https://doi.org/10.5392/IJoC.2018.14.3.069

Evaluation Criteria for Student-Centered University Education Programs

Hong-Tak Lim
Graduate School of Science & Technology Policy
Pukyung University, Busan, 48547, Korea

ABSTRACT

A new breed of universities equipped with student-centered education programs and advanced digital technologies is changing the face of higher education. "Flipped learning" is heralded as a new model of education, yet its effect is underexplored. The purpose of this study is to provide evaluation criteria to assess and understand the merit of student-centered education programs and apply them to actual cases. Discussion on the nature of knowledge, its production mechanism and system, and possible contribution of digital technology to user-centered programs are discussed to produce five key criteria; initiative of students, interaction in class, interaction in field, customization of courses, and automated personal service. They are applied to evaluation of Minerva and Ecole 42.

Key words*: Student-centered Education Program, Evaluation Criteria, Digital Technology, Knowledge Production.*

1. INTRODUCTION

A new breed of higher education institutions such as Minerva and Ecole 42 has emerged with innovative education programs. Their extensive and intelligent use of digital technologies is heralded as not just a sign of but also a requirement for a new model of university education. So called 'Flipped Learning', where the initiative of education is in the hands of students, demarcates these new breed of universities that employ user-centered or student-centered learning approach. The structural transformation in higher education institutions is under way along with the diffusion of digital technologies into various aspects of modern social system [1]-[3]. .

This study aims to provide evaluation criteria for such transformation. Equipped with state-of-art digital technologies, new user-centered education programs are welcomed and advocated worldwide. Yet scientific discussion on the educational effect or contribution of these programs remains underexplored [2]. The utility of professor-centered or supplier-oriented education model may still be relevant [4]. The identification of elements which would demonstrate the merit of new user-centered education programs is in need. Those elements can be used as evaluation criteria for new programs.

Since the principle goal of university education is to raise and nurture students' capability to use and generate knowledge, the nature of knowledge and its production mechanism are first discussed. The learning mechanism as a core process of education is analyzed to identify elements that would assess student-centered approach. The opportunities digital technologies provide are also discussed to clarify their contribution to new programs, in particular, to user-centered approach. The evaluation criteria are selected and applied to the several programs adopted by Minerva and Ecole 42 respectively. It concludes with policy implications along with future research directions.

2. ELEMENTS OF KNOWLEDGE PRODUCTION AND USER-CENTERED LEANRING

2.1 Nature of Knowledge and Learning

"We know more than we can tell." [5] succinctly illuminates the intrinsic nature of knowledge; tacitness. The size of one's total knowledge pool is much bigger than what one can tell or show. For instance you know how to ride a bicycle even though it is very difficult to explain in explicit terms. What one can write or document is even less than what one can tell. What science and scientists are trying to do is to make tacit knowledge into explicit one. A good engineer certainly has a good command of science yet his/her real strength is often coming from something that cannot be easily documented nor transferred. Because of tacit nature of knowledge, quite often one can only acquire it through doing, using and interacting rather than reading, listening to or watching lectures [6].

Jensen et al.[6] define 'Learning' as a generation and accumulation mechanism of knowledge and propose two modes of learning processes; STI(Science-Technology-Innovation) mode and DUI(Doing-Using-Interacting) mode. STI mode refers to more formal ways of learning through lecture or demonstration by professors while DUI mode refers

* *Corresponding author, Email: htlim@pknu.ac.kr*
Manuscript received Aug. 13, 2018; revised Sep. 19, 2018; accepted Sep. 19, 2018

to more informal ways of learning such as discussion, questions & answers, pilot tests and operations by students. The use and generation of tangible, explicit and artifact-embodied knowledge is usually the focus of STI mode of learning. Scientist and experts are the key actors and formal institutions such as universities or research institutes are the principal place of STI mode of learning.

In DUI mode, on the contrary, tacit, implicit, intangible and human-embodied knowledge is used and generated. Not all knowledge in lectures, talks, documents or presentations are transferred to the audiences. Recipients also matter in knowledge transfer let alone generation. Students and practitioners, those who are actually doing, using and interacting, are the key actors in DUI mode of knowledge generation [7]. Experiment, laboratories and factory shop-floors where real actions take place are the sites of DUI mode of learning.

The discussion on the nature of knowledge and two modes of learning suggests that students should not be regarded as just passive recipients of knowledge in university education. Due to tacit & human-embodied nature of knowledge, initiatives and actions of students are critical in learning. The role of professors is necessary but not sufficient. The merit and strength of new breed of higher education institutions may originate from their widespread adoption of user-centered education programs. The initiative of student is important for the STI mode of leaning but even more so for the DUI mode. Tacit nature of knowledge and the way it is acquired necessitates user-centered or student-centered approach to learning.

The evaluation criteria, thus, would include such questions as whether there are student-centered education program is; to what extent students are actually doing and using what he/she has learned from lecture; to what extent students are encouraged to interact with others. A user-centered education program may intend to embed DUI mode of learning within university education. To what extent such efforts are made headway into university programs would be the first criteria of evaluation.

2.2 Knowledge Production System and Learning

Bernal [8] recognized the power of science and witnessed the professionalization and institutionalization of science in the early 20th century. Universities and research institutes have taken the social responsibility of new knowledge generation. Social division of labor in relation to knowledge generation is manifested in the form of universities promulgating into modern society. STI mode of learning is socially acknowledged and institutionalized through the establishment of universities as a main body of generation of new knowledge and experts while DUI mode of learning is less accommodated into university system. Generation of explicit knowledge and systematic disciplinary approach to learning is much more appreciated as scientists and experts become key actors in the knowledge system.

'Mode 1' represent such centralized system of knowledge production in a society where new knowledge are generated at centers like universities and diffused to other parts of a society [9]. The linear model where investments in science would lead to the development of new technology and eventually result in the creation of new wealth has been the industrial & economic translation of the Mode 1 system of knowledge production. Conventional thinking on the relationship between science and society is largely based on the mode 1 production where disciplined research and learning is the key to new knowledge generation.

Mode 2, however, questions the centrality of Mode 1 in knowledge production [9], [10]. It emphasizes that new knowledge is produced more and more in application contexts rather than university laboratory. The proportion of new knowledge generated from real world problem-solving activities is getting bigger and bigger than those from centers of knowledge. Disciplinary approaches to problem-solving are seldom enough, interdisciplinary and trans-disciplinary researches are the proper description of real world knowledge production. Users and practitioners also, compared with scientists and experts, play a critical role in knowledge production. In other words, distributed system of knowledge production is becoming more relevant than centralized system of Mode 1.

The intrinsic nature of context and local specificity of the problem at hand, the secularization of higher education and the large number of university graduates, and the revolutionary advancement of ICT which dramatically reduced the cost & difficulty of knowledge processing, storage and dissemination would explain the rise of Mode 2 system [9]. New knowledge is certainly produced in universities and research institutes yet, at shop-floors in the factory, contaminated site in oil field, and other places of real world can also take place knowledge generation. Practitioners, shop-floor workers, residents, students and ordinary people can tackle the matters by themselves with the help of digital technologies.

The discussion on mode 1 and mode 2 indicates another important element of user-centered learning; whether students are exposed to application contexts. Putting students in real life context can have effects on two levels in relation to knowledge generation. First, new questions are put forward to the students, which are qualitatively different from those in university laboratory or disciplinary approaches. In order to address them, students might draw and integrate knowledge from other disciplines (interdisciplinary) or even from non-experts, users or ordinary people (transdisciplinary). Different types of explicit knowledge are exchanged and discussed, which makes STI mode of learning qualitatively different from that in university. Second, the interaction with ordinary people, users or practitioners also results in different DUI mode of learning. During laboratory experiment, students certainly learn and accumulate related tacit knowledge, yet completely different tacit knowledge is generated and accumulated in application context of real world problem-solving. With whom students interact, thus, constitutes another elements of user-centered university education program.

2.3 Digital technology and Learning

4 features or functions can be identified in relation to the practical utility brought by digital technology [11]. First, it acts like an information node which can detect, collect, process and record almost any information including that of machines.

Second it can provide new experiences through virtual reality(VR) or accelerated reality(AR). Third, it can suggest customized solutions based on automated extensive data analysis, manifested in the case of Watson or Alpha Go. So called 4th industrial revolution probably owes much to the emergence of the 4th science paradigm, data-intensive science paradigm [12]. Finally, digital technology enables people to enjoy benefits of platforms by significantly decreasing transaction cost utilizing demand-side scale economy.

As for user-centered learning programs, the potential contributions from digital technologies can be summarized into 2 fundamental functions of business. First, digital technology has made customization of learning a lot easier with less cost. Students are no longer at the end of recipient side; they can align and arrange their education portfolio beyond their departmental boundary. One can access any educational contents through the internet including lectures of prestigious university like Harvard or MIT. Transaction structure in education can be changed like other systems in a society [13]. As clearly indicated in the discussion of DUI mode of learning, downloading and watching video clips of famous lectures would not replace the classroom university lecture. Interactions with professors and classmates are important elements of learning process. User-centered programs, however, should devise the methods to utilize customization potential of digital technologies in order to assist student's initiative in learning. The accumulated data on personal behavior could show and tell who the person is and what he/she wants.

Second, digital technology enables students to enjoy automated education assistance service based on intelligent mechanization [14]. Classrooms are getting smarter and activities in the room are all recorded, processed and analyzed to assist learning experience. Students do not have to show up. Teleconference enables virtual class in which students can participate while are being scattered all over the world. The assessment of essay becomes less time-consuming thanks to A.I. assisted content analysis solutions. The transition of test system from multiple choice to essay would certainly be a challenging task yet achievable with less cost. Automation, sensing & communication, and analysis by intelligent algorithm can provide customized educational service to students. By customizing the whole education process to individual student, digital technology can increase the efficiency as well as effectiveness of user-centered learning program.

3. EVALUATION OF USER-CENTERED UNIVERSITY EDUCATION PROGRAMS

3.1 Evaluation Criteria

The above review can be summed up into 5 evaluation criteria for digital user-centered learning programs; initiative of student, interaction in class, interaction in application context, customization of curriculum, and automated data-based customized service. These can be used to assess the utility of new digital university education programs more logically.

'Initiative of students' acknowledges the critical importance of users in learning process. Regardless of whether the learning is associated with explicit knowledge (STI mode) or tacit knowledge (DUI mode), the student needs to play an active role in education programs. He/she should be ready to take on the subject in terms of not just attitude but also capability. Entry barrier or test requirement could be used as preparatory steps for students' initiative. Flipped learning would not be effective when students are locked in conventional professor-centered lecture.

'Interaction in a class' is selected to point out the importance of DUI mode of learning. Whether it is in a lecture theatre or an experiment laboratory, interaction with professors or colleagues is fundamental to acquiring and processing new knowledge. Unidirectional knowledge transfer seldom achieves intended outcome. Discussion and Q&A are essential element of the learning process.

'Interaction in field' asserts the need to integrate Mode 2 knowledge production system into university education program. The claim that new knowledge is also generated in application context and interdisciplinary or transdisciplinary approaches needs to be accommodated into user-centered programs. The candidates would be project-based programs such as university-industry collaboration projects, social problem-solving projects, and internship in private sector organizations.

One of the fundamental values generated by digital technology is that it enables consumers or users to customize what they want when they want and align production processes accordingly. It is worthwhile to check whether digital customization takes place in university education. Departmental boundary or disciplinary tradition may resist such attempt to generate a customized curriculum. In terms of sustainability of knowledge accumulation, interdisciplinary or transdisciplinary approaches might prove to be a daunting task in university education. It would be difficult to imagine degree course comprised of project-based learning without formal guide by professors

Finally, digital technology or information & communication technology enables students to enjoy automated intelligent assistance. Digital twins represent not just the provision of new experience in relation to learning but also the visualization and documentation of once tacit knowledge. Algorithm based on extensive data analysis or machine learning becomes an engine of new value generation. The responses of individual student can be recorded and analyzed to produce customized solution to specific purpose. Whether such automated educational assistances are available needs to be checked out.

Table 1. Evaluation Criteria for User-centered Program

Criteria	Definition
Initiative	*To what extent students have the initiative and they are ready to take it*
Interaction in Class	*To what extent students interact in class, with professors or with classmates*
Interaction in Field	*To what extent students interact in application context, with practitioners or with people*
Customization Curriculum	*To what extent students are able to customize & align curriculum*
Automated Service	*To what extent students enjoy automated data-based customized service*

Table. 1 summarizes the evaluation criteria and definition. The next section applies 5 evaluation criteria to the case of Minerva and Ecole 42.

3.2 Evaluation of New Education Programs

Minerva school began as a certified official university program, part of KGI, in September, 2014 in San Francisco, California USA [15]. There is no conventional off-line campus comprised of library, classroom and professor's laboratory. All classes are done through on-line education solution called 'Active Learning Forum' and students change their residence of study each semester travelling 7 cities all over the world while staying in dormitories there. Formal bachelor's degree is granted upon graduation, which is associated with KGI(Keck Graduate Institute) [16].

Active Learning Forum is a state-of-art on-line flip learning solution with which students read, listen or watch study material and discuss and debate related issues suggested by professors. The frequency of participation is automatically recorded and displayed in different color on the screen of professors so that he/she can balance and lead the students' interaction [17], [18].

In relation to initiative of students, high competition rate around 1:100 indicates new entrants seem to be determined to take on challenges provided by programs of Minerva which is, in fact, a kind of higher education service start-up [19]. Active learning forum, the format of every course, is designed to solicit interactions among classmates as well as with professors. It thus can be counted as state-of-art flip learning in action. Interaction in field is taking place in 'Civic projects' which requires working with local partners in 7 cities. It is also occurring in 'WILs'(What I've learned) where students interview practitioners in the shop-floor to apply and correct what they have learned from the class in the real world context. Apart from 'Co-curriculars', an everyday slot where students would reflect on what they have leant on that day, curriculum customization is not particularly different from that of conventional university programs. Active learning forum does keep the record of individual student's activity at the class so one could expect that it would be used to provide data-based personalized solution.

Table 2. Evaluation of Minerva and Ecole 42

Programs \ Criteria		Initiative	Interaction In Class	Interaction In Field	Customiza-tioin	Automat-ed Service
MINERVA	Score		●		○	○
	Comment	High Competiti-on Rate	Active Learning Forum debate-based class	Civic project WILs requires interaction with partners in the field	Co-Curricular Helps student stock-taking	Active learning forum record student activity
ECOLE42	Score	●	●	●	●	X
	Comment	Piscine 4 week long entrance exam.	Project-based classes	Compulsory internship (4-6months)	Personal Project & Group Project at student discretion	Not available

● : Strong : Moderate
○ : Minor X : Not Available

'Ecole42' was established by Xabier Niel, the founder of SFR, a successful French ICT company, to raise digital manpower and support digital start-ups in 2013 [20], [21]. The founder has pledged to donate up to 50 million euro to the school for 10 years. The tuition is free and the school is open 24hrs a day for throughout a year. There are no required courses, classes for completion of the program. There are no professors for theoretical courses either. Individual projects or group projects are the main educational contents of the program. Students proceeds from level 0 to level 21 upon completion of each project. No formal bachelor's degree is granted yet it can be obtained through arrangement with existing university.

In relation to initiative of student, 'Piscine', a 4 week long entrance examination, make sure students get ready to take on the challenge of Ecole 42, which is the process of preparing and selecting students those who are capable of problem-solving, independent project execution and teamwork. Project-based curriculum without any formal professorial intervention maximizes interaction in class and customization of courses, which is a stark contrast with conventional higher education programs. Along the course, 3 internship opportunities for the duration of 4 to 6 months are given, which also maximizes the interaction in the field with practitioners. Ecole 42 is proud of having top class companies in its internship host list. The information on automated data-based personalized service is not available from publically available sources [22], [23].

Table 2 summarizes evaluation results of Minerva and Ecole 42.

4. CONCLUSION

Digital technologies are transforming university education. Customization, aligning production & consumption process according to the needs of individual user does increase the effectiveness of learning activity, while mechanization with intelligence continues the efficiency gaining history of technology development yet takes it to the different level. New education programs adopt digital technologies aggressively and smartly to unleash the innovative power of users in learning [24]. Students become co-producers of university education service [25].

This study suggests 5 evaluation criteria and applies them to the case of Minerva and Ecole 42. Both school as a kind of higher education start-ups enjoys highly motivated students who survive fierce competition or harsh entrance examination process. The structure of class, flip learning or project-based learning, requires interaction with peers and professors in the class (DUI mode). Civic projects in 7 cities and internships with top class companies also put students in real life context exposing them to interact with practitioners and ordinary people (Mode 2). While students in Minerva seem to select courses, those in Ecole 42 have to fully customize courses through projects of their design. Students are given automated data-based personal service as in active learning forum, although the information on them is yet limited.

The evaluation of Minerva clearly shows that digital technologies do contribute to the transformation of higher education, breaking lock-in situation of supplier-dominance in

conventional education system. New user-centered university education programs have embedded digital technologies deep into the learning process, resulting in the structural transformation. The 5 evaluation criteria help to understand the merit of new user-centered higher education programs, the contribution of digital technologies and drivers of structural transformation.

There are however some remaining questions to be answered. While the power of selecting courses in Ecole 42 is certainly given to the hands of students, some might wonder whether it is merely a vocational training center for ICT capability rather than a higher education institution. In other words, some may question what it is Ecole 42 provides as a higher education institution. User-centered programs have clearly transformed university and contributed to its evolution as an institution of raising and nurturing manpower to use and generate knowledge, which, yet, does not mean that conventional supply-oriented disciplinary approach is of no use. The social institution of university as a pursuer and generator of new knowledge still matters. It is the combination of supply-oriented disciplinary approach and user-centered transdisciplinary approach that is making a difference. What kinds of combination and to what extent such combination affect the capability of university as an education institution would be the challenges facing professors and other stakeholders. The evaluation criteria would help them navigate and respond to such challenges. The application of the criteria to university programs in Korea would be an appropriate next research project in the same vein.

ACKNOWLEDGEMENT

The authors would like to express sincere gratitude to Miss So-Yeon Ock, Mr. Yeon-Ho Seong at Graduate Program of S&T Policy in Pukyong National University for their assistance. This research was supported by the Ministry of Science and ICT, and Ministry of Strategy and Finance

REFERENCES

[1] J. Y. Chung, *Education Policy Agenda for Future Information Society*, Korea Association of Education Academy, 2016.
[2] B. H. Sohn, J. H. Kim, and D. H. Choi, *S&T Ageda for the 4th Industrial Revolution*, KISTEP Issue Paper 2017-4, KISTEP, 2017.
[3] UNIST CTL, *UNIST Flipped Learning Guidebook*, 2016.
[4] M. Balconi, S. Brusoni, and L. Orsenigo, "In defence of the linear model: An essay," Research Policy, vol. 39, no. 1, 2010. pp. 1-13.
[5] M. Polanyi, *The Tacit Dimension*, Anchor Books, 1967.
[6] M. B. Jensen, B. Johnson, E. Lorenz, and B.A. Lundvall, "Forms of Knowledge and modes of innovation," Research Policy, vol. 36, 2007, pp. 680-693.
[7] B. A. Lundvall, "Innovation as an interactive process: From user-producer interaction to the national system of innovation," In G. Dosi, C. Freeman, R. Nelson, G. Silverberg, and L. Soete (Eds.), *Technical Change and Economic Theory,* London: Frances Pinter, 1988.
[8] J. D. Bernal, *The Social Function of Science*, Routledge, 1939.
[9] M. Gibbons, H. Nowonty, C. Limoges, M. Trow, S. Schwartzman, and P. Scott, *The New Production of Knowledge*, SAGE Publications, 1994.
[10] C. Nowotny, P. Scott, and M. Gibbons, *Rethinking Science*, Polity, 2001.
[11] H. T. Lim and J. W. Han, "A User-centred Classification Framework for Digital Service Innovation: Case for Elderly Care Service," International Journal of Contents, vol. 14, no. 1, 2018, pp. 7-11.
[12] J. Gray, "Jim Gray on eScience: A Transformed Scientific Method," In T. Hey, S. Tansley, and K. Tolle(eds), *The Fourth Paradigm: Data-intensive Scientific Discovery,* Redmond, Washington: Microsoft Research, 2009.
[13] R. Amit and C. Zott, "Value Creation in E-Business," Strategic Management Journal, vol. 22, 2001, pp. 493-520.
[14] W. B. Arthur, "The Second Economy," McKinsey Quarterly, issue 4, 2011, pp. 90-99.
[15] Digieco, *Future University of Entrepreneurship*, Digieco report, 2016.
[16] Minerva School at KGI, https://www.minerva.kgi.edu/about/
[17] Joongang Daily Newspaper, "Icon of Innovation, Minerva," 2017.1.15. news.joins.com/article/21123862
[18] Active Learning Forum: A New Way to Learn (full length), youtu.be/Gk5iiXqh7Tg
[19] S. Y. Joo, Innovative University, more difficult to get in than Harvard, Chosun Daily Newspaper, 2017.7.25. http://news.chosun.com/site/data/html_dir/2017/07/24/2017072401844.html
[20] KDI Finance and Economics Research Group, *Report on Retry and Start-up Policy in France*, Business Trip Report, 2016.
[21] 42 : une formation unique et une pedagogie revolutionnaire, www.42.fr
[22] H. R. Yoon, "French Youth Strat-up: Come to Ecole 42 no tuition fee," KOTRA Foreign Market News, 2015.2.27. https://news.kotra.or.kr/user/globalBbs/kotranews/4/globalBbsDataView.do?setIdx=243&dataIdx=140940
[23] J. Y. Lee, "At Ecole 42, French Start-up Academy," Maeil Business News Korea, 2015.2.2.
[24] E. Von Hippel, *Democratizing Innovation,* MIT Press, 2005.
[25] S. L. Vargo and R. F. Lusch, "Evolving to a New Dominant Logic for Marketing," Journal of Marketing, vol. 68, 2004, pp. 1-17.

Hong-Tak Lim

He received B.Sc. in Microbiology, M.UP. in Environment Management from Seoul National University, Korea in 1989, 1991 respectively and also received M.Sc. in S&T policy from Science Policy Research Unit(SPRU) Sussex University, Ph.D. in Management of S&T, Innovation from Manchester Business School, University of Manchester, the U.K. in 1994, 2010. Since then, he has been with Jeju National University, Korea Advanced Institute of S&T and Pukyung National University. His main research interests revolves around public participation in decision-making, knowledge generation and value creation including such issues as user-driven innovation, service innovation and transformation of socio-technical system and latecomer development.