

Facing the Rise of Maker Movement, What Should Universities and Students Do?

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ABSTRACT. I have read “maker-new industrial revolution” written by Chris Anderson many times, but every time I read it, I can still be attracted by some new concepts and ideas put forward in the book, and also be shocked by the prospect of the future new industrial revolution described in the book. The author has bought more than 20 copies of the book and distributed them to the teachers and students of their respective research groups. I hope that through reading, they can further develop their innovative thinking and inspire their higher innovation passion. As a university teacher, we should think about such a question: what should universities do in the face of the rise of “maker movement”?

KEYWORDS: Industrial revolution, Maker movement

1. Introduction

In the “2015 Chinese Government Work Report”, it is proposed that “mass entrepreneurship and innovation” be taken as the new engine of China's economic growth, and “maker” and “maker movement” have become hot words, causing widespread concern.

Maker, originated from English “a creator”, refers to people who try to turn all kinds of creativity into reality out of interests and hobbies, or put innovative design into practice. Everyone is born with a passion for creativity. Chris Anderson points out in his book “maker-new industrial revolution” that everyone who makes or participates in creation is a maker in essence. When more and more people join the maker team, the “innovative design and practice” of makers can form the “maker movement”. When tens of thousands of global “solo” makers are connected through the Internet and work together around common hobbies, the maker movement will set off a new wave of epoch-making significance. The maker movement in the Internet era can be divided into three levels: one is to use digital desktop tools to design new models and products, and to use desktop factories or cloud factories for manufacturing, so as to experience and enjoy DIY spirit. The second is to establish or participate in the open source innovation community, contribute enthusiasm and wisdom to their hobbies, and experience the maker's sense of accomplishment. Third, while establishing or participating in the open source innovation community, we should seek opportunities for entrepreneurship and put them into action. Of course, the innovative characteristics of maker movement make new levels emerge constantly.

Maker movement is the most feasible way to realize “mass entrepreneurship and innovation”. Facing the rise of maker movement, what can universities do and how to do it?

2. Abstracts of the Book “Maker-New Industrial Revolution”

In this book, Chris Anderson, editor in chief of Wired magazine and best-selling author, takes you to the forefront of the new industrial revolution to explore how today's entrepreneurs can use open source design and 3D printing to bring manufacturing to their desks. In the era of customized manufacturing, “do it yourself” product design and innovation, the collective potential of millions of garage inventors and enthusiasts is about to burst out, and the U.S. manufacturing industry will recover. As digital design and rapid prototyping technology endows everyone with the ability to invent, that is, the “physical long tail effect” - the innovative mode of “maker” using the world wide web for generations will surely become the trendsetter of the next global economic tide.

3. What Should Universities Do?

The responsibilities of universities are to cultivate talents, carry out scientific research, serve the society, inherit and innovate culture, etc. In the face of maker movement, how should these responsibilities be embodied and implemented? Compared with the characteristics and levels of maker movement, the author thinks that universities should consider constructing or perfecting education platform, scientific research and innovation platform and entrepreneurship platform.

3.1 Establish and Improve a New Education Platform That Can Meet the Knowledge Needs of Maker Movement

The use and popularization of digital tools is the basic ability of makers in the Internet era. In view of this demand, the education platform should highlight the use and learning of various digital tools. Taking mechanical product design as an example, digital design tools such as AutoCAD and SolidWorks should be emphasized. Any design has its basic principles and principles to follow. Digital tools are only a method and means of implementation. Therefore, professional basic knowledge is also essential.

In fact, universities have scientific systems and methods in knowledge transfer. Therefore, the construction and improvement of education platform need to consider how to adapt to the new changes brought about by the expansion of educational objects. After all, from the past only aimed at the students in the school, but now it is extended to the makers in the whole society including students. The emergence of massive online open course (MOOC) solves this problem well. MOOC, a form of education, makes it possible for makers to learn for life. As the builders of MOOC courses, universities need to update and launch courses according to social needs. At the same time, with the construction and popularization of MOOC courses, universities should gradually open the teaching experimental conditions to makers to improve the education effect.

3.2 Establish and Improve the Platform of Scientific and Technological Innovation That Can Promote the Maker Movement

This platform can be divided into two levels or categories, one is the technology support platform supporting open source innovation, the other is the open source scientific research platform. One of the most important characteristics of maker movement is open source innovation. The purpose of open source is to share technology, break technology monopoly, and enable each participant to promote continuous innovation on a higher platform and starting point.

University is the gathering place of science and technology innovation resources, including talents, disciplines, platforms, etc. it is the explorer and leader of science and technology frontier. In the face of maker movement, universities should first become a technology support platform for open source innovation. Open source innovation is inseparable from technical support. Universities can establish open source innovation community according to scientific research direction, provide a platform for makers to contribute their enthusiasm and creativity, and provide professional technical support for makers' innovation practice. The university can make it a practice place of open source innovation community through open research platform, and further stimulate the innovation enthusiasm of makers. To a large extent, whoever dominates the open source innovation community will dominate the future. Universities should also be the founders and pioneers of open source innovation in some fields.

Nowadays, scientific research is more and more interdisciplinary, and it is difficult to support scientific research with single discipline background and scientific research experience. Under the idea of open source innovation, it is worth exploring how to attract researchers with different academic backgrounds and professional skills to conduct in-depth research on issues of common interest. In this context, open source scientific research platform emerges as the times require. Mass online open research (Moore) is such a platform. With the help of the real-time interaction of the platform, Moore reflects the collective, open and instant wisdom collision. Through the interaction of collective wisdom, Moore forms the best scheme and results of scientific research. Compared with the open source innovation community, this is a higher-level and more professional open-source innovation activity, which requires higher professional and skills of makers.

3.3 Establish and Improve the Technology Incubation Platform from Maker Movement to Entrepreneurship Practice

With the help of the platform of science and technology, the university should play a leading role in the innovation of the whole society. While participating in the open source innovation community, makers will seek possible entrepreneurial opportunities and put them into action. Companies based on maker model emerge as the times require.

Universities should set up a technology incubation platform to support the establishment and development of Maker Companies. Through the introduction of social capital or the establishment of a financing platform based on the “crowd investment” mode, it provides economic support for the development of the company; through the establishment of a hardware platform for technology incubation, it provides the necessary office and production conditions for the company. At the same time, the technology incubation platform can also provide many daily management including financial management, so that the company can concentrate on innovation and entrepreneurship. Thanks to the support of open source innovation community, the company with maker mode has the characteristics of network and globalization since its establishment, which makes the company unique or competitive in specific products. The rise of maker model companies will surely lead to the climax of maker entrepreneurship.

People are the core of innovation. The biggest advantage of university is to have a group of talents with strong innovation potential. Making good use of this advantage, universities will play an increasingly important role in the new round of larger maker movement. It is the unshirkable responsibility of universities to establish a good education platform, scientific and technological innovation platform, science and Technology Incubation Platform, strengthen the cultivation of innovative spirit and consciousness, and create a unique cultural atmosphere

4. What Should Graduate Students Do?

4.1 Determination of Individual Research Objectives

(1) Focusing on the cultivation of scientific research ability, scientific research runs through the whole process of training. Paying equal attention to training and scientific research is the main mode of graduate education in many famous American universities. The number and direction of postgraduate recruitment are often related to the requirements of scientific research projects undertaken by teachers of the discipline. After entering the University, graduate students take part in the scientific research work of the instructor, and combine the course study with the project research organically.

(2) We should pay attention to the role of course learning and strengthen the training of basic knowledge and skills through elective courses. Both liberal arts and science and engineering graduate students have a large number of courses. In addition to the main required courses, there are a wide range of elective courses. Through the study of the course, we can achieve the goal of solid discipline foundation and skilled discipline methods, and prepare for the follow-up research to engage in advanced and creative work.

(3) We should give full play to students' autonomy and initiative, protect and encourage students' interest in research, and make research work based on personal initiative. Students are encouraged to determine the research direction and research topic according to their own interests, abilities and practical conditions within the scope of the discipline. The tutor put forward suggestions for consultation and adjustment.

(4) We should attach importance to the collective strength of subject teachers, and provide group guidance resources for graduate students with teachers of related disciplines. Tutors, faculty teams and teachers play a guiding role in the study and research of students, which enables graduate students to fully understand the theoretical knowledge and research hotspots of the discipline through the communication with related teachers of multiple disciplines, so as to avoid academic degradation caused by inbreeding.

4.2 The Construction of Curriculum Knowledge System

It can be seen that “research” is the most important and basic component of graduate education. In the process of graduate education, research is always closely combined with it, which is not only the core element of graduate education, but also the basic embodiment of the quality of graduate education. Specifically, the ability to “research” can be divided into four aspects,

(1) The first is the ability to build critical thinking, including insight, analysis and evaluation in the thinking process. Critical thinking refers to the process of thinking which may be tangible or intangible in order to get a positive judgment. The result of this kind of thinking training requires a person not to follow suit and obey unconditionally. He should analyze any problem in a practical and realistic way. He should seek differences rather than similarities. He should not only read books but also be realistic.

(2) The second is to cultivate the ability of effective communication. On the one hand, the ability to express one's own ideas in writing and oral, and to convey one's thinking activities to the audience; on the other hand, the ability to communicate with the audience in the process of expression, so as to get the ideas and opinions of others, and make correct feedback, so as to realize the thinking activities Communication.

(3) The third aspect is to cultivate the ability to solve problems. Whether it is theoretical problems or practical problems, the goal of scientific research can be considered to solve various problems, large and small, encountered in the process of human civilization. It is emphasized that research is driven by theoretical and practical needs, and is to solve difficult problems and dilemmas.

(4) The fourth aspect of ability is to establish the spirit of teamwork. The important feature of modern science and technology is a more specialized and meticulous division of labor. Everyone's research must be based on the foundation and cooperation of predecessors or others in order to play a maximum effect. The mode of lone ranger is no longer suitable for most scientific fields.

The cultivation of these abilities should be paid more attention to in the process of graduate students' training, which should also run through the whole process from enrollment to graduation. In the study of postgraduate courses, in addition to completing the teaching of course knowledge, more emphasis is placed on the cultivation of these abilities, which requires the completion of the construction goal of "teaching people to fish, more teaching to fish".

5. Conclusion

Since 2018, more than 10 graduate students have been trained in the research direction of the author. Whether they stay in this direction to engage in teaching and scientific research, or are assigned to other scientific research institutes or front-line forces, they all show good adaptability to their work and are well received by their units. It is a kind of military school maker training mode to formulate personalized training mode, take ability training as the core requirement of postgraduate training, and ensure the quality of graduate training through the construction of graduate guidance team.

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References

- [1] Merriam S B. Qualitative Research and Case Study Applications in Education. *British Educational Research Journal*, Vol. 41, No. 2, pp. 287–302, 1998.
- [2] Hsu Y C, Ching Y H, Baldwin S. Physical Computing for STEAM Education: Maker-Educators' Experiences in an Online Graduate Course. *Journal of computers in mathematics and science teaching*, Vol. 37, No. 1, pp. :53-67, 2018.
- [3] Bowers-Brown T, Stahl G, Lacey S, et al. Higher education, social class and social mobility:the degree generation. *International Studies in Sociology of Education*, Vol. 26, No. 3, pp. 326-334, 2016.
- [4] Griffiths P A. Reshaping the Graduate Education of Scientists and Engineers. *Academic Medicine*, Vol. 70, No. 9, pp. 826-827, 1995.
- [5] Zhang Y L. Analysis on the Path of the Innovation of the Cultural Quality-Oriented Education in University. *Creative Education*, Vol. 6, No. 3, pp. 415-419, 2015.