18th SEAAIR Conference 2018 "Best Paper" Award

Development of Education Informatics in Korea

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ABSTRACT

Informatics changes data and information into knowledge that people apply to many aspects of daily life and was recognized as one of the ten emerging trends in the 2012 World Economic Forum (Davos Forum). Currently, informatics is mainly adopted in health and information science areas, and applications of informatics in education are limited. However, education informatics in terms of the use of information science and technology to support teaching and learning could lead to tremendous changes in the educational landscape in the future. This study intends to explore the possibility of education informatics in higher education by introducing a case study of Sungkyunkwan University in Korea. In 2015, a research team initiated a multi-year project, Cultivating Creative Talents through Educational Informatics, which is sponsored by the National Research Foundation of Korea. The project aims to cultivate global talents in education informatics who are talented professionals with specialized competencies such as the ability to analyze big data, to apply computing and information systems, and to utilize education technology. For the last two years, several courses including Teaching Methods Using Technology and Application of Computer Technology for graduate students, and Education Informatics, Big-data Analysis and Future Forecast, Emotional Intelligence and Informatics, and Data-driven Policy Analyses for undergraduate students have been developed and operated. In addition, Education Informatics shows additional possibilities including its connection to institutional research, enhancing campus-based student engagement, and improving students' competencies and learning outcomes.

Keywords: Informatics, Education informatics, Higher education, Korea

Introduction

Informatics changes data and information into knowledge that people apply to many aspects of daily life and was recognized as one of the ten emerging trends in the 2012 World Economic Forum (Davos Forum). Currently, informatics is mainly adopted in health and information science areas, and applications of informatics in education are limited. However, education informatics in terms of the use of information science and technology to support teaching and learning could lead to tremendous changes in the educational landscape in the future.

Many scholars and practitioners (i.e. Ford, 2004; Collins and Weiner, 2010) have been exploring the possibility of understanding 'education informatics' or 'educational informatics' as a discipline. Nevertheless, discussion about education informatics is rare in general and studies in education informatics are very limited. If informatics is the future and one of the keys to solve the future challenges, education informatics also can be the future of education, in both educational research and practice. This study intends to explore the possibility of education informatics as a sub-discipline in higher education by introducing a case study of Sungkyunkwan University in Korea.

Education Informatics as an emerging field of study

Definition of Education Informatics

Informatics first emerged in the field of medicine in the mid-twentieth century (Collen, 1994), and began to be adopted by other disciplines including nursing, public health, bioinformatics, environmental informatics, behavioral health, organizations, community informatics, social work, and social informatics (Collins & Weiner, 2010). Because the term *informatics* is used in a wide range of academic disciplines, the definitions of informatics vary across subject areas. For instance, informatics is commonly used to refer to topics related to the representation, processing, and communication of information within computational systems in computer science, and in information science, informatics is always concerned with the semantics of digital information use and communication and with digital interactions between multiple information sources (Levy et al., 2003). When applied to nursing, informatics integrates nursing science, computer science, and information science to manage and communicate data, information, and knowledge in nursing practice (Collins & Weiner, 2010).

In general, however, informatics commonly incorporates multiple disciplines and is, therefore, more broadly defined. For example, informatics is an interdisciplinary science employing information on science, information technology, and statistics (Wan, 2006), and informatics develop new uses for information technology to solve specific problems in diverse areas (Indiana University, 2018). Other aspects of informatics include understanding and promoting the

effective organization, analysis, management, and use of information; a reliance on knowledge-based or evidence-based decision-making; and the integration of data, information, and knowledge (Collins & Weiner, 2010). In addition, Hersh (2009) distinguishes informatics from information science and computer science, which is its root in a domain. He also emphasizes more about information than technology although technology is an important tool to make the best use of information.

The concept of informatics has also been applied to the discipline of education. Stewart (2000: 4) defined education informatics as "the collection, classification, storage, retrieval, and dissemination of recorded knowledge treated both as a pure and as an applied science" (as cited Collins & Weiner, 2010). Other definitions of education informatics include "the study of the application of digital technologies and techniques to the use and communication of information in learning and education" (Levy et al., 2003) and "the study of the development and application of digital technologies concerning the analysis, storage, manipulation, retrieval and use of information selected from multiple independent information sources, concerning learning" (Ford, 2004). In particular, Levy et al. (2003) insisted that "educational informatics is located at the intersection of three broad disciplines: information science, education, and computer science. Each of these encompasses a range of sub-disciplines and domains, including information systems, information management, information literacy, educational psychology, learning technology, computer-supported collaborative learning and instructional design (p. 299)".

Meanwhile, Collins and Weiner (2010) approached education informatics with different perspectives from previous studies. They argued that previously defined concepts of educational informatics mainly emphasized the *technology* part, and insisted that education informatics should focus on *users* of that knowledge and the information problems they experience. They believed that education informatics would "incorporate new technologies and learning strategies to enhance the capture, organization, and utilization of information within the field of education (Collins & Weiner, 2010, p.2)". By focusing on the user, they argued that "information problems can readily be identified and this will result in practical solutions and, therefore, provide incentives for the *adoption* of the solutions (p.7)".

Current fact/trends of Education Informatics

Many universities and colleges currently provide degree and certificate programs in informatics at undergraduate and/or graduate levels. For instance, Indiana University School of Informatics and Computing provides not only Bachelor of Science Degrees in three areas, Biomedical Informatics, Health Information Management, and Informatics, but also graduate degrees including master's, Ph.D. minors, certificates, and Ph.D. program in informatics (Indiana University, 2018). According to Ko (2016), the University of California-Irvine has the School of Information and Computer Science, which consists of three departments, the Department of

Informatics, the Department of Computer Science, and the Department of Statistics. University of Michigan - Ann Arbor and the University of Albany-SUNY also have a Department of Informatics: interdisciplinary. In the UK, the University of Sussex (Department of Informatics in School of Engineering and Informatics), the University of Edinburgh (School of Informatics), and the City University of London (School of Informatics) also provide degree programs in informatics.

As previously reviewed, education informatics has emerged as a new discipline. However, only a few universities provide degree programs in education informatics. One of the programs is the Education Informatics program offered by the University at Buffalo (UB), State University of New York. The Graduate School of Education provides Master of Education (Ed.M.) in Education Studies: Focus on Education Informatics. The Education Informatics program is designed for students who are interested in studying how information can be used to inform our knowledge of learning and education and prepares students to organize, analyze, and disseminate information to facilitate educational and organizational objectives. In this program, students will develop the understanding and skills necessary to become leaders in applying the information to address the needs of both formal and informal learners and learn the pedagogy of information use and how to improve people's use of information (State University of New York-Buffalo, 2017).

In addition, there are a couple of academic journals focusing on educational informatics, including *Informatics in Education* by the Lithuanian Academy of Sciences and *the Journal of Informatics Education and Research* by the International Academy for Information Management. Yet, those journals are more focused on educational technology, rather than a broader scope of education informatics.

Education Informatics: A case study of SKKU

Project background

Two major projects have contributed to the establishment and implementation of the education informatics initiative at Sungkyunkwan University (SKKU). One is the CK project and the other is the BK21 Plus project, both multi-year government-sponsored projects. We will provide the policy background first and then describe each project with a focus on how SKKU has implemented education informatics based on those projects.

University for Creative Korea Project (CK project): The CK project aims to lay the groundwork for university characterization, therefore universities are encouraged to focus mainly on developing their areas of academic strength considering the demands and features of the community. Accordingly, the project induced radical reform in universities. The CK project was

initiated in 2014 with over 1.2 trillion Korean won (KW) in overall investment over five years. In the first year, it supported 203.1 billion KW to local universities (CK-I) and 54.6 billion KW to universities in the capital region (CK-II).

After a rigorous evaluation process, 6 research teams at SKKU were selected and "Convergence-based Creative Informatics" was one of them. Six departments, the Department of Education, Department of Global Economics, Department of Global Business Administration, Department of Design, Department of Software, and Department of Global Biomedical Engineering at SKKU, were involved in this project.

The Creative Informatics team was aware of the advent of the age of Big Data and the importance of Informatics. Massive amounts of data and information are accumulated in the form of Big Data in all sectors of society, and handling and utilizing such exponentially growing amounts of information is becoming a major social challenge. The team believes that Informatics is the key to solving problems related to Big Data in each social sector by use of software technology.

We define Informatics as a field of study involving multidisciplinary convergence in efforts to develop new knowledge and value from meanings discovered or created in Big Data produced from the convergence of multiple organically connected domains. Thus, Creative Informatics is a study that targets the discovery and solving of problems through the convergence of domain knowledge and software technology in systematic processes, and the creation of new knowledge and value. It consists of Creativity (Ability to Generate and Solve Creative Problems) and Informatics (Domain Knowledge + SW Utilization Skills).

The goals are to create a convergence-based knowledge ecosystem and to build an open platform for convergence education. The first goal is to build an open convergence education platform where, as a solution to the problems of subject-centered major immersion education, single or multiple departments join in collective engagements for common educational goals and the vision of fostering talent. The second goal is to build an "Ecosystem and Learning Center where each knowledge community, on and off-campus, can engage in the production and consumption of knowledge," an agent or powerhouse of knowledge where student-professor interactions are facilitated and all walls between departments are removed. To accomplish these goals, four strategies are set to embody the goal of building up a Student-Centered Convergence Education Platform to foster talent in Creative Informatics: (1) Student-Centered Specialized Educational Curriculum, (2) Advanced Teaching/Learning Methodology, (3) Specialized Educational Support Infrastructure, (4) Shared Values Creation and Social Contributions.

Brain Korea 21 Plus (BK21+ project): The Brain Korea 21(BK 21) project is a national human resources development project initiated to produce creative master and doctoral-level human

resources and to promote the creation of new knowledge and technology based on creativity. It was launched in 1999 as the largest government-initiated project in the education sector in terms of its budget. The Korean government invested 1,306 billion KW during the first phase of the BK 21 project (1999–2005) and invested a total of 1,847 billion KW during the second phase (2006–2012). Started from 2013 the third phase of the BK 21 project (2013-2020) was renamed BK 21 PLUS, and the government plans to invest about 1.9 trillion KW.

In 2015, a research team, *Cultivating Creative Talents through Educational Informatics*, at SKKU was selected as one of the five research teams in the field of education. The project aims to cultivate global talents in education informatics who are talented professionals with specialized competencies such as the ability to analyze big data, to apply computing and information systems, and to utilize education technology. Four professors majoring in higher education, educational administration, counseling psychology, and educational technology in the Department of Education lead the research team with over 30 graduate students.

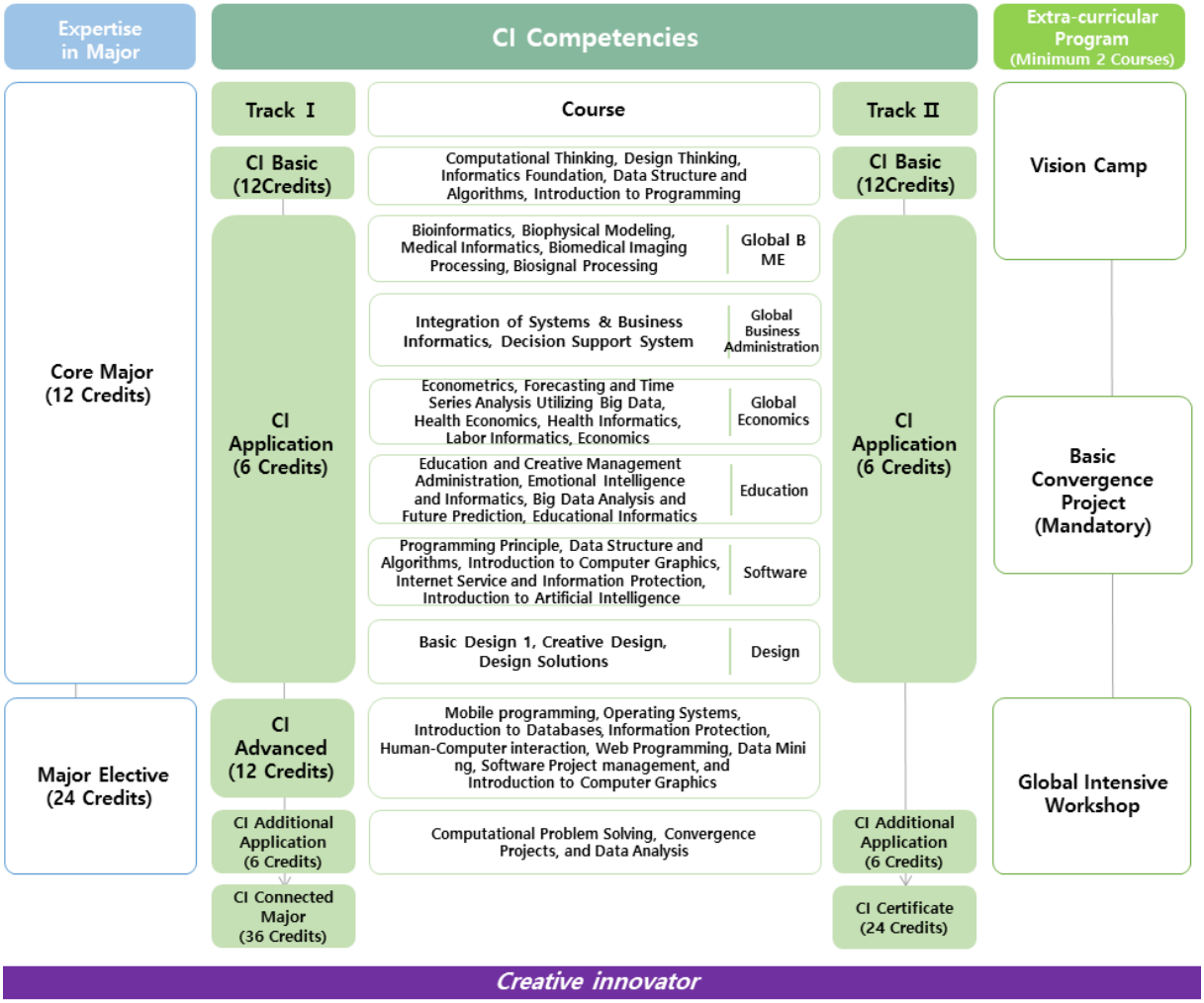
Implementing Education Informatics program

The C School: The C-School was established to implement the *Convergence-based Creative Informatics* project. Six departments including Global Business Administration, Global Economics, Global BME, Education, Software, and Design participated in the C-School. The C-School offers a systematic curriculum to educate students to become creative innovators. C-School's educational system consists of convergence courses bringing together Expertise of Major, CI Competencies, and Extra-curricular Experiences. There are two tracks and students can choose either CI Track I or II.

The core major courses consist of CI basic courses and CI applied for courses. CI basic courses are comprised of Computational Thinking, Design Thinking, Informatics Basics, Data Analysis, and Programming Basics. CI applied courses are offered by each participating department. The courses are cross-listed so students from other departments can earn credits from those courses. Figure 1 presents the roadmap of the C-School. To obtain a degree in Informatics, students should complete 12 credit hours in basic or core courses and 24 credit hours in applied courses.

The C-School also offers various extra-curricular courses including Vision Camp, the Basic Convergence Project, and Global Intensive Workshops. Vision Camp aims to help students improve their informatics abilities over a short period with the help of lectures by invited field professionals on advanced knowledge and technology in informatics. The Basic Convergence Project, a mandatory course for C-School Certificate and Interdisciplinary Program majors, is designed to cultivate problem-solving skills for working in multi-disciplinary, multi-level convergence teams, exploring global issues, and solving problems in local communities. Global Intensive Workshops offer opportunities for visits to major industries in global markets related to

new growth engines and potential industries and help in developing global perspectives through meetings with young entrepreneurs in local communities.



[Figure 1] Roadmap of the C-School

Source: Sungkyunkwan University (2018).

Courses in Education Informatics: In the Department of Education, for the last four years, several courses including Teaching Methods Using Technology and Application of Computer Technology for graduate students, and Education Informatics, Big-data Analysis and Future Forecast, Emotional Intelligence and Informatics, and Data-driven Policy Analyses for undergraduate students have been developed and operated.

Among the courses, Education Informatics was offered to undergraduate students in 2015 and 2018. As an introductory course, the objectives of the Education Informatics course in 2015 were to understand the impact of information and digital devices on humans based on the understanding of education and informatics and to explore how to utilize and apply education informatics in the field of education. This course consisted of two main parts: education and

information and institutional research. The first part, education, and information included an overview of education and informatics, searching for the true meaning of education and valuable information, and understanding education informatics. The second part, institutional research, included institutional/organizational intelligence, the creation of data and information in higher education institutions, the flow of information in a university, and a series of practices for using data and information in real-life settings. The Education Informatics course in 2018 was improved in terms of utilizing more data and information in higher education. That is, the 2018 course introduced not only technical skills using SAS and SQL in Education Informatics but also practical hands-on training such as big data analysis and classroom utilization analysis. One of the important contributions of these courses is to connect education informatics to institutional research. If "the philosophical foundation of informatics is the commitment to knowledge-based or evidence-based decision-making (Wan, 2006, p.3)", institutional research (IR) has to be linked with education informatics research because providing valuable data and information for the decision-making process and data management (generating, managing, and disseminating data to internal and external constituencies) and data analysis (providing valuable information) is considered to be the basic and essential function of IR (Ko, 2018).

Research on Education Informatics: As previously described, the aim of the *Cultivating Creative Talents through Educational Informatics* project is to cultivate global talents in education informatics who are talented professionals with specialized competencies such as the ability to analyze big data, to apply computing and information system, and to utilize education technology. In this project, we place a special emphasis on graduate-level students. Although certain courses are not provided for the graduate students, participating professors, together with graduate students, conduct studies related to education informatics. For instance, professor Ko not only offered a course, Education Informatics, for undergraduate students but also presented a paper entitled "Understanding Education Informatics". In addition, he and one of his students presented their paper, "A research on the possibility of educational informatics: Focusing on the analysis of the classroom utilization", at the 2016 Korean Education Research Association (KERA) Annual Conference (Kim & Ko, 2016). This study used classroom utilization analysis as a case study of applying informatics to education. Analysis of classroom utilization is a systematic analysis of how many hours a week a classroom within a campus is utilized by several students. The results of the analysis can provide useful information for making institutional decisions and planning for classroom use and facility expansion. This study finds a clear connection between education informatics and institutional research.

Issues and Challenges

Although the projects have been well recognized so far, some challenges still lie ahead. One of the biggest challenges is a low participation rate in the project. Several incentives such as a chance to take domestic and international field trips were provided to participating students, yet

not many students from the Department of Education were enrolled in the project. This is understandable from students' perspective considering that education informatics is a new area and therefore the career path after graduation is not clear. However, all educational programs in the university should meet a required minimum number of students set by the school, and a low student participation rate, which occurs continuously, may result in the closure of the Education Informatics course. The upcoming termination of the two projects which have been providing financial resources and administrative support is another major challenge. The CK project will be terminated in early 2019 and only a few programs will continue to operate after the end of the project. The BK21+ project will be completed in summer 2020. Lack of funding for education informatics programs after the end of the two projects will be an issue. The university has to decide whether or not to maintain the education informatics programs, and to maintain the programs, the university must secure sufficient financial resources. The last challenge is a lack of technology skills among students. Most students in the Department of Education do not have in-depth computer and technology skills, which are important tools to utilize information effectively. Students are more oriented toward humanities and social sciences, and most programs at the Department of Education aim to cultivate secondary school teachers. Hence students in the Department of Education possess relatively weak academic knowledge in software, computer, and technology. Without proper knowledge and skills, students will have a hard time completing the education informatics programs.

Nevertheless, there are possibilities for further growth of the education informatics programs. Several courses on information sciences and technology have been added to degree programs and participating professors and students are keen to teach and learn more about education informatics. The most significant point is that Sungkyunkwan University plans to establish a new college, School of Convergence, which will run all programs using the university's budget, instead of relying on external funds like the CK project and BK21+ project. The School of Convergence will include all convergence programs such as Informatics, Data Science, and Self-designed Transdisciplinary Studies. Education Informatics could be included in the Informatics program, and in this case, the university is expected to broaden the scope of the targeted student groups.

In particular, this study provides new possibilities to link Education Informatics with Institutional Research. Even though Education Informatics may not be a part of a new college program, it can establish its area when linking to institutional research. Higher education institutions should utilize data and information for university decision-making and strategic planning. For instance, Education Informatics can contribute to analyzing student retention and graduation rates, classroom utilization to examine how the university uses all classrooms and labs efficiently, the hourly population on campus to check the busiest hour during a day for campus management, enhancing campus-based student engagement, and improving students' competencies and learning outcomes.

Conclusions

The purpose of this study was to explore the possibility of education informatics in higher education by introducing a case study of Sungkyunkwan University in Korea. Two multi-year government projects at the Department of Education have initiated education informatics programs for the past four years. Five informatics-related courses were developed and in particular, an Education Informatics course is intended to understand the impacts of education information and to explore how to utilize informatics in the field of education. This course not only delivered knowledge about education informatics but also provided technical skills and practical hands-on training. Education Informatics at SKKU as the first undergraduate course in this field could serve as a basic and essential guideline for the further development of education informatics programs in other countries.

References

Collen, M. F. (1994). The origins of informatics. *Journal of the American Informatics Association, 1*(2), 91-107.

Collins, J. W., & Weiner, S. A. (2010). Proposal for the creation of a sub-discipline: Education informatics. *Teachers College Record, 112*(10), 2523-2536.

Ford, N. (2004). Towards a model of learning for educational informatics. *Journal of Documentation, 60*(2), 183-225.

Hersh, W. R. (2009). A stimulus to define informatics and health information technology. *BMC Medical Informatics and Decision Making*, *9*(1), 24.

Indiana University (2018, April 30). Informatics. Retrieved from https://www.sice.indiana.edu/graduate/degrees/informatics/index.html.

Kim, S., & Ko, J. (2016). A research on the possibility of educational informatics: Focusing on the analysis of the classroom utilization. Paper presented at the 2016 Korean Education Research Association (KERA) Annual Conference. Daegu Education Training Institute, Daegu, Korea, June 25, 2016.

Ko, J. (2016). Exploring the possibility of educational informatics. Paper presented at the Education Informatics Seminar. Sungkyunkwan University, Seoul, Korea, December 12, 2016.

Ko, J. (2018). Institutional research and themes, Asia. In J. C. Shin, & P. Teixeira (Eds.), *Encyclopedia of International Higher Education Systems and Institutions*. Springer. On-line version.

Levy, P., Ford, N., Foster, J., Madden, A., Miller, D., Nunes, M. B., et al. (2003). Educational informatics: An emerging research agenda. *Journal of Information Science, 29*(4), 298-310.

Sungkyunkwan University (2018, April 30). Sungkyun C-School Curriculum Roadmap. Retrieved from http://cihe.skku.edu/en/cschool/course01.do

State University of New York-Buffalo (2017, November 4). Education Studies, EdM: Education Informatics Focus Area. Retrieved from http://ed.buffalo.edu/teaching/academics/masters/ed-studies/ed-info.html.

Wan, T. T. H. (2006). Introduction. *International Journal of Public Policy, 1*(4), 333-342.