

The Study on the Development of University Curriculum to Cultivate Students' Creativity and Innovation

Futao Huang*

Research Institute for Higher Education, Hiroshima University

Abstract

The aim of this paper is to address the issues concerning the nurturing of creativity and innovation in university and college students from the perspective of curriculum development. Firstly, the paper outlines a research focus and identifies the concepts of creativity and innovation, as well as their key dispositions. By making an analysis of earlier studies of the two terms, this paper suggests that both concepts have general aspects which are transferable across all disciplines but which are domain-specific from the view of university education. They are not only viewed differently in different fields or professions, but are also expressed in a number of different forms, depending on the unique cultures, and environments in which they exist. Secondly, the paper presents a brief introduction to major university curriculum patterns from historical and comparative perspectives, examining the connection between these curriculum patterns and the cultivation of students' creativity and innovation. Thirdly, the paper suggests what strategies and measures should be undertaken in order to develop and encourage students' creativity and innovation. The paper concludes with an argument of the practical implications for nurturing students' creativity and innovation, as well as key research issues to be addressed in the future.

Keywords: creativity and innovation, curriculum development, undergraduate students

1 Introduction

With the advancement of knowledge society and economic globalization, we are entering a new age where creativity and innovation are becoming increasingly important. As argued by a large number of scholars, creativity and innovation are essential qualities not only for surviving and thriving in the knowledge-based society of the twenty-first century, but also for managing the complexity, challenges and turbulence of the economic and social orders in which we live, where knowledge creation is a highly valued commodity (Cremin, Burnard, & Craft,

2006). The response of higher education, therefore, is to support and prepare students to effectively manage and work in such environments by supporting the development of creativity, flexibility and motivation (Knight & Yorke, 2003). Actually, in recent years, more and more countries have recognized the importance of fostering creativity and innovation in students at various education levels. They include not only the OECD countries or mature systems (Looney, 2009), but also emerging countries.

To illustrate (Huang, 2006), prior to the mid- 1990s, one of the most striking features of the undergraduate curriculum in Chinese higher education institutions, a curriculum modeled on the that of the former Soviet Union, was the special emphasis placed on training professional manpower through specialized education for industry and socialist construction, especially with respect to engineering programs. As a result, undergraduate curriculum concerning professional education played a very important role in Chinese higher education institutions. Since the latter part of the 1990s, the Chinese government has carried out various strategies for reconstructing structures of university curriculum, including decreased attention to professional education based on specialty, provision of general education programs, and increased consideration given to developing students' capacities or competencies. With the increasing influence of economic globalization and the growing competition of higher education at a global level in recent years, more efforts have been made to foster the creativity of university graduates through the revision of undergraduate programs and renewal of methods of instruction. For example, the National Middle and Long-Term Plan for Developing Human Resources, issued by the Ministry of Education in China in 2010, described concrete, practical strategies and measures concerning the objectives and methods of cultivating human resources with creativity for the next 10 (MOE, 2010).

The aim of this paper is to address the issues concerning the nurturing of creativity and innovation in university and college students from the perspective of curriculum development. The paper begins by outlining a research focus and identifying the concepts of creativity and innovation, as well as key dispositions of creativity

* Corresponding Author: Dr. Huang Futao (futao@hiroshima-u.ac.jp)
Professor, Research Institute for Higher Education
Hiroshima University

and innovation in university. It then provides a brief introduction to major university curriculum patterns from historical and comparative perspectives, examining the correlation between these curriculum patterns and the cultivation of students' creativity and innovation. Thirdly, the paper suggests what strategies and measures should be undertaken in order to develop and encourage creativity and innovation in students in university and college. The paper concludes with an argument of the practical implications for the nurturing of students' creativity and innovation and the research issues to be dealt with in future.

2 Research Focus and Definitions of Key Concepts

2.1 Research Focus

It is generally considered that curriculum development or course planning plays a central role in producing and training students in any higher education institution. Although many studies have explored issues concerning curriculum development at different levels and in different types of educational institutions (e.g., Dewey, 1938; Dressel, 1963a; Evelyn, 1996; Goodlad, 1979; Goodlad & Su, 1992; Haworth, Lattuca, & Conrad, 2002; Levin, 1977; Stark & Lattuca, 1997; Tayler, 1949), there is relatively little research about the correlation between curriculum development and the nutrition of creativity and innovation in students, especially at an undergraduate level. Therefore, this study will make more intensive efforts towards the analysis of university and college curriculum development, focussing on the following research questions.

1. What are core dispositions of creativity and innovation in university students?
2. How can traditional and current curriculum patterns be used, changed, and coordinated to promote and produce university and college students with creativity and innovation?
3. And what strategies and measures can be conducted to foster students' creativity and innovation and to better promote it?

2.2 Definitions of Creativity and Innovation

Arguably, while there are several English terms which have similar meanings to the Chinese term 创新能力 (*Chuangxin nengli*), it seems that both creativity and innovation are equivalent in meaning to the Chinese expression. This paper employs these two English terms to refer to the Chinese word 创新能力. The following argument is mainly concerned with the issue of how these two terms are understood, both in general and more specifically from the perspective of educational science. Firstly, it will review the major literature of creativity, then

it will examine how the concept of innovation is defined in earlier studies. Finally, it will introduce the latest research on both concepts by the OECD research teams.

As both creativity and innovation have diverse meanings and many dimensions, and can be interpreted from different perspectives and at various educational levels, it is extremely difficult and challenging to isolate an accurate definition for them. However, previous research indicates that some common characteristics have been found in the two terms. For instance, some scholars claim that creativity involves the production of novel, useful products (Mumford, 2003). Others believe that creativity can also be defined as the process of producing something that is both original and worthwhile, or characterized by originality and expressiveness and imaginative (Albert & Runco, 1999; Csikszentmihályi, 1996; Sternberg, 2006).

From the view of the educational field, according to an earlier literature review (Cheng, 2004), in recent decades, there is a growing body of literature that concerns not only divergent thinking, but the integration of divergent and convergent thinking in the productive thinking process (i.e., producing new and useful ideas). Instead of focusing on problem solving, studies also recognize the importance of problem finding and sensitivity in the creative process. In affective aspects, William's Taxonomy of Creative Thought suggested that curiosity, imagination, challenge-taking and risk-taking attitudes are conducive to creativity development, while motivational factors, like interest, confidence and value in creative thinking are also important determinants. Amabile's studies emphasized that intrinsic motivation on the tasks and playful attitudes facilitate the emergence of creativity. Some creativity-enhancement programs also involve the learning of specific idea-generating heuristics, like brainstorming, mind-mapping, forced association, check-listing, creating metaphors, and creative dramatics. Among them, the brainstorming technique and the creative problem solving technique (CPS) are the most widely adopted in creative learning activities.

While the above-mentioned scholars concentrated on general aspects of creativity, some scholars believe that creativity is domain-sensitive (Baer, 1999). The former might believe that there exist a set of general creative attitudes and abilities that influence an individual's creative behaviors across a given domain, and, through nurturing these aspects, the overall creativity of a person can be enhanced. In contrast, the latter suggested that training in creativity cannot be transferred across domains. Whether this means that creative activities in specific domains, such as science, can enhance general creative attitudes or abilities of students across the spectrum is still an unanswered question.

Recently, the working definition of creativity used by the OECD research group (Lucas, Claxton, & Spencer, 2013), includes approaches which are deemed to be:

1. Complex and multi-faceted, occurring in all domains of life.
2. Learnable.
3. Core to what it is to be successful today.
4. Capable of being analysed at an individual level in terms of dispositions.
5. And strongly influenced by context and by social factors.

Similarly, the concept of innovation can also be defined as something original and new that “breaks in to” the market or into society. For example, according to Frabkelius’ definition, “an innovation is something original, new, and important -- In whatever field -- That breaks in to (or obtains a foothold in) a market or society.” (Frankelius, 2009).

Since 2005, the definition of innovation that is recognized by OECD countries with an intention of developing to build an internationally consistent way of measuring innovation is widely adopted (OECD, 2005). It suggests that: *Innovation is the implementation of a new or significantly improved product (good or service), process, new marketing method or a new organisational method in business practices, workplace organisation or external relations.*

Apparently, innovation is about more than just the generation of novel ideas or the dissemination of knowledge, it is about making a change or doing something in a new way. This second element of innovation, *implementation*, is crucial as only those novel ideas that are implemented can have an impact on society. It is this implementation element that separates *knowledge* and *invention* from *innovation*.

Recently, from the perspective of education, there is increasing consensus about which dispositions might serve as indicators of the strength of creative-mindedness in individuals. For example, in a comprehensive meta-analytical review of the creativity literature, Treffinger et al. (2002) compared 120 definitions of creativity in papers exploring the ‘traits,’ ‘characteristics,’ and other personal ‘attributes’ distinguishing highly creative individuals from their peers. From these 120 definitions they compiled a list of creative dispositions (cognitive, personality, and biographical), cited in at least three sources, clustering them into four categories:

1. Generating ideas.
2. Digging deeper into ideas.
3. Openness and courage to explore ideas; and
4. Listening to one’s ‘inner voice’.

Furthermore, after carefully weighing the pros and cons of existing lists of creative dispositions in the light of our criteria, Lucas et al. explored the following five core dispositions of the creative mind in their research model, describing creative approaches as:

1. Inquisitive. Clearly creative individuals are good at uncovering and pursuing interesting and worthwhile questions in their creative domain.
2. Persistent: Including sticking with difficulty, daring to be different, and tolerating uncertainty.
3. Imaginative. At the heart of a wide range of analyses of the creative personality is the ability to come up with imaginative solutions and possibilities.
4. Collaborative. An emphasis on the social and collaborative nature of the creative process. And
5. Disciplined. As a counterbalance to the ‘dreamy,’ imaginative side of creativity, there is a need for knowledge and craft in shaping the creative product and in developing expertise.

In the study, though there exist slight differences in the two terms, many more similarities can be found in them through a review of research literature. Therefore, the concepts of creativity and innovation are treated as follows:

1. The two concepts are used interchangeably in the paper.
2. The core dispositions or components of both creativity and innovation consist of a combination of abilities, skills, motivations, attitudes and especially divergent thinking and general problem-solving heuristics which transcend traditional ideas, rules, patterns, relationships, and the like to generate new ideas, artefacts, products, interpretations or ways of viewing situations and/or problems.
3. Both terms have general aspects, which can be transferred across all disciplines but are domain-specific from the view of university education.
4. Creativity and innovation are not only viewed differently in different fields or professions, but also expressed in a number of different forms, depending on the unique cultures, and environments in which they exist.

To sum up, the cultivation of creativity and innovation in university students is mainly concerned with the production of students who are imaginative, observant, persistent, expressive, explorative, flexible, playful, and critically reflective.

3 Major University Curriculum Patterns

There are a vast number of ways to describe patterns of university and college curriculum. For example, according to Dressel, there are four distinctive types of undergraduate programs. They include liberal education of a non-preparatory nature, preparatory education for graduate study, professional undergraduate programs, and occupational curriculums (Dressel, 1963b). Gellert divided the European university tradition into three strands. The first is a strand in which “scientific education” is emphasized in essence, this strand the Humboldtian

tradition of German university. The second is a strand in which “professional education” is emphasized, and is epitomized by France’s *grandes ecoles*. The third is a strand that values “liberal education,” which is attributed to the Oxbridge ideal (Gellert, 1993). More recently, Scott discussed the synergies and the contradictions between general education and mass higher education by identifying five main types of general education. These include liberal education, general education, popular education, interdisciplinary education, and the education focusing on core competencies, and generic and transferable employability skills (Scott, 2002).

Gellert’s earlier research provides a basic conceptual framework from which the argument made in this study was taken. In this study, major patterns of university and college curriculum, particularly at an undergraduate level, are identified from the perspective of objectives of university education. Impacted by various factors, including social, economic and political changes, as well as the advancement of knowledge, from the medieval times to the present day, there have emerged different types of university and college curriculums which are responsive to the diversifying demands of society. In the study, four major patterns are discussed. They include liberal and general education, professional education, scientific or research-oriented education, and competence-based education. Historically speaking, the pattern of liberal education developed as early as the 12th century in Europe. With the appearance of modern states, the pattern of professional education in the 18th century in France emerged. Based on the idea of liberal education, the pattern of general education came into being in the latter part of the 19th century in the United States. Especially since the 1980s, with the growing influence of globalization, the pattern of competence or competency-based education has gradually exerted a considerable impact on graduating students in European countries. As will be discussed below, these four patterns emerged in different phases, are changing over time, and their key characteristics are represented in some typical countries.

During the medieval era, in the later part of the 12th century when the University of Paris took its full shape, evidence shows that both liberal education and professional education had a strong impact on the school’s teaching activities. Though liberal education was largely considered a fundamental education program, in which professional educational programs were provided, it almost dominated the entire education approach of the two traditional universities in England: the University of Oxford and the University of Cambridge. At an ideal level, it was aimed at producing well-educated, well-rounded elites and leaders of society; at a system level, it was delivered in small-sized colleges; at a program level, it was mainly concerned with

the provision of the “seven liberal arts” which included Greek and Latin languages, literature and history, religious and moral education -- Especially studies in humanities. In the early 17th century, liberal education was introduced into North America and provided the basis for the core curriculums at the Harvard College. However, by the 19th century, nearly 150 years after the term liberal education was exported from Europe, in particular from England, the concept had changed considerably, resulting in an educational approach with clear American characteristics. This is partly reflected in the Yale Report of 1828. Since then, it has been revived as the model of general education in USA and has provided an important basis for the theory and practice of general education, as was evidenced in the report of the Harvard Committee on “The Objectives of a General Education in a Free Society” (Harvard Committee, 1945). Differing from the liberal education, the primary objective of general education is to produce free and responsible citizens with critical thinking, in addition to various capabilities and skills. Mainly provided in the first half of an undergraduate education, its programs include a wide range of elective programs in humanities, social science and natural science, alongside majors chosen according to students’ interests and preferences. But since 1980s, the two terms have shared more and more similarities. In a major sense, currently they can be considered as two interchangeable terms in many US universities and colleges (AACU, 2009). Before the 18th century, the model of the liberal curriculum had played a major role in European and North America university education, in particular in traditional universities in England. During the Modern era, in addition to this model, the other three models, which were mentioned earlier, were developed.

With respect to the professional education, after the French Revolution of 1789, a new pattern of professional educational curriculums came into existence. One of its most striking characters was its focus on the preparation of qualified professional and specialized graduates, especially technical manpower, for the state. Normally, this type of education was carried out in the non-university sector, in settings such as specialized colleges or technical institutions. Compared with the broad-ranging instruction in the liberal or general education, more emphasis was placed on the delivery of narrowly and highly specialized scientific, technical and professional training programs, mostly in applied sciences and engineering fields.

Almost at the same time, based on the Wilhelm von Humboldt’s concept, the pattern of the research-oriented curriculum was formed in the University of Berlin. By integrating teaching and research in research universities, this pattern aimed to graduate scholars and researchers pursuing pure science and truth without any practical

or utilitarian purpose. At a program level, it stressed the importance of modern studies concerning humanities, social science and natural science with a special emphasis on philosophy, basically in the form of seminars focused on research activities which were chaired by professors in institute or laboratorum. Though this ideal was not put into practice at the undergraduate level in many countries, including its site of inception, Germany, it was used as a model for graduate education systems in the US and affected Japanese academics' preferences for research since its establishment of modern university in later nineteenth century.

Prior to the end of the WWII, the significance of the role of the liberal or general education and professional education at the undergraduate level cannot be overestimated. In a major sense, by the 1950s, the two patterns had significantly shaped undergraduate systems in the vast majority of countries, though their influence differs considerably by region, country, institution, and even by discipline. In some countries, the history of curricular reforms has been essentially undertaken in defense of either liberal/general education or professional education (Rudolph, 1977). And it seems that the familiar debate still continues in more countries nowadays.

Since the 1960s, originated in vocational education and training at a secondary education level, there have appeared two representative approaches to competence-based education at a tertiary education level. The behavioristic approach to competence-related education has typically been represented by the Anglo-Saxon countries, while the holistic or integrated approach to it is more widely accepted in the European Continent countries. To illustrate, the behavioristic approach is essentially concerned with the evaluation of performance, in accordance with established norms. "Competency refers to the group of skills and knowledge which are applied in order to carry out a task or function, in accordance with the requirements imposed by the job." In contrast, the holistic-integrative focus is closely linked to "global professional definitions which place greater emphasis on the improvement of the training process" (Tippelt & Amoros, 2003). Moreover, some scholars claim that competence is seen as a whole, representing the sum of knowledge, capabilities, skills and attitudes displayed in a context with an appropriate level of generality or holism (Hodkinson & Issitt, 1995).

Currently, the competence-based education in Europe is affected by the social constructionism approach at an ideal level. At a system level, it is implemented in technical or vocational institutions, outside of research of comprehensive universities. At the level of curriculum or programs, it is mainly concerned with subject-specific competence and generic competence. However, though many differences exist in the understanding and practice of the two approaches, since the late 1990s, both of them have

increasingly emphasized the comprehensive or generic competence-based education and training, in addition to subject-specific competence. It seems that the ongoing reforms of competence-based education include, not only the traditional vocational programs, but also professional knowledge and subject-specific competence, as well as some core value which is pursued in liberal and general education (Huang, 2011).

As mentioned above, since the early 20th century, cultural factors, especially the rapidity of industrialization, the expansion of higher education and the introduction of science and technology have influenced a dramatic change in curricular models. Both the pattern of liberal curriculums (though the term is still employed in many US universities) and the pattern of research-oriented curriculums gradually gave way to the patterns of general curriculums and professional curriculums as well as competence-based education in some countries at the undergraduate level. In a major sense, especially in the most recent years, these three curricular models have exerted an increasingly significant impact on changes and reforms in undergraduate programs worldwide.

It appears that, according to the definition of creativity and innovation employed in the study, all of the patterns of curriculum presented so far include some aspects of developing students' creativity and innovation. Though each pattern has its own focus, in a major sense, each one could be employed to serve the cultivation of students' creativity and innovation, especially the pattern of competence-based curriculum, which holds striking promise. Despite this advantage, it is neither fully accepted nor fully implemented even in most European countries when, at least at an ideal level, it shares many components and dispositions with the concepts of creativity and innovation and might therefore be utilized as one of the most efficient and effective patterns to foster creativity and innovation in students.

4 Strategies and Measures

Since the mid-1980s, several researchers have proposed methods of increasing the creativity and innovation of individuals, including university students. Such ideas range from the psychological-cognitive -- Such as Osborn-Parne's creative problem-solving process, Syntectic's science-based creative thinking, Purdue's creative thinking program, and Edward de Bono's later thinking -- To the highly structured, such as TRIZ (the Theory of Inventive Problem-Solving) and its variant Algorithm of Inventive Problem Solving¹, as well as Computer-Aided Morphological analysis.

¹ This approach was developed by the Russian scientist Genricher Altshuller.

From the perspective of curriculum development, tremendous attempts have been made to foster students' creativity and innovation. To illustrate, Nickerson provides a summary of the various creativity techniques that have been proposed (Nickerson, 1999). These include approaches that have been developed by both academia and industry, such as:

1. Establishing purpose and intention.
2. Building basic skills.
3. Encouraging acquisitions of domain-specific knowledge.
4. Stimulating and rewarding curiosity and exploration.
5. Building motivation, especially internal motivation.
6. Encouraging confidence and a willingness to take risks.
7. Focusing on mastery and self-competition.
8. Promoting supportable beliefs about creativity.
9. Providing opportunities for choice and discovery.
10. Developing self-management (metacognitive skills).
11. Teaching techniques and strategies for facilitating creative performance.
12. Providing balance.

In addition, some professional associations in the United States have also made both general and specific suggestions about the encouragement of student innovation in their curriculum development. For example, in 2011 the ABET (Accreditation Board for Engineering and Technology) made the following suggestions regarding how to foster innovation in curriculum (ABET, 2011).

4.1 Program-Oriented Suggestions

- Introduce practice-based problems.
- Innovation with technical electives.
- Have interdisciplinary programs.
- Value innovation in curriculum in tenure decisions.
- Hold professional development education in innovation for professors.

4.2 ABET-Oriented Suggestions

- Perceived “bean counting” about form rather than substance stifles innovation.
- Create awards to recognize innovation.
- ABET could be more explicit about what innovation could look like as part of a program -- More explicit direction and told how students can be brought along.
- Explicitly ask for examples in self-study -- Share examples with visit team.
- Help programs understand the areas where innovation is “permitted” (or won’t conflict with essential elements of “compliance”).

The direct result of what we have learnt from the review of literature about the concepts of both creativity and innovation, as well as an analysis of changing patterns of university curriculums in the historical and comparative perspectives, suggests that individual strategies and

measures should be implemented if the aim of cultivating students' creativity and innovation is to be achieved.

4.3 Facilitating a Collaboration of Various Stakeholders with Academics and Students

In a strict sense, it is a new challenge for most countries and systems to adopt a totally new model of cultivating their students through a partnership and collaboration between government, industry, academics and other diverse stakeholders. Therefore policy makers should first of all develop supportive policies and favorable environments to foster students' creativity and innovation and the resulting positive benefits. Such supportive policies might range from funding both national and institutional curriculum reforms to supporting regulatory change, funding good practices in relation to the cultivation of students' creativity and innovation, and using national frameworks of quality assurance to ‘pull’ the production of students' creativity and innovation through. In addition, good communication, especially a direct and close collaboration between government, industry, academics, students and other stakeholders is ultimately necessary and important. The integration of government supportive policies and institutional incentives are especially desirable.

In order to create this kind of educational change, on the one hand, individual governments would be expected to develop and implement national policies to stress the importance of cultivating creativity and innovation in their students, both in light of their national context and social background, and also to allocate public funding in supporting each institution to change its curriculum pattern, engage in faculty development activities, renew methods of teaching, and so forth. On the other hand, individual institutions should endeavor to set up their own missions of education and establish supportive systems and environments in which activities concerning the production of students' creativity and innovation could be carried out.

4.4 Building up the Clear Objective and Changing Culture in Overall Curriculum

Although there are no universally-accepted definitions of the concepts of creativity and innovation, and educational systems vary significantly depending on different regions, countries, and systems, the primary and essential strategy that should be conducted is that each system and institution should set up a clear-cut educational objective in which the cultivation of students' creativity and innovation is embedded. More importantly, in some systems and institutions where traditional patterns of professional or general education have a dominant role in curriculum development, the educational culture ought to be changed and improved to devote more efforts to students' creative and innovative development alongside

the existing traditional forms of curriculum and academic programs.

Repeatedly, each system and institution will need to invent its own solutions in ways that are consistent with the society and its cultures, and decide whether the competence-based curriculum will replace the traditional or current curriculum patterns in many countries to become the new paradigm is yet to be seen. Seemingly, it is more directly concerned with the nurturing of students' creativity and innovation, the study suggests that the curriculum development which is indicated in Figure 1 may be considered as an alternative option while students' creativity and innovation is to be produced and encouraged.

4.5 Adopting Diversified Means of Fostering Students' Creativity and Innovation

Related strategies and measures which are expected to be undertaken at an institutional level are that development of flexible, operational and diversified means to foster students' creativity and innovation at an institutional and departmental, and even at program levels. According to the previous research (Ennis, 1989, 1998), it is recommended that at least three approaches could be taken to the curriculum development, aiming at cultivating creativity and innovation in students.

1. General approach:

To develop and design comprehensive and university-wide curriculum and programs with a focus on the

aspects of problem-finding, problem-solving and critical thinking and other content which are of relevance to students' creativity and innovation.

2. Infusion approach:

To incorporate deliberately content and materials which help students form creativity and innovation in individual programs, including professional, vocational, and technical educational programs.

3. Immersion approach:

Differing from the general approach, this method does not provide specific programs of fostering students' creativity and innovation, but students are immersed into the process of acquiring relevant dispositions and components consisting of creativity and innovation during their regular learning activities.

4. Mixed approach:

To combine different types of teaching methods and approach, most often faculty members make a range of approaches to the provision of their programs and lectures with an intention of cultivating creativity and innovation in their students.

4.6 Developing Operational Method of Assessing Students' Creativity and Innovation

Another important issue concerning the production of students' creativity and innovation, as pointed out by many previous studies, is how to measure and assess students' creativity and innovation. This is especially true in higher

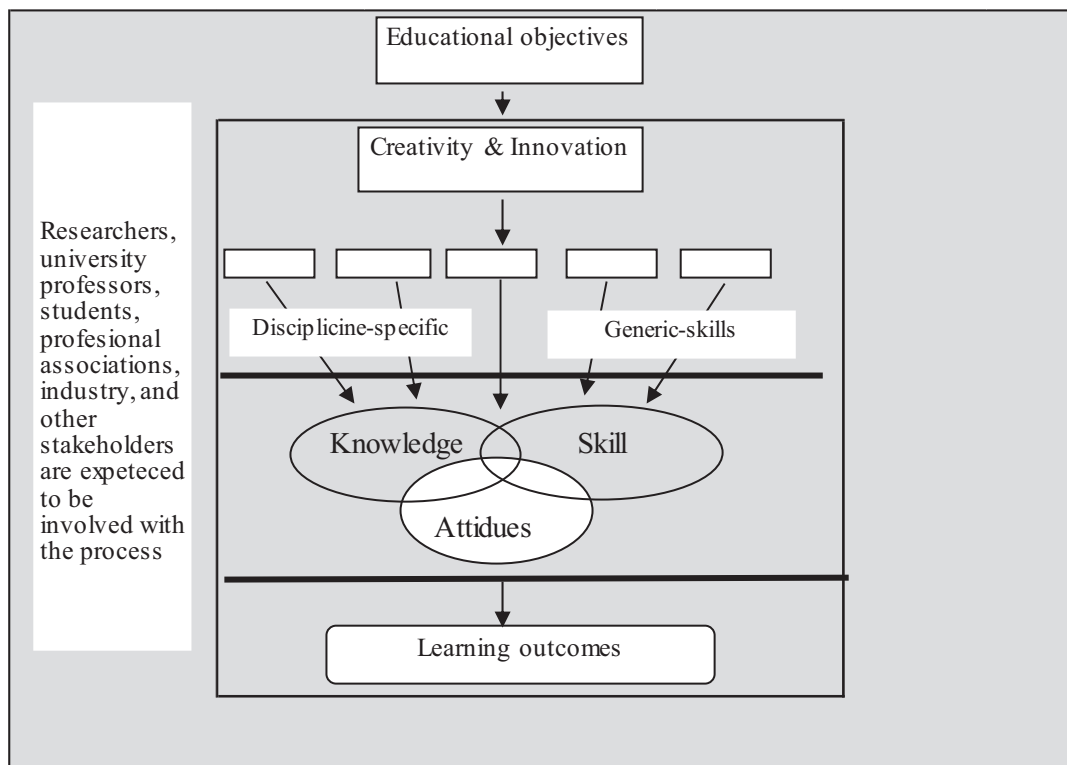


Figure 1 The Curriculum Development of Fostering Creativity and Innovation in Students.

Source: Based on Kouwenhoven (2009) with author's major modifications.

education. For example, as early as 2000, Jackson identified a range of problems that embraced: Creativity and innovation in higher education, the first is assessment and standards as serious constraints (Janson, 2000). In addition, The OECD research group also confirmed that their review found no examples of widely used and credible methods of assessing creativity in schools, although it uncovered some noble attempts and experiments.

However, despite the difficulties, since the early 1980s, a great deal of progress has been made in assessing creativity and innovation in school and university education. One of them is that an increasing consensus has been reached among scholars, faculty members, and policy to assess students' creativity and innovation by looking at their learning outcomes instead of paying attention to what has been taught for them. Consequently, though very complicated and socially situated, developing an operational method of assessing students' creativity and innovation based on various evidence, with a focus on how far they have acquired relevant and key dispositions and components of creativity and innovation, or how significantly students have changed by taking different approaches to learning activities concerning creativity and innovation appears to become a dominant way in assessing students' creativity and innovation.

5 Concluding Remarks

Though there is no universally acknowledged definition of either creativity or innovation from the perspective of education science, several key characteristics of these concepts have been identified. Therefore, except for the transmission of fixed knowledge and mere vocation or profession-oriented skills, all the traditional and existing curriculum patterns and all the disciplines can contribute to the cultivation of students' creativity and innovation though there may be conceptual variations in how it is understood. Among all the patterns, it appears that the idea of competence-based curriculum is more and directly involved with the production and encouragement of students' creativity and innovation.

As discussed earlier, because students' creativity and innovation is culture-based and socially situated, such activities which are implemented through curriculum development and other means tend to be significantly dependent on distinctive contexts, systems and societies. The objective and curriculum pattern based on which students' creativity and innovation are expected to be developed ought to be judged, evaluated and accepted by individual systems, culture and societies.

Any system, institution, or program with a purpose of cultivating students' creativity and innovation, first of all, needs to identify in what context or social background its curriculum is developed and based on what major

curriculum pattern its teaching activities are undertaken for the production of graduates. Then it needs to make a decision of whether it should adopt a totally new pattern to foster students' creativity and innovation or just maintain the current pattern but devote more efforts to the nurturing of students' creativity and innovation. Furthermore, it needs to assess what part and at what level of its curriculum, as well as what approach can be best -- Or at least sufficiently -- Employed to achieve its purpose.

As noted earlier, due to the fact that a vast majority of Asian countries established their modern universities by central governments with the clear aim of producing elites and manpower for the state's economic growth. Their university curriculum patterns are fundamentally based on the vocational and professional education models. For example, compared with the United States, the undergraduate educational programs in China, Japan, South Korea, Malaysia, Singapore, Viet Name, as well as Hong Kong, all concentrate on providing professional and vocational education content (Barnett & Symons, 2000; Yee, 1994). It is likely to assume that a general approach is expected to be made to the formation of students' creativity and innovation, together with other approaches.

Finally, from the discussions of the production and encouragement of students' creativity and innovation, which have been made from the perspective of curriculum development, it is clear that a great deal more comprehensive and in-depth research needs to be undertaken. For example, on what aspects should the educational approach to creativity and innovation be focussed? What are the typical views of creativity and innovation from the field or profession of education? How does the educational view of creativity and innovation vary depending on different cultures, countries, systems and regions? What are effective ways to foster students' creativity and innovation at an undergraduate level? And how to develop scientific and operational indicators to measure students' creativity and innovation from the perspective of education?

References

- AACU (2009). *Trends and Emerging Practices in General Education: Based on a Survey Among Members of the Association of American Colleges and Universities Conducted by Hart Research Associates, Hart Research Associates, Washington DC*. Retrieved June 12, 2013, from http://www.aacu.org/membership/documents/2009MemberSurvey_Part2.pdf
- ABET (2011, October). How can ABET better foster innovation in curriculum design, student engagement, and workforce development? Paper presented at the 2011 ABET Annual Conference, Baltimore, MD.

- Albert, R. S., & Runco, M. A. (1999). A history of research on creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 16-31). Cambridge, UK: Cambridge University Press.
- Baer, J. (1999). Domains of creativity. In M. A. Runco & S. R. Pritzker (Eds.), *Encyclopedia of creativity Vol. 1* (pp. 591-596). San Diego, CA: Academic.
- Barnett, S. W., & Symons, V. J. (2000). *Asia in the undergraduate curriculum: A case for Asian studies in liberal arts education*. Armonk, NY: M E Sharpe.
- Cheng, V. M. Y. (2004). *Developing physics learning activities for fostering student creativity in Hong Kong context*. Retrieved September 5, 2013, from http://www.ied.edu.hk/apfslt/v5_issue2/chengmy/index.htm#contents
- Conant, J. B. (1955). *General education in a free society: Report of the Harvard committee*. Cambridge, MA, Harvard University Press.
- Cremin, T., Burnard, P., & Craft, A. (2006). Pedagogy and possibility thinking in the early years. *Thinking Skills and Creativity, 1*, 108-119.
- Csikszentmihályi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York, NY: Harper Collins.
- Dewey, J. (1938). *Experience and education*. New York, NY: Macmillan.
- Dressel, P. L. (1963a). *College and university curriculum*. Berkeley, CA: The Center for Applied Research in Education.
- Dressel, P. L. (1963b). *The undergraduate curriculum in higher education*. Washington, DC: The Center for Applied Research in Education.
- Ennis, R. H. (1989). Critical thinking and subject specificity: Clarification and needed research. *Educational Researcher, 18*(3), 4-10.
- Ennis, R. H. (1998). Is critical thinking culturally biased? *Teaching Philosophy, 21*(1), 15-33.
- Evelyn, J. S. (1996). *Curriculum: An integrative introduction*. Englewood Cliffs, NJ: Merrill.
- Frankelius, P. (2009). Questioning two myths in innovation literature. *Journal of High Technology Management Research, 20*, 40-51.
- Gellert, C. (1993). Structures and functional differentiation: Remarks on changing paradigms of tertiary education in Europe. In C. Gellert (Ed.), *Higher education in Europe* (pp. 234-246). London, UK: Jessica Kingsley.
- Goodlad, J. I. (1979). *Curriculum inquiry: The study of curriculum practice*. New York, NY: McGraw-Hill.
- Goodlad, J. I., & Su, Z. (1992). Organization of the curriculum. In P. W. Jackson (Ed.), *Handbook of research on curriculum* (pp. 327-344). New York, NY: Macmillan.
- Haworth, J. G., Lattuca, L. R., & Conrad, C. (Eds.). (2002). *College and university curriculum: Developing and cultivating programs of study that enhance student learning*. Boston, MA: Pearson Custom.
- Hodkinson, P., & Issitt, M. (1995). *The challenge of competence: Professionalism through vocational education and training*. London, UK: Cassell.
- Huang, F. (2006). Undergraduate curriculum reforms in China. In Research Institute for Higher Education (Ed.), *A cross-national analysis of undergraduate curriculum models: Focusing on research-intensive universities* (pp. 13-26). COE Publication Series 21. Hiroshima, Japan: Research Institute for Higher Education, Hiroshima University.
- Huang, F. (2011). An historical and comparative study of competence-based education: Focusing on levels of concept, system and curriculum. In Research Institute for Higher Education. (Ed.), *Daiaku Ronshu (Research in Higher Education)* (pp. 1-18). Hiroshima, Japan: Research Institute for Higher Education, Hiroshima University. (In Japanese)
- Jackson, N., Oliver, M., Shaw, M., & Wisdom, J. (2006). *Developing creativity in higher education: An imaginary curriculum*. New York, NY: Routledge.
- Knight, M., & Yorke, P. (2003). *Embedding employability into the curriculum*. Learning and Employability Series 1. York, UK: The Higher Education Academy.
- Kouwenhoven, G. W. (2009). Competence-based curriculum development in higher education: A globalised concept? In A. Lazinica & C. Calafate (Eds.), *Technology Education and Development*. Retrieved September 15, 2013, from <http://www.intechopen.com/books/technology-education-and-development/competence-based-curriculum-development-in-higher-education-a-globalised-concept->
- Levin, A. (1977). *Undergraduate curriculum*. San Francisco, CA: Jossey-Bass.
- Looney, J. W. (2009). Assessment and Innovation in Education (OECD Education Working Paper No. 24). Paris, France: OECD.
- Lucas, B., Claxton, G., & Spencer, E. (2013). Progression in student creativity in school: First steps towards new forms of formative assessments (OECD Education Working Paper No. 86). Paris, France: OECD.
- Ministry of Education of the People's Republic of China (MOE). (2010). *Outline of China's National plan for medium and long-term education reform and development*. Retrieved June 18, 2013, from https://www.aei.gov.au/news/newsarchive/2010/documents/china_education_reform_pdf.pdf

- Mumford, M. D. (2003). Where have we been, where are we going? Taking stock in creativity research. *Creativity Research Journal*, 15, 107-120. doi:10.1080/10400419.2003.9651403
- Nickerson, R. S. (1999). Enhancing creativity. In R. J. Sternberg (Ed.), *Handbook of Creativity* (pp. 392-340). New York, NY: Cambridge University Press.
- Organisation for Economic Co-operation and Development (OECD). (2005). *Oslo manual: Guidelines for collecting and interpreting innovation data* (3rd ed.). Paris, France: Author.
- Rudolph, F. (1977). *Curriculum: A history of the american undergraduate course of study since 1636*. San Francisco, CA: Jossey-Bass.
- Scott, P. (2002). The future of general education in mass higher education systems. *Higher Education Policy*, 15, 61-75. doi:10.1016/S0952-8733(01)00036-8
- Stark, J. S., & Lattuca, L. R. (1997). *Shaping the college curriculum: Academic plans in action*. Boston, MA: Allyn and Bacon.
- Sternberg, R. J. (2006). The nature of creativity. *Creativity Research Journal*, 18, 87-98. doi: 10.1207/s15326934crj1801_10
- Tayler, R. W. (1949). *Basic principles of curriculum and instruction*. Chicago, IL: University of Chicago Press.
- Tippelt, R., & Amoros, A. (2003). *Competency-based training: Compilation of seminar subject matter: Training the trainers. Germany: Mannheim*. Retrieved May 8, 2013, from http://wdae.files.wordpress.com/2012/05/1_competency_based_training.pdf
- Treffinger, D. J., Young, G. C., Selby, E. C., & Shepardson, C. (2002). *Assessing creativity: A guide for educators*. Storrs, CT: The National Research Centre on the Gifted and Talented.
- Yee, A. H. (1994). *East Asian higher education: Traditions and transformations*. Oxford, UK: IAU Press.