A New Approach in Abolishing Poverty: A Case Study and Construction Strategy for Integrating Inclusive Innovation into Engineering Ethics Education

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Abstract: At present, macro engineering ethics urgently requires the engineering talents to play a positive role in realizing human welfare, maintaining social justice and world equality. Therefore, it is necessary to think about how to make engineering students better participate in solving major social development problems through engineering ethics education, especially with the help of engineering students' professional knowledge and product design ability to help 2.47 billion people in the world "tackle poverty and get rich". Inclusive innovation proposes a new idea for solving this problem. Promoting the economic prosperity and abolishing poverty in developing countries are the purpose of inclusive innovation which guided by the idea of "building a community with a shared future for mankind". This paper attempts to explore how to integrate inclusive innovation into engineering ethics education in order to provide a viable solution for improving the ability of engineering students to promote positive social change.

Firstly, on the basis of explaining the connotation, characteristics and national practice of inclusive innovation, this paper puts forward that the core goals and philosophical starting points of engineering ethics and inclusive innovation are consistent, which provides the possibility and necessity for integrating inclusive innovation into engineering ethics education. Secondly, through the case analysis framework, which includes the three dimensions of "Concept-Pedagogy-Output", we systematically analyzed the typical case of MIT D-Lab. Our paper finds that MIT D-Lab has developed the educational tenet from three levels of knowledge, consciousness and ability. Meanwhile, this tenet is achieved through interdisciplinary courses, technology development and community activities. In the end, engineering students can play the role of "product/service designer" and "technology promoter" in inclusive innovation, and provide affordable products and service to poor areas through "knowledge creation" and "product innovation".

In conclusion, this paper offers suggestions for integrating inclusive innovation into engineering ethics education in four aspects: (1) constructing the curriculum content system solving the poverty problem; (2) building a high-quality interdisciplinary teaching team; (3) using multi-functional collaborative external support network; and (4) innovative teaching methods to expose engineering students to the "real world".

Key words: Engineering Ethics Education; Inclusive Innovation; MIT D-Lab; Case Study; Poverty alleviation

1 Introduction

At present, 2.47 billion people in the world still live on less than $2 a day. These individuals and families live in substandard housing, with limited or no access to sanitation, potable water, and health care, have low levels of literacy, and earn very low incomes.[1][2]Therefore, how to better provide “support and development” for the poverty group and “reduce the opportunity inequality caused by personal background and environmental differences” has become a hot issue concerned by governments all over the world, especially in developing countries. For example, the Chinese government regards “shaking off poverty by 2020” as the first priority and key livelihood project during the “13th Five-Year Plan” period, and is committed to building a well-off society in an all-round way and achieving common prosperity.

For a long time, economic growth and external charitable aid have been regarded as “panaceas” for poverty alleviation. Although there have been literature studies arguing that there is a clear positive correlation between economic growth and poverty alleviation, the empirical results show that there is a high heterogeneity between economic growth and poverty reduction. Countries such as Georgia, Bangladesh, Peru, and Turkey have maintained sustained economic growth throughout the year. However, there were little success in poverty alleviation. Simply relying on economic growth is not enough to lead to an inevitable relief of poverty.[3] At the same time, international aid has not reduced global poverty in the past 50 years. External charitable aid is facing many difficulties because of its poor sustainability and “address the symptoms, not the cause”. At present, a large number of studies regard inclusive innovation as a new idea and an important way of sustainable poverty alleviation.[4] Inclusive innovation always regards engineers as one of the most important participants. It can be said that “there is no way the world can succeed in eradication of poverty if the engineers are not part of the knowledge creation and technical product development”.

Chinese President Xi Jinping particularly emphasized the need to cultivate massive engineering talents with a sense of inclusive innovation and social responsibility. Through the technological innovation of engineers, China can enable the poor to enjoy “more satisfactory income, more reliable social security, more comfortable living conditions.”. Successful Chinese practices such as planting crops in deserts and developing fisheries through Internet of Things have pushed “technology + poverty alleviation” to the foreground of history. Technological innovation has greatly enhanced the poverty-stricken groups to overcome poverty-causing factors and broaden their path to becoming rich. Ultimately, China will achieve high quality and sustainable poverty alleviation.

Meanwhile, most professional engineering codes of ethics require that engineers shall understand and promote the principles of “contribution to the society and human well-being”. The National Academy of Engineering (2004) argued that engineering students need to develop “high ethical standards” and a “strong sense of professionalism” to effectively lead in a “dynamic world”.[5] However, the ethical obligations towards “poverty alleviation” are incorporated into the teaching of engineering ethics in very few programmes. Therefore, the

research question of this paper will focus on how to integrate inclusive innovation into engineering ethics education and cultivate “excellent” engineers with both technical and non-technical advantages to promote technical services for poverty groups.

2 Integrating Inclusive Innovation: Mission and New Topic of Engineering Ethics Education

2.1 Connotation and Characteristics of Inclusive Innovation and the Practice of Countries

In 2007, the World Bank released a report entitled *Unleashing India's Innovation: Toward Sustainable and Inclusive Growth*, which formally put forward the concept of inclusive innovation. The report defines inclusive innovation as an effort to create knowledge and produce products that are most relevant to the needs of the poor.[6] George, McGahan and Prabhu (2012) define inclusive innovation as the development and implementation of new ideas which aspire to create opportunities that enhance social and economic wellbeing for disenfranchised members of society.[7] Foster and Heeks (2013) define inclusive innovation simply as “the inclusion within some aspect of innovation of groups who are currently marginalized”.[8] No matter how to define “inclusive innovation”, however, it focused on the structures and processes required to develop and deliver innovative technologies (goods and services) incorporating the needs and interests of the poor. Meanwhile, it has novel features including significant involvement of the engineers, growth of technological capabilities within developing countries and the involvement of new technologies.[9][10] In this paper, we argue that inclusive innovation combines the unique resources and abilities of poverty groups with the advantages of production, technology and knowledge of innovation subjects (engineers, enterprises, governments and universities). It also eliminates all kinds of exclusive factors for economically impoverished or excluded groups, so as to bring forward and implement new ideas, practices and models for sustainable improvement of their social and economic welfare.

Theoretically, the characteristics of inclusive innovation are as follows:

First, the universality of the object. The object of inclusive innovation is quite broad, but the main object now should be poverty groups, especially farmers living in economically backward rural areas. **Secondly, the connection of process.** Inclusive innovation should be combined with local unique resource capabilities. Only in this way can local groups be truly integrated into innovation activities to effectively address inclusive issues. Innovative entities that can achieve this must have the advantages of production, technology, and knowledge that are closely related to the local community's resource capabilities and local industries. **Third, the sustainability of the results.** The sustainability of inclusive results means that the resources, capabilities and opportunities of the poor are truly improved and they can continue to seek more benefits for themselves. Meanwhile, the innovation subjects need to provide “hematopoietic” functions for the poor, not just “blood transfusion”. **Fourth, the availability**

of innovative products. Traditional innovation pays more attention to the learning and application of frontier knowledge in the process of innovation, and is committed to gaining more business benefits and value wealth. Traditional innovation pursues new functions and new experiences, and the unit cost is invested. Therefore, the value of products is relatively high, which makes it impossible for low-income people to share innovative products and services. Different from traditional innovation, inclusive innovation advocates on the basis of existing technology, based on developing the potential of poverty groups, and maintains the equality of participants and the sharing of innovation results. This requires inclusive products with low cost, low price and high market demand.[11]

Overall, inclusive innovation is conducive to the sustainable development of society and economy. Therefore, the power of inclusive innovation to alleviate social problems has been generally accepted by policy makers, international organization leaders and business managers as an important mechanism in addressing needs for societal change. There were growing engagement with inclusive innovation by international organizations such as the World Bank (2013) [12], OECD (2013) [13] and UNDP (2014) [14]. And by multinationals enterprises alongside large-and medium-sized firms, examples of these innovations include the Tata Nano, the Sakshat $35 web notebook, the Hrudayalaya Heart Hospital, Discovery Health, Ushahidiand new business models in such activities as microfinance, rural electrification, crowd sourcing through mobile telephony, and health insurance.[15] And also, by national governments such as China and India (OAPM, 2011).[16] Inclusive innovation (and by extension inclusive growth) has been widely acknowledged as a goal of public and business policy. For example, the concept of inclusive growth and inclusive innovation is very much at the center of China's 12th Five Year Plan (2011-2015), and is taken as an attempt to transform Chinese economic and social development model. While the government of India cites inclusive growth as the overarching objective of legislation and budgetary allocation, it provides significant resources towards programs that "[reduce] poverty and [create] employment opportunities, access to essential services especially for the poor, equality of opportunity, and empowerment through education and skill development" (Planning Commission, 2006). [17]

2.2 The Possibility and Necessity of Integrating Inclusive Innovation into Engineering Ethics Education

Engineering ethics and inclusive innovation are the "two wings" that promote social change. The two are symbiotic and co-prosperous and closely related.

Firstly, the core goals of engineering ethics and inclusive innovation are consistent. Engineering ethics denotes both a growing academic field and a normative corpus that overall enjoins engineers to "hold paramount the safety, health, and welfare of the public", as phrased by the US. National Society of Professional Engineers (NSPE).[18] Meanwhile, inclusive innovation always takes the well-being of the poor as the endogenous motive force, and is committed to solving the imbalance of social development, while traditional means of poverty eradication cannot fundamentally solve the problem. It can be said that both

engineering ethics and inclusive innovation share the core goals of “changing the potential of people's lives, solving social problems, and maintaining fairness and justice”.

Secondly, reflecting the social fairness, building a community with a shared future for mankind and fully stimulating the social innovative vitality are the philosophical starting points of engineering ethics and inclusive innovation. There are two principles need to be considered when we reflect the social fairness. The principles are as follows:(1) Equality of opportunities. Under the condition of fair equality of opportunity, all must share the benefits of innovative growth. (2) Difference principle. Engineering ethics and inclusive innovation are committed to making up for the “unfair starting point” caused by the “imbalance” of factors such as policy constraints, low educational level and poor living environment. [19] In order to make sure the disadvantaged members of the community could be got attention, both of engineering ethics and inclusive innovation focus on the realization of “process fairness” and “result fairness”.

Finally, although most engineering associations and universities have fully realized the great value of engineering ethics in reducing poverty and achieving social justice, there are few implementation plans. By searching on the “Web of Science” with “engineering ethics” or “engineering ethics education” as the theme, we can find that the research topics of "sustainable development in engineering practice or how to implement green engineering education" have been fully discussed. However, the literature on the subject of “engineering and social justice” is exceedingly scarce. Therefore, fulfilling “the overall mission of the [engineering] profession as contributing to human welfare”,[20] urgently need to integrate inclusive innovation into engineering ethics education.

3 Case Study on Engineering Ethics Education Integrating Inclusive Innovation

3.1 Analytical Framework of Case Study

The study was a case study research (Eisenhardt 1989) realized in an immersion at the MIT Development Lab (short for D-Lab), which is considered to be the most important engineering university in the world. To provide greater consistency in the production of the study, some scientific premises were followed based on Eisenhardt’s proposals. (1) Multiple investigators: three researchers, from different fields of knowledge, participated in the research, in order to bring complementary visions and reduce individual biases. (2) Multiple materials collection methods: mainly includes officially published reports and scholarly research literatures. [21]

The analytical framework for case study includes the three dimensions of “Concept-Pedagogy-Output”. The “concept” dimension refers to the tenet and goal of education. The “pedagogy” dimension mainly includes the construction strategy and implementation plan of

engineering ethics education that integrates inclusive innovation. The “output” dimension is expressed in the cultivation of engineering talents with ethical awareness and practical ability to “benefit human society” and to promote “inclusive development” in a certain region. In theory, the “output” of engineering students is closely related to the connotation of inclusive innovation, that is, it closely revolves around “knowledge creation” and “product innovation”.

3.2 An Inclusive Innovation Informed Ethics Based Case Study – MIT D-Lab

Global participation is an essential part of MIT's commitment to solving world problems and improving human life. As a world-class university with a world-renowned reputation, MIT has an abundance of scientific & technological resources and engineering talents, which provides a core support for its technology improvement and service network. By allowing students to break through the established worldview and experience diverse life experiences, MIT supports students' growth and gives students a better understanding of the world and where they are. In the process of serving the society with technology, MIT has formed a group of well-targeted and distinctive laboratories. The D-Lab (Development Lab), which is aimed at coping with the challenges of poverty, is a typical representative.

D-Lab was founded in 2002 by Amy Smith, a senior lecturer in Mechanical Engineering. D-Lab has developed and improved a range of technologies, including community water quality testing and treatment systems, human-powered agro-processing machinery, cooking fuels for global health care and ancillary equipment, and clean burning waste, which are actually relevant to the lives of people in underdeveloped areas. In addition, all D-Lab courses and projects are connected to community groups around the world, including partners in Brazil, Nicaragua, Honduras, Guatemala, Zambia, Cambodia and India, all of which are developing countries.

3.2.1 “Concept” Dimension: Designing for A More Equitable World

In response to the challenge of poverty and improving the living conditions of poor people through knowledge production and technology diffusion, D-Lab is devoted to develop a global innovation network and “create and deliver transformational student experiences in global poverty alleviation”. This tenet is achieved through interdisciplinary courses, technology development and community activities.

Essentially, the education of MIT D-Lab belongs to the category of macro engineering ethics education. Therefore, when summarizing the educational tenets and goals of MIT D-Lab, we can get inspiration from the research results of scholars such as Newberry and Haws. Newberry (2004) condensed these goals into three broad categories; (a) emotional engagement or wanting to be ethical, (b) intellectual engagement or knowing how to be ethical, and (c) particular knowledge or the discipline specific knowledge of codes or practices that allows one to make ethical decisions.[22] Haws (2006) called for a holistic and contextualized ethics education that would help students develop “enactive mastery, as they

encounter moral dilemma and work through ethical deliberations" while being provided "vicarious experience, encountering the moral dilemma of others with whom they identify; and expert testimony, following those whose expertise they accept".[23] More recently, scholars' research on the goals of engineering ethics can be covered in two dimensions: internalization in mind, including knowledge and consciousness, and externalization in action.[24]

First, at the "knowledge" level, MIT D-Lab has designed a series of courses, such as *Introduction to Energy in Global Development*, *Water, Climate Change & Health*, *Smallholder Agriculture*, etc. Engineering students acquire competency in the participatory design process, understand and apply principles of engineering and design, engage in hands-on shop work, learn to think critically about theories of development, and obtain meaningful experiences in the field. Second, at the level of "consciousness", students will be more sensitive to the issues of "social inequality and poverty" and will be able to examine their worldviews in a critical and self-improving spirit, while firmly convinced that inclusive technological innovation can greatly benefit human society. Finally, at the "capability" level, students are allowed to "use professional knowledge to try to produce inclusive technical products" through engineering practice and field work, thereby encouraging students to make "moral behavior" and improve their abilities of ethical judgment, decision-making, imagination and practice (Table 1).

Table 1 Educational goals of MIT D-Lab

Dimension		
Interior	Knowledge	Acquisition of engineering expertise related to solving the problem of "social inequality and poverty"
	Consciousness	Increase sensitivity to "social issues" Enhance ethical willpower
Exterior	Capability	Make ethical behavior Improve the ability of ethical judgment, decision making, imagination and practice

3.2.2 "Pedagogy" Dimension: Teaching the Ideas, Knowledge and Skills of Inclusive Innovative to Engineering Students

(1) Interdisciplinary courses

In order to ensure that a series of interdisciplinary courses can be established with high quality, D-Lab courses are taught by faculty and lecturers from across the Institute – from engineering to architecture and planning to management. At the same time, D-Lab classes feature instructors from a rich range of backgrounds – an instructor could be a social entrepreneur, an industrial designer, a humanitarian aid worker, a public-school teacher, an engineer, a social scientist, or a coastal ecologist. D-Lab instructors have taken many paths through their careers and bring complex, fascinating work and life experiences to the classroom. Take *Water, Sanitation, and Hygiene* course as an example, which is jointly conducted by MIT faculty, alumni, and experts in the fields of water/environment.

D-Lab enrolls students from every part of MIT, and expertise and interest diversity make for strong interdisciplinary students' teams. D-Lab courses usually include 15-30 students. At the same time, D-Lab uses plentiful engineering ethics education methods and activities, including weekly seminars, along with readings and discussions, workshops/games, and films. In addition, D-Lab places special emphasis on the educational methods of *field research* and *real-world exposure*. For example, field trips, which include coastal watershed restoration, flood protection, carbon sequestration, and zero carbon sites in the Boston area, are the important part of the *Water, Climate Change, & Health* course and helps students truly understand the mitigation and adaptation to climate change as it pertains to water and health.

(2) Technology research and development

D-Lab recruits community partners, students, employees, teachers, and alumni to develop technologies that may have a significant impact on improving the lives of the poor. Current projects include low-cost environmental sensing, microfluidics and microscopy, food processing and oil production, biometric data collection, energy production, refrigeration, and water purification.

(3) Community Activity

Community activities, mainly includes Communities of Practice, International Development and Design Summit, provide opportunities and ways for engineering students to reach out to poverty-stricken areas, grasp the actual needs of the poverty groups. On this basis, engineering students can carry out "knowledge creation" and "research and development of inclusive products". For example, in January 2018, a team of five students from the D-Lab: Development class traveled to D'kar and Kaputura, Botswana for three weeks of project work, relationship building, and cultural experiences (Figure 1).

Figure 1 Team Botswana: D-Lab Student Fieldwork in January 2018

Communities of Practice：A multi-day practical skill building workshop. D-Lab students

introduce the design process of technical products to the poor on the basis of taking full account of their educational level.

- All teachers and students work together to develop new technologies to meet the needs of local communities and/or generate income.
- The project team improves the manufacturing capability of local groups by developing products.
- All participants in the project need to produce, modify and adjust technology.

International Development and Design Summit： An annual event that lasts for weeks of practical design experience, bringing together teachers and students, economists and engineers, professors and pastors, masons and mechanics, doctors, welders, farmers and community organizers from more than 20 countries improve technology and start businesses to improve the living standards of the poor. Unlike most academic conferences, the International Development and Design Summit produces technical prototypes rather than papers. All participants learn basic design and entrepreneurial principles through courses and then address design challenges in agriculture, energy, health, water and sanitation, education in an interdisciplinary team. Particularly, engineering students need to work with local groups to develop and design products, and integrate technology into the mode of sustainable economic development.

Through community activities, a large number of external resources are brought into poverty-stricken areas, and combined with the resources and capabilities of local groups, providing practical channels for poor groups to earn income and improve living standards by using inclusive products. At the same time, engineering students can apply their expertise to transform the world in this process.

3.2.3 "Output" Dimension: The Role the Engineering Students Could Play in Inclusive Innovation

The primary output of incorporating inclusive innovation into engineering ethics education is the knowledge production and diffusion. On the one hand, engineering students bring their professional knowledge into poverty-stricken areas, on the other hand, the process of embedding local situations stimulates students to generate new knowledge and form new perspectives on social issues. For example, the MIT D-Lab students' teams provide production technology and tools for poor areas, popularize knowledge of design and use, and greatly realize the high-quality poverty alleviation of local poverty groups. At the same time, in the process of joint research and development with local groups, technology is continuously improved, modified and adjusted to produce new technologies and knowledge adapted to the local situation.

Meanwhile, through interdisciplinary curriculum learning, technology development and community activities, engineering students can consciously assume and play the role of "product/service designer" and "technology promoter", and become the backbone of promoting social development and progress.

(1) Product/service designer

Product/service designer refers to the engineering students should fully understand the needs of poverty groups, and focus on a specific need, such as lower-cost heating need, health care need under frequent power outages, and so on. The designed product or service should effectively meet local needs and have the potential for large-scale promotion. The engineering students studying in MIT's labs have consistently responded positively to global inclusive needs to design affordable and acceptable products and services for excluded or poor groups. For example, DIY Medical Equipment Toolkit (MEDIKits), designed to unleash the creativity of medical practitioners in developing countries, low-cost stoves that use pine needles as fuel, portable, pedal-driven washing machines, low-cost, solar-powered high-pressure sterilizer equipment, and so on.

(2) Technology promoter

Technology promoter refers to the promotion of products or technologies by engineering students in the local area on the basis of product/service design. To ensure the poverty groups actually enjoy the benefits of inclusive innovation to achieve economic and welfare improvement, the engineering students need to invest time and money to promote and popularize inclusive products or technologies researched and developed independently or jointly with other institutions. During the promotion process, MIT D-Lab engineering students took advantage of the role of formal and informal intermediaries such as local governments, associations, NGOs, and authorities to form a social network embedded in the local community. D-Lab field activities include: Innovation Capacity Building, International Development Innovator Network (IDIN), Technology Assessment Integrated Project, D-Lab Scale-Ups and Youth Outreach. For example, in 2007, four field studies were conducted in different parts of India by the MIT D-Lab project team. Through interviews, surveys, focus group discussions, and hands-on design workshops, rural and urban communities helped the team understand not only their needs and current practices related to water treatment, but also their design preferences for water filters, willingness to pay, and behavior change required for the sustained adoption of these filters.

Over the past 17 years, more than 2,000 of MIT students have had a D-Lab experience and most of them contributed ideas, expertise, perspectives, and hard work to make the world a better place! For example, Elliot Avila, who graduated from MIT in 2014 having taken D-Lab: Development, D-Lab: Design, and D-Lab: Cycle Ventures. He traveled with D-Lab to India to work on a solar dryer project as well as natural crayon manufacturing. On a D-Lab trip to Tanzania, he worked on a bicycle-powered corn sheller and a multicrop thresher. He also completed an undergraduate research project and his senior thesis was on a D-Lab project. In an interview, he said, "When I arrived at MIT, I was interested in science for the sake of science. Now it feels like the problems I work on have much more meaning, and it's a constant motivator for me to take on new challenges…I expected that I would either end up working for a financial firm or at a lab like the Jet Propulsion Laboratory or NASA. Now I'm much more interested in how science and technology play a role in people's every-day lives. D-Lab was a place where I learned the value of my education and the opportunities it affords

me."

Through the analysis of MIT D-Lab case, this paper summarizes Implementation framework of Integrating inclusive innovation into engineering ethics education from the "concept" dimension, the "pedagogy" dimension and the "output" dimension (Figure 2).

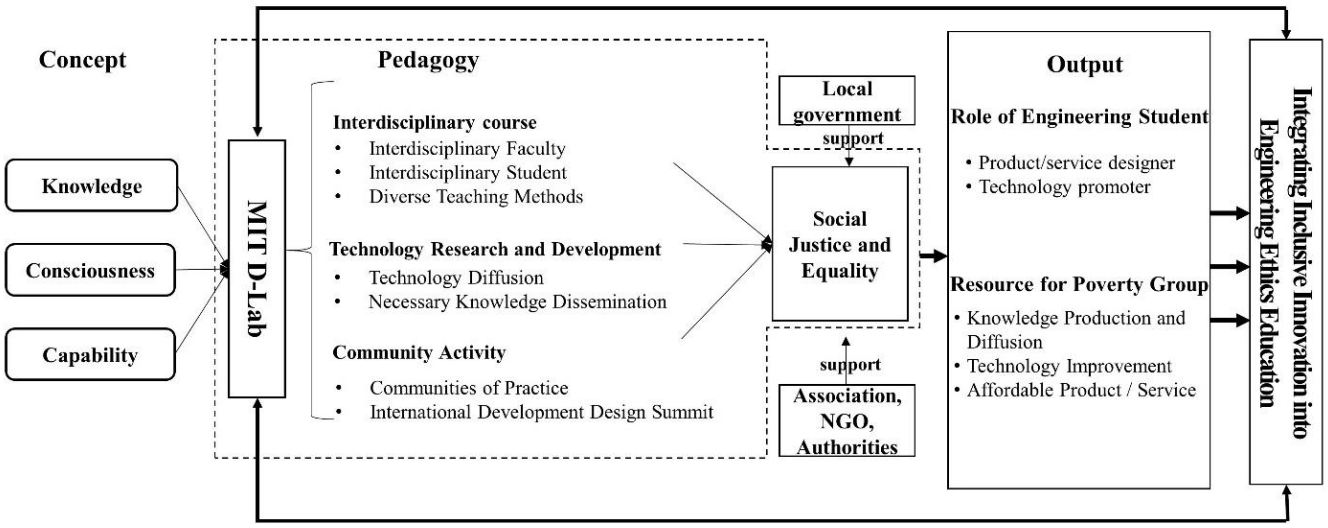

Figure 2 Implementation framework of Integrating inclusive innovation into engineering ethics education：based on the case study of MIT D-Lab

4 Construction Ideas and Strategies of Integrating Inclusive Innovation into Engineering Ethics Education

4.1 Constructing the Curriculum Content System Solving the Poverty Problem

The core demands of engineering students in solving poverty problems can be summarized as mastering relevant professional knowledge and grasping the requirements of poverty groups. Therefore, the construction of curriculum content system is guided by two core demands.

The first is professional and technical courses to improve the ability of engineering students to design and manufacture inclusive products. Close integration with the profession, through technological innovation to enhance the availability and professionalism of inclusive products is one of the main focus of engineering students to solve poverty problems. Professional and technical courses mainly focus on specific social or poverty issues. For example, MIT D-Lab offers courses such as "Water, Climate Change, & Health" to provide engineering students with expertise in inclusive technical applications and product design in the professional field.

The second is market strategy courses that are oriented to understand requirements of poverty groups. Engineering students in the universities have relatively shallow social

experience, not strong sensitivity to social problems, and many ideas have certain blindness. The course of market strategy provides engineering students with professional knowledge and decision support such as demand and behavior analysis, investigation and prediction of poor groups. For example, MIT D-Lab offers courses such as *Supply Chains.*

4.2 Building A High-Quality Interdisciplinary Teaching Team

Knowledge based on solving social problems is cross-complex and relatively open. It is difficult for a single-disciplinary teacher to solve all the problems faced by engineering students. This requires the construction of a high-quality interdisciplinary faculty team. The interdisciplinary faculty team aims to continuously help engineering students to solve the problems faced in the process of serving the society. It brings together teachers from various fields and mastering different skills to carry out education and teaching activities, including social entrepreneur, an industrial designer, a humanitarian aid worker, a public-school teacher, an engineer, a social scientist, and so on. This is the necessary guarantee and effective way to integrate inclusive innovation into engineering ethics education.

4.3 Using Multi-Functional Collaborative External Support Network

Enterprise cooperation networks, technology transformation networks and social service networks are the most important external support networks for a university or a certain engineering major to integrate inclusive innovation into engineering ethics education. These networks contain abundant resources.

The first is the Enterprise cooperation networks. Like the engineering community, companies are regarded as one of the main participants involved in inclusive innovation, such as India's Tata Group. Enterprises generally have strong capabilities of capital turnover, market development, product design, and talent cultivation. Therefore, colleges or universities should actively seek the support of enterprises to achieve mutual benefit and common development.

The second is the technology transformation networks. Engineering students often get invention patents by participating in inclusive innovation. Therefore, universities or majors can make full use of technology transformation networks to effectively transform the invention patents of engineering students by holding patent information conferences and technology transfer meetings. Thereby achieving the growth of multiple benefits such as “individual-university-poor groups”.

The third is the social service networks. The purpose of engineering students participating in inclusive innovation is to achieve inclusive economic growth in a country or region, which is in line with the vision of government agencies and NGOs. Government agencies, NGOs, etc. can also provide problem solving solutions and resource support for engineering students, such as assisting engineering students to locate social welfare undertakings, formulating social entrepreneurship project development strategies and providing them with necessary

financial support.

4.4 Innovative Teaching Methods to Expose Engineering Students to the "Real World"

D-Lab uses a variety of engineering ethics education methods and activities, but attaches particular importance to field practices and real-world exposure. By organizing practical activities such as Communities of Practice, International Development and Design Summit and so on, engineering students are helped to transform the concept of inclusive innovation into action force. Therefore, it is suggested to provide engineering students with 5-15 days of social practice activities. Through observing the "real situation" in poor areas, they can correlate what they learn, know and think with the real situation, and think about how to innovate technology and develop inclusive products for poverty groups in the process of social practices.

5 Limitation of the Study and Further Research

Our study is subject to certain limitations and warrants further research. First, more case study methods, such as interviews and observations, should be used to analyze typical cases of universities in different countries, such as Punjab University (India), Tsinghua University (China). Then we should further explore the construction strategies of integrating inclusive innovation into engineering ethics education. Secondly, simply relying on case studies is not enough to fully demonstrate the teaching performances of MIT D-Lab. Therefore, it is necessary to construct a scientific scale or questionnaire to empirically test the educational outcomes of MIT D-Lab.

Integrating inclusive innovation into engineering ethics education is a new idea, and its theoretical foundation and construction strategy are in the process of exploration. Our paper focuses on the introduction of relevant practical programs. The issue of how to use engineering ethics education to promote social development is still to be further discussed and improved by scholars. Awakening scholars' attention to this issue is also one of the purposes of this paper.

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