Whitehead's educational unity principle in the development of engineering and technical talent

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ABSTRACT: The unity in Whitehead's philosophy of education is summarised in this article. Whitehead advocates that education should unify curriculum and the educational process should combine theory and practice. An adequate education should include a literary component, a technical component and a scientific component. Education should address all these three aspects. Education should unify teachers and students, and the educational process should pay due regard to how individuals develop and grow by delivering education according to each individual's aptitude. Hunan First Normal University is a contemporary example of successfully utilising Whitehead's approach to education as reported earlier [1], while the data collected for this article confirm the previous findings, and provides a basis for further discussion on this topic.

INTRODUCTION

In a nutshell, the main thought of Alfred North Whitehead (a renowned British educator) on education is that it is a process that emphasises unity. Whitehead insisted that the critical issue in education is the combination of theory with practice, and that education should produce students who not only have a good understanding of theoretical knowledge, but also excel in practical skills [2].

Whitehead believed that education is a process which follows certain rules [3]. The rules are manifested by certain rhythms that run through the educational process. Moreover, such rhythms or rules should not become rigid, since each entity and every stage in the educational process has its own characteristics. He also thought that the educational process is a unity of components and that the connection among these components will affect teaching implementation and outcomes [4].

In this article, the authors discuss the implications of Whitehead's unity of education and how to materialise and implement his ideas in the development of engineering and technical talent.

UNITY OF EDUCATION

Whitehead believed that unity of education is one that shall include educational curricula, contents and the educational practitioners.

Unity of Curriculum

Whitehead insists that curricula and subjects should not be isolated from each other and among various curricula there are some kinds of connection, which needs to be reflected in the educational process. He said, ...*The solution which I am urging, is to eradicate the fatal disconnection of subjects which kills the vitality of our modern curriculum* [5]. Whitehead claims that education shall serve life, while life shall be put into the schedule of education. Life is the link between curricula for ...*life has relation to some essential characteristic of all intelligent or emotional perception.*

Cultural curriculum and specialist courses shall be in unity. Because *the general culture is designed to foster an activity of mind; the specialist course utilises this activity* [5]*,* so both should be mutually supportive. Persons who lack interests and are poor thinkers would be the product of education, unless in education the specialist course and the cultural course are linked.

Unified Content

Education should include a literary component, a scientific component and a technical component. These deliver an appreciation of beauty, a scientific education and a technical education, respectively. Whitehead holds that the three components should be included to get a balance between intellect and character. The technical component is to deliver the ability to provide services that meet national needs. The literary component is to develop the ability of thought and appreciation of beauty, to pass on broad knowledge concerning multiple disciplines to the educated. The scientific component is to train to observe natural phenomena and impart the art of deduction and reasoning using relevant scientific laws.

Unity between the literary component and the technical component: Whitehead believes that the literary component and the technical component are mutually complementary ...*the technical education involving no literary component is incomplete and the literary education is unsatisfactory without the technical component*. In other wor*ds ...education must impart both the technical aspect and imagination full of wisdom*. Literature can express and expand human vision by imagination, and makes it possible to provide full-of-wisdom imagination and morality for technical education, so as to make the work enjoyable and increase working efficiency. Artists need to receive technical education and turn their artistic imagination into reality, while developing their ability to appreciate beauty.

Unity between the literary component and the scientific component: Whitehead insists that it is necessary to combine the literary component with the scientific component ...*the joy that art and science bring to hard work is pleasure from succeeded aims*. Literary education helps expand thoughts, adjust emotions and facilitate development of scientific research for scientific education. Some reputed scientists have attained high levels in humanities and arts, for example, Einstein played the violin during his scientific career.

Unity between the technical component and the scientific component: ...*the unique worth of scientific education is that it puts thoughts above direct observation; the worth of technical education lies in that it follows the natural instinct deep in our heart to turn thoughts into handicraft and handicraft activities into thoughts*, and thoughts make it possible to bridge technical and scientific education. The technical component involves training to use knowledge to produce substances and some stages of technical training may require scientific knowledge.

Unity of Educational Practitioners

Teachers and students should develop a co-operative relationship and be partners in the educational process. In the educational process, teachers should play a role as guide and instructor rather than as an authority figure. Whitehead opines ...*successful teachers will have a knowhow: he, in his mind, surely knows that his (her) students have to learn things in precise ways*, and ...*in each type of curriculum, the precise knowledge required to be learnt and mastered of each discipline shall be determined after the most prudent investigation. Too wide, it will kill students' interest and your aim will fail. Too narrow, knowledge cannot be imparted to students effectively.*

That is, teachers should try to understand what their students are interested in and stimulate this. They do this with their own personality and character, and their passion, so as to keep extending and imparting to students a desire to learn. This makes teachers and students into one harmonious practical team. In addition, teachers of different disciplines should not only co-operate and inspire each other, but also be able to decide on their respective activities and play different roles in the team.

DEVELOPMENT OF ENGINEERING AND TECHNICAL TALENT

A majority of students majoring in engineering and technology, after graduation, will begin their careers engaging themselves in productive activities. Therefore, they will have had to master sufficient theoretical knowledge to support their future careers, while possessing adequate practical ability to meet the demands for applying that knowledge. Talent development must stick to the principle that education should serve life, and should integrate theory with practice. Education should take into consideration general regularity, but also individual differences.

More critically, comprehensive development includes the literary, scientific and technical components in accordance with Whitehead's philosophy of education. In this article, the building and development of the education system for the major of communication engineering at Hunan First Normal College, Hunan, China, is an exemplar of Whitehead's unity of education principle in the cultivation of engineering and technical talent.

Integrated Theory and Practice

Given technology trends, wireless mobile and data communication technology will be the future mainstream technologies. The graduates from the major of communication engineering at Hunan First Normal College, Hunan, are educated and technically trained to work for small and medium enterprises engaged in the design and production of mobile smart terminals. The education programme is committed to developing talent at home in design and production of mobile smart terminals, with a dichotomy of wireless mobile communication and data communication. The essential

content of wireless mobile communication includes radio-frequency selection and realisation; while data communication requires the realisation of 3G communication protocols. The teaching content involves unity at three levels: integration of theory and practice for specialist teaching, for the directed teaching content and for the course teaching content. The system integrating theory and practice, and building on the three levels is shown in Figure 1, for the major of communication engineering.

Based on the unity at three levels, the teaching content of the various courses constitutes a unified, well-organised unit, which helps to define the role of each course in the entire teaching system and refine the content for integration of theory with practice for the courses. This results in course content that helps students to achieve mastery through a comprehensive study of the subject.

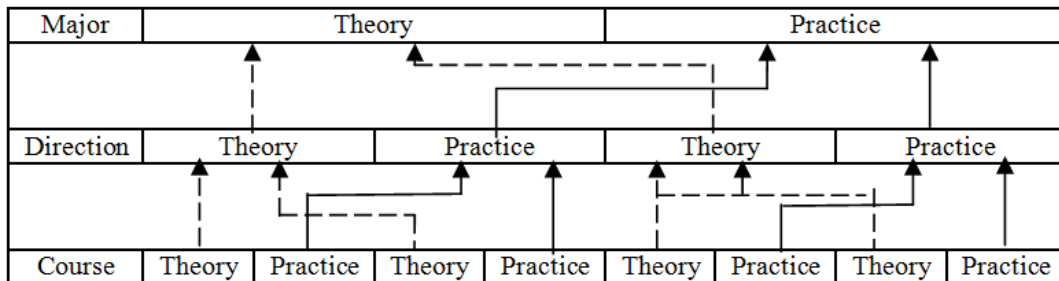| Major	Theory				Practice			
Direction	Theory		Practice		Theory		Practice	
Course	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice

Figure 1: The engineering teaching system integrating theory with practice.

In the teaching process, the theories and practice mainly use the C language, because it is applied as the development tool in the practical teaching of both wireless mobile communication and data communication. Figure 2 shows the engineering course sequence.
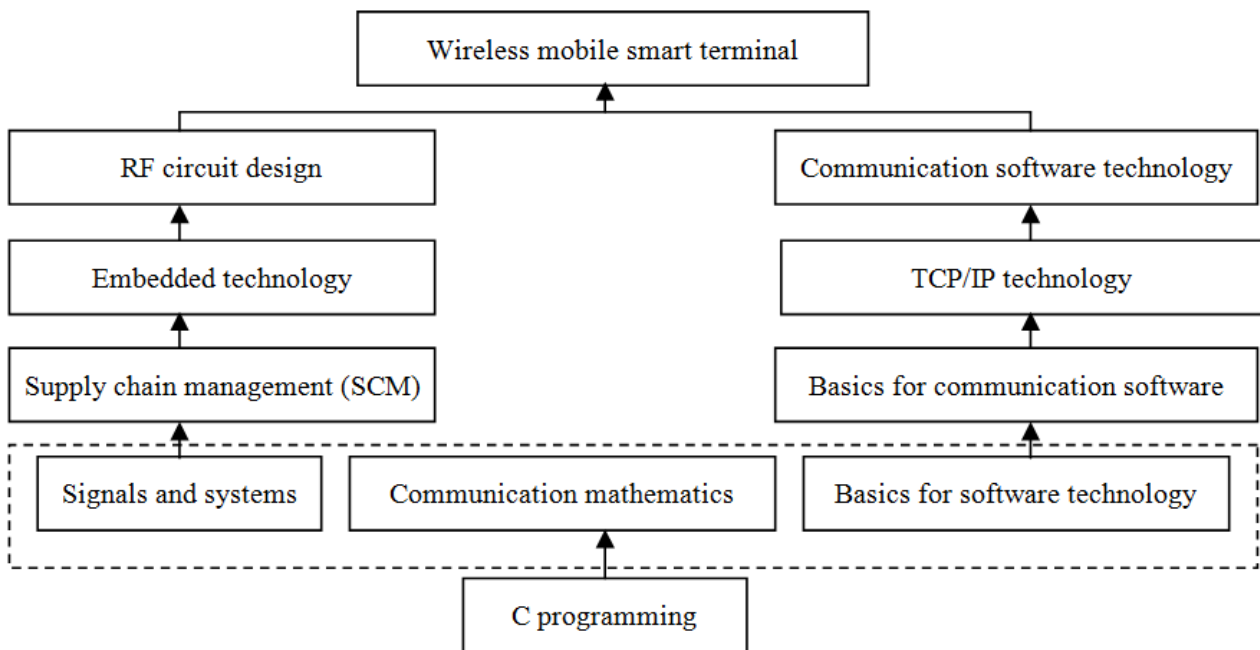
Figure 2: The engineering course sequence.

Unity Teaching - Literary, Scientific, Technical

At the three levels of the teaching, clear integration of the teaching of theory with practice unifies the scientific and technical components. Literary elements may be embedded in the definition of the teaching content and in the teaching methodology.

The literary elements are, as well as the scientific and technical content, an integral part of the teaching. For example, in teaching Introduction to Communications, the history of communication technology development runs through the entire teaching process, including descriptions of the concepts, as well as the theoretical basis and literary allusions in communication technology. The literary allusions not only make it possible for teachers to get a better teaching result, they also stimulate students' imagination such that they embrace science more enthusiastically.

In addition to enhancing the teaching of the scientific and technical content, the literary elements can make students better cultivated literally and improve their ability to organise, co-ordinate and communicate. For example, in the

teaching of Introduction to Communication, some chapters contain content independent of others. The course learning groups will address questions, raised by teachers, through organised learning and discussion, as well as by independent information searching; thus, enhancing their ability to organise, co-ordinate and communicate.

Unity between Curriculum Teaching and Extra-curricular Activities

The extra-curricular practical activities compensate for the shortage of time in the curriculum resulting from the difficulty of the course, with a consequent heavy workload. To provide guidance for students' extra-curricular study, the study organiser arranges the content of extra-curricular activities such that the curriculum teaching and the extra-curricular activities are consistent. For example, consider the course C Programming; the curriculum teaching covers basic knowledge, while the extra-curricular activities focus on the integrated use of that knowledge. The curriculum teaching and extra-curricular activities are carried out in parallel; the former providing the basis for the latter, while the latter provide learning goals for the former in turn. Hence, curriculum teaching and extra-curricula activities are conducted alternately and progressively.

Unity between Teaching and Learning

The unity between teaching and learning requires that the teaching be informed by the learning demands of the students and should anticipate possible problems students may encounter; thereby, conducting the teaching process with helpful and sensitive communication between teachers and students. Additionally, senior students can coach junior students' practical work. This not only reinforces and solidifies the senior student's knowledge, but also gives them some experience as a teacher. This increases students' appreciation of, and respect for, the teaching role, as well as encouraging them to more actively engage in the teaching process.

Results of the Reform of the Major

Before the reform, communication engineering students felt they were not well informed about the major and enrolments were poor. Students were affected by a broadly negative view of the University in society and the fact that the University was too teacher-oriented. After two years of teaching reform, students felt they had substantial learning achievements and were able to apply what they had learnt. This led to improved recognition of the major and increased enrolments.

Investigation and comparative analysis revealed that recognition of the major had risen, from 78% at the beginning of the 2013 academic year to 90% after one year, and was 83% for those enrolled in 2014; an increase when compared with those in 2013. Of the students enrolled in 2013, the percentage of admissions from the first application increased to 95% in 2014, from 90% in 2013.

CONCLUSIONS

Whitehead holds that education has both general regularities and individual differences. Therefore, students should be taught based on their respective aptitudes. Knowledge comes from life and should be used to serve life. Students' education should have a literary component, a scientific component and a technical component because these components are mutually interconnected. Students should develop independence through the process of education. Putting into practice Whitehead's unified education principles has demonstrated that they can play a direct and positive role in engineering and technical education.

ACKNOWLEDGEMENT

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