unified academic year systems and compulsory course systems, leaving little room for humanistic quality education in the cultivation of undergraduates and even graduate students in science and engineering institutions. Coupled with utilitarian value orientations, the curriculum settings in science and engineering universities are too one-sided, with excessive pressure from science and technology courses, resulting in science and engineering students seriously lacking autonomy for comprehensive development."[3]

2.2.3.2. Support provided by the university

Through the survey question "What is your evaluation of the university's humanistic atmosphere and campus cultural life?" it was found that although as many as 52.5% of students expressed being "relatively

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satisfied," 35.7% of students still selected "dissatisfied," and additionally 6.5% of students selected "very disappointed." This survey demonstrates that students are not very satisfied with the university's humanistic quality education. There exist rather serious problems in various aspects such as campus atmosphere, library resources provided, lectures held, and assessment methods, which are also important factors constraining the progress of humanistic quality education for science and engineering students.

2.2.3.3. Humanities instructors in the university

The survey results for the question "What do you think of the teaching methods of humanities instructors currently teaching humanities courses in the university?" are shown in Figure 5. Evidently, there remains considerable room for improvement among humanities instructors; many problems still exist regarding their own quality, teaching methods, and teaching artistry. The lack of artistic quality in teaching and the singularity of teaching methods are likely direct causes of student dissatisfaction with humanities courses, which will seriously constrain the improvement of humanistic quality among science and engineering students.

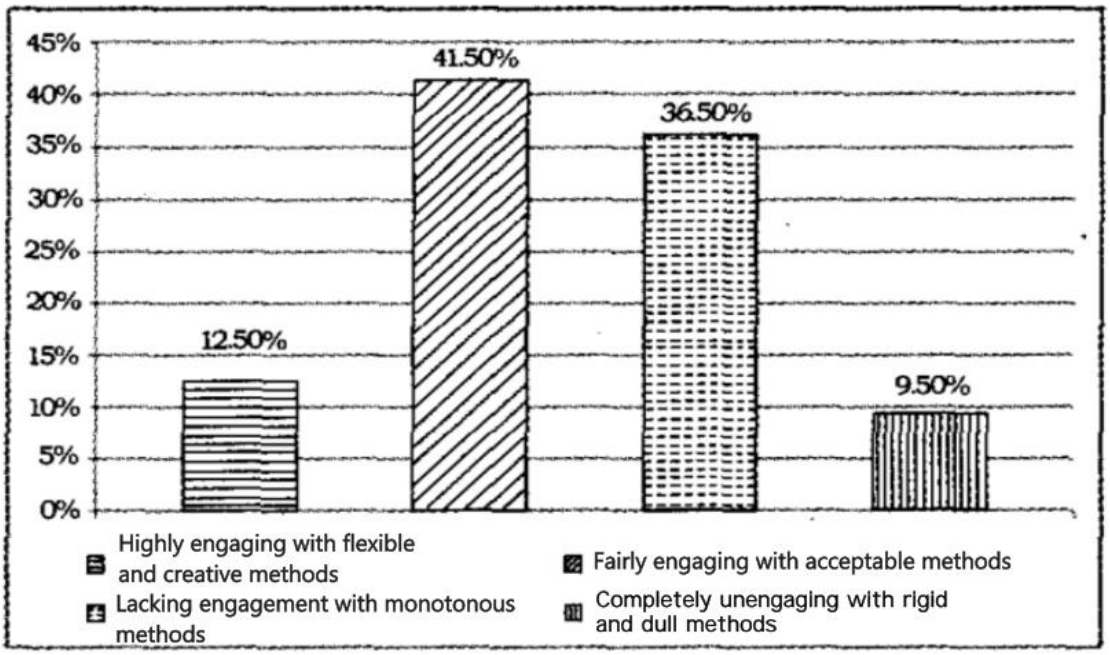

Figure 5 Survey Results: "Evaluation of Humanities Instructors' Teaching Methods"

2.3. Summary of problems

Through the detailed analysis of the survey results presented above, four main problems in the current humanistic quality education for science and engineering students in China can be identified: First, regarding the curriculum system, on the one hand, most students study general humanities courses merely for the purpose of passing exams; on the other hand, the course content is empty and uninteresting, failing to stimulate students' learning interest. Second, regarding campus culture, the frequency and forms of campus cultural activities organized by the university cannot satisfy students' needs. Third, regarding instructor quality, this is manifested in the insufficient humanistic quality of teachers themselves and the failure of humanities instructors to play their proper role. Finally, regarding educational concepts, this is reflected in the university's lack of emphasis on humanistic quality and teachers' own lack of emphasis on humanistic quality in the teaching process. In response to these problems, this paper proposes four corresponding implementation strategies for humanistic quality education of science and engineering students.

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3. Strategies for humanities education in STEM

3.1. Reforming curriculum to enhance classroom teaching

Curriculum is the carrier of talent cultivation in universities, and the construction of curriculum systems is also a key component of university talent training programs. In terms of curriculum system construction, universities should integrate professional courses, humanistic quality education courses, and general courses to form a science and engineering education curriculum system with broad coverage and distinctive characteristics. For example, "Science and engineering universities in Beijing should incorporate humanistic quality courses into teaching plans, offering humanities and social science courses such as history, philosophy, and art, ensuring that humanistic quality education for college students is 'continuous throughout four years' through corresponding compulsory and elective courses, actively constructing humanistic quality courses with distinctive institutional characteristics, with a focus on offering literature courses, so that students truly possess humanistic knowledge, understand humanistic ideas, master humanistic methods, and follow the humanistic spirit."[4] Survey results reveal that humanities courses currently offered by science and engineering institutions fall far short of meeting students' needs, and the course content is disconnected from students' interests. Although most students will attend lectures if they find them interesting, a considerable number of students still study merely for examination purposes. For instance, the Zhong nan Cultural Academy established by Xi Dian University offers courses including: seminars on humanistic literacy, guided reading of excellent traditional cultural classics, applied writing and speech skills, introduction to aesthetics, contemporary Chinese political reform and modernization of state governance, guided reading of life education research classics, environmental ethics and ecological civilization, among others. Furthermore, universities may also offer some humanities courses related to specific majors or interdisciplinary courses connected to majors based on their own characteristics, fostering holistic and dialectical ways of thinking. Additionally, regarding the curriculum system setting for humanistic quality education, science and engineering institutions in China may also refer to international practices: "The Massachusetts Institute of Technology requires science and engineering students to concentrate relatively in a certain field for humanities elective courses (MIT stipulates that each student must have three courses concentrated in a certain field). For example, students may concentrate relatively on 'Chinese History,' or 'Foreign Literature,' or 'Art,' etc., according to their own interests. In this way, students can avoid superficial skimming and gain relatively in-depth entry into the humanities field."[5]

3.2. Building campus culture for humanistic development

First, actively promote elegant arts activities on campus. Introduce high-quality artistic activities into the campus, regularly screen classic films, organize cultural performances, and various thematic activities. In addition, schools in Shaanxi Province may also leverage the province's unique characteristics of rich historical atmosphere to help students review history and commemorate revolutionary martyrs by organizing events such as Red Song concerts. Second, strengthen the construction of student associations and clubs to further enrich students' campus cultural life. Third, "organize reading month activities in schools, adopting various forms of promotional activities, such as increasing book borrowing quotas, establishing reader associations, selecting outstanding readers, holding book report sessions, book reviews, and calligraphy and painting exhibitions, etc., allowing students to be influenced and enlightened subtly."[6] Universities should encourage extensive reading through activities such as reading exchange months and library months, and invite renowned masters and experts to deliver humanities education lectures that touch students' hearts. While conducting activities and lectures, various humanistic practice activities should also be organized to help students transform the humanistic knowledge learned and humanistic emotions felt into humanistic practice. Resolutely avoid showmanship and prevent the entire process from becoming formalistic.

3.3. Improving teachers for humanistic education

First, fully utilize the role of humanities instructors by offering elective courses for science and engineering students and organizing more lectures and reports on humanistic quality. Second, utilize the role of science and engineering instructors, who have more opportunities to interact with students and better

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understand their ideas and characteristics. "Improve teachers' cultural literacy and promote the integration of humanistic education with professional teaching. Specific measures include: summarizing effective methods for infiltrating humanistic education into professional and basic courses through research; and promoting the improvement of teachers' cultural literacy through activities such as teachers' reading classes for classic works and humanities salons."[7] Teachers should not only possess extensive knowledge of the subjects they teach and profound professional expertise, but also have sound personalities, positive outlooks on life, firm political directions, and noble morality and social conscience. In addition, they should possess the art and skills of cultivating students' abilities, transmitting knowledge from books to students in the most acceptable way through their own teaching artistry, and then helping students progress from understanding to acceptance and finally internalizing it as their own quality. As is well known, teachers' important responsibility is to "impart knowledge and cultivate people": "imparting knowledge" refers to teaching students disciplinary and professional knowledge; "cultivating people" refers to helping students establish correct outlooks on life and promoting their comprehensive physical and mental development. In current universities, besides humanities course instructors, there is another category of teachers who have more contact with students—counselors. Counselors have more contact with students' daily lives, while humanities instructors have more contact with students in the classroom. Through the above survey, it can be seen that many students dislike attending humanistic quality courses, or reading other books in humanities classes or even skipping classes, largely because they are not interested in what the teachers teach, the teachers lack teaching artistry, and the teaching methods are rigid and monotonous.

3.4. Rethinking humanities integration in STEM education

In the current talent cultivation model, universities—especially science and engineering institutions—place the learning of professional knowledge and skills in the primary position. A complete person should be someone with an integrated personality, good comprehensive quality, and comprehensive physical and mental development, rather than merely someone who has mastered a large amount of professional knowledge and skills. Many students believe that only knowledge in their own discipline is truly useful, consider humanistic knowledge to be of little value, and overly emphasize the utilitarian and purposeful nature of education, which also leads to students' subjective lack of sufficient attention to humanistic knowledge. According to the above survey, it can be seen that when a large number of students were asked the question "Which of the following problems regarding humanistic quality education do you think is particularly serious in your school?" they selected "the school does not attach importance to humanistic quality education," believing that the school should emphasize humanistic quality education, "integrating humanistic factors and spirit with professional knowledge content, infiltrating them into professional course teaching to enrich professional courses, and providing science and engineering students with complete and reasonable knowledge structures. This enables them to acquire not only scientific knowledge but also the edification of noble humanistic spirit and moral sentiment—that is, embedding humanistic quality education within professional knowledge education." Zhang Xiaoming believes that "there are three implementation strategies for integrating humanistic education into professional education: incorporating scientific methodology and the history of science and technology into the scope of professional courses; emphasizing the cultivation of scientific spirit in the process of exploring and applying knowledge; and improving the cultural literacy of professional teachers while establishing relevant incentive mechanisms and policies."[8] On the other hand, teachers should also transform their own teaching concepts and integrate humanistic quality education into their daily teaching.[9] "For example, exchange meetings on humanistic knowledge can be held with students, where students can present their views on humanistic knowledge, and teachers should also provide positive evaluations of students' opinions, encouraging students to read more books on humanities and philosophy to enrich their knowledge."[10]

4. Conclusion

This paper, through a questionnaire survey of 465 students from five science and engineering universities in Shaanxi Province, reveals the core contradictions in the current humanistic quality education for science and engineering students: students generally attach importance to humanistic quality but rate themselves poorly (64.7% considered it "average"), are eager to expand their humanistic knowledge but are constrained

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by time and energy, and show relatively low satisfaction with existing humanities courses, campus cultural atmosphere, and teaching methods. In response to deep-rooted problems such as imperfect curriculum systems, weak campus culture, insufficient humanistic literacy among teachers, and utilitarian educational concepts, this paper proposes that efforts should be made from four dimensions: reforming the curriculum system (achieving integration of professional and humanistic education, adopting the MIT model of concentrated electives), strengthening campus culture construction (elegant arts, reading activities), improving teachers' humanistic literacy and teaching artistry, and transforming utilitarian educational concepts. By constructing a "continuous throughout four years" humanistic quality education system, we can cultivate high-quality talents who possess both scientific spirit and humanistic sentiments.

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