Advantage of Converged Education for a ‘Wicked Problem’: The Application of ‘Ecology Humanities’ in Liberal Arts Course

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Abstract: The purpose of this study is to analyze class activities that define the needs of converged education in order to solve for a ‘Wicked Problem,’ to anticipate the students and researchers to guide resolution courses for the evolution in the world of COVID-19. With the pandemic, the academics need to utilize more external and fusion perspectives in order to find an adaptable solution to current and trending issues for the students. The study was conducted on students with multiple disciplines in order to investigate interdepartmental effects of the course. The design of a converged class was to combine a basic liberal arts writing class with ecology studies including field studies. A total of 191 students participated during four semesters from 2019 to 2020. The composition of the students by discipline was as follows: Engineering 23.6%, Liberal Arts 8.4%, Arts 8.4%, Education 4.6%, Economics 25.7% and Science 29.3%. The class was designed as a “flipped” learning. First, to have collaboration and co-governance in order to produce and utilize new ideas via multilayered perspectives. Second, to understand information and knowledge from various media in order to examine issues, and to foster the ability to utilize in a problem solving situation. Initially, the class needed to achieve calibration of varying disciplines between literature and sciences into a converged perspective of ecology humanities first. Then, it was essential to find a reason and resolution of drastic changes of the environment with a liberal arts perspective to understand global challenges in ecology. Lastly, the development of comprehension ability on converged ideas between humanities and science was aimed with interdisciplinary communication based on basic science knowledge of the nature, life of species along with humankind. The results are summarized as follows: The students were able to understand different perspectives of different discipline backgrounds. 1. The understanding cultivated new ideas coming from interdisciplinary collaborations with flipped learning design. 2. The class developed an ability to foster an idea of resolution for current challenges with multilayered perspectives. However, more diversified disciplines were not cumulated for the class with limited number of students, and therefore the effect of converged education was limited with disciplines. The empirical projects were not sufficient as for a converged education. The “flipped” learning session was to be designed by students themselves from the start. In conclusion, the study suggests that the university needs to increase the number of classes for the students to introduce an idea of resolution of current Wicked Problem with inter-disciplinary collaboration from the basic liberal arts courses. Furthermore the empirical projects need to be a major activity of the class in order to have the students be more proactive designing the class resulting in a positive effect for the “flipped” learning.

Keywords: Wicked Problem, Converged Liberal Arts, Ecology Humanities, Flipped Learning, COVID-19

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1. Introduction

The Science and Technology Policy Institute of Korea set up 39 'Wicked Problems'[1] in ten categories in its published paper called 'Socioeconomic Innovation Strategy from S&T Perspective to Solve National Wicked Problems' in 2019. As it is stated, a 'Wicked Problem' is defined as a fundamental problem that requires in collaboration or co-governance but is difficult to resolve with an immediately available method. The terminology of a 'Wicked Problem' was used by Rittel & Webber in 1973 when they summarized its characteristics in ten categories[2] criticizing the theoretical approach of public administration policy. To review the summary: 1. No clear explanation 2. No rule to stop it 3. It is not a matter right or wrong but better or worse. 4. An immediate and ultimate experiment is not possible. 5. All resolution is applied as a disposable. 6. No potential resolution is there to list. 7. All issues are distinctive. 8. All issues are linked to other symptoms of issues. 9. It could be explained in various ways. 10. A designer is held responsible for the result. A 'Wicked Problem' is considered as a subject that could be close to a real world application in the education sector due to the fact that it should have multiple approaches because of the relationships with other 'Wicked Problems' and its questions in liberal arts perspectives. A 'Wicked Problem' is caused by multilayered modern society but it has no objection that it cannot be resolved with a single approach. Therefore, a basic liberal arts class needs to combine a liberal arts perspective approach and scientific approaches in order to develop a resolution of social issues. A 'Wicked Problem' does not have a clear resolution but an academic research with inter-disciplinary perspectives is needed in order to tackle unsolvable issues. A majority of the public administrative perspective states that 'collaboration advantage'[3] is key to have a strategic resolution of a 'Wicked Problem.' It is because a 'Wicked Problem' is a practical issue rather than a judgement of right or wrong according to Rittel & Webber. Therefore, it is essential to have the collaboration and co-governance via communication with multiple interests groups. The policy paper conducted by The Science and Technology Policy Institute of Korea had most of the researchers and advisors from engineering colleges such as Pohang University of Science and Technology and Korea Advanced Institute of Science and Technology and medical colleges. Not a single liberal arts researcher participated in the project analyzing the national 'Wicked Problem.' It was an evidence of deficiency in undertaking this level of project. Albeit the paper 'Socioeconomic Innovation Strategy from the Science & Technology Perspective to Solve National Wicked Problems' was just a simple science and engineering perspective research, it had to reflect more diversified perspectives as a general indicator so that it could have anchored the resolution through collaboration and co-governance. When a group of researchers consisted only a single discipline with similar perspectives in the course of establishing theories, the communication for resolution would correspondingly adapt only a single method without multi-layered perspectives. The converged education from the basic liberal arts course is needed to have a presence of co-governance to solve a 'Wicked Problem'

Diversified ideas can be derived when dichotomous education separated by science and liberal arts[4] was applied in a practical environment on a research paper to distinguish the different interpretations on a single object such as a flower or a tree by literature and science students. The class of ecology humanities was set as a sample case study for this paper. The class provided the students an experience where diversified perspectives with different background converged to a single interpretation from multilayered arguments. And this type of trait became one of the education courses to provide clues to resolve micro or macro level 'Wicked Problems' while reflecting reality. It does not provide a correctly converged answer from review and interpretation of independent perspectives of different individual disciplines. However, a key of converged education is to provide comprehensible answers on what kind of design should be applied in order to achieve an objective of liberal arts education when the converged perspective is applied to the course.

Most of the high school students in Korea have seldom experienced and studied a subject dealing with current issues outside of the school due to their burdens of college entrance system in Korea. The class was aimed to introduce to the students the approaches of how to deal with a 'Wicked Problem' in practicality perspective and how to develop an issue based problem solving in multi-layered converged environment. The class was designed to explore from the issue identification phase to the self-resolution phase in order to have the students exposed to a converged environment with colleagues from other disciplines. This is part of 'lived experience research' which is utilized in liberal arts studies as one of the qualitative phenomenology researches. The research was conducted in which the students would be able to find a methodology to approach a 'Wicked Problem.' Therefore, the research data was gathered based on statistics from the design, plan and class activities as qualitative research methodology. The phenomenology case studies were collected from the data of the survey. It is a considerable practice in liberal arts studies that quantitative statistics represents student's behavior and thought changes. This study also needed to gather statistical numbers collected from accumulated case studies of the classes. However, it is important that the class was designed to reflect the current situation faced by the students and the necessity of converged education. The study was aimed to find out what kind of thought changes the students experienced and what kind of positive impact was given to the students after the class. Moreover, it was also aimed to collect the evidence of qualitative improvement from the class and researched before the accumulated data.

2. Relationship of Converged Education with 'Wicked Problem'

Converged education researches are diversified from the definition analysis to converged design in education technology. As it is indicated in 'The Case Study of Converged Education and the definition of Ecology Humanities Utilizing Classic Literature,'[5] a converged education cannot be simply defined as a parallel class connecting disciplines A and B. A general explanation similar to a 'converged education' in this paper would be 'an education that is only applied existing knowledge of one's discipline'[6]. In other words, an individual expertise could be gathered and combined as one single converged class. The convergence has been interpreted as consilience and explained as an interdisciplinary convergence[7] since 'Consilience' by E.O. Wilson, who is physical reductionism oriented, was introduced in Korean. When approaches of consilience, convergence and totalistic are desperately required[7] for the advance of 21st century science technology and human cultures, the definition of convergence could be designed as a convergent education as 'two different academics converged into one.' The key point should be to derive educational objectives uniquely to a converged class via having "a common concept or conceptual blending for a designated research objective while individual subject academics maintain their integrity and independence." [8] This applies significantly when it comes to designing a converged class in liberal arts. This paper suggests not a team teaching but co-teaching, and coaching to sustain objectives of converged liberal arts course even though differences exist between liberal arts and science disciplines. It also asserts that the downside of converged education could be eliminated when professors from different disciplines could have various approaches for a single subject and provide students a diversified subject to think. In the past, a team teaching had different professors from different disciplines conducting one class at a time or chronological turns, however a co-teaching would have professors to design the class in collaboration to share and motivate free discussions. For example, Paul Kim, a Stanford University professor in education technology indicated an 'alien professor'[9] method to have students teaching each other and have a professor as a coach and a designer. The reason why it is called Alien Professor is because of its characteristic of coaching method. A converged education in basic liberal arts courses has an advantage for students from other majors to keep interest on their disciplines as well as to educate

macro level approaches in liberal arts perspective. Additionally, it is completely meaningful[10] to provide an opportunity to have different perspectives from the disciplines in order to enable an academic quality to read current and future key words. In order to sustain an academic quality, a co-teaching by a professor is inevitable to design a free discussion and to recognize between the multiple disciplines.

[Fig. 1] Nine Dot Game

When Nine Dot Game was introduced to the class as shown in Fig. 1, the students realized that the line should go outside the map to solve the game. This provided the students an understanding of a diversified perspective and they realized that a perspective expansion from a status quo is necessary as well.

Inter-disciplinary convergence is possible when multiple perspectives interchanges to solve an issue or to relocate an issue itself to have an insight to objections. The Students learned from the discussions when incommensurable theories from their discipline and others conflicted each other. The class needed to mediate and coach to achieve a class objective whenever non-explainable perspectives with common language are exposed. This means that coaching could be open to multilayered and diversified solutions by discussions of other perspectives from other disciplines in order to find difficulties of a 'Wicked Problem.' Thereby, the students supported themselves to solidify individual perspective using 'reflective equilibrium.'

3. The design of 'Ecology Humanities' for a 'Wicked Problem'

The education reflects sociocultural circumstances that combine the reality and education environment. The education context needs to develop and resolve sociocultural issues with applying theories that have multilayered perspectives on social issues and to have a mutual ground between nature and humankind. The meaning of 'resolve' in this context is to eliminate related issues by a learner empathizing with social sufferings and, in case of converged liberal arts education, to realize and resolve threatening issues to humankind such as environment and extinction of species. Furthermore, our humanity is facing unprecedented challenges for survival after the existing social system is replaced by a 'New Normal' amidst the global pandemic of COVID-19. Therefore, a 'Wicked Problem' has surfaced on humanity and environmental issues which require imminent actions, and hence converged classes are needed in the future in order to find a 'reflective equilibrium' of repeating answers and enduring questions.

"In continuing education, we need to find many related issues to the zeitgeist and we also need to search and educate why we have the pandemic situation by COVID-19. That is an environment issue. I would be happy to see a course that looks into environmental and climate issues based on how to

make better ground for a mutual co-existence more advanced than a simple environment education from the past.”[11]

The Above issue awareness was one of the motivations behind the design of [ecology humanity] course. The course [Ecology Humanities Observed by Literature and Appreciated by Science] (Intensive 2 hours 2 credits) was designated as one of the competition courses in Kon Kuk University and was a converged liberal arts course that had students from liberal arts and science majors. As indicated in the title, it was a course that provided self-instructed study to find an intersection between ecology and liberal arts. A primary objective of the course was to find ‘a converged perspective analyzing two different fields of literature and science.’ The other objective was to have balanced knowledge and experience by gauging frames of global environment than existing anthropocentric. The course supported to enhance one’s discipline by having an experience of interdisciplinary expansion of a study in an intellectual community comprised with other students of various disciplines within the university. A total of 191 students participated during four semesters from 2019 to 2020. The distribution of students by the semester was as follows: Spring of 2019 51, Fall of 2019 77, Spring of 2020 39 and Fall of 2020 24. The composition of the students by discipline was as follows: Engineering 23.6%, Liberal Arts 8.4%, Arts 8.4%, Education 4.6%, Economics 25.7% and Science 29.3%.

The status of converged college education indicates that ‘it has a limit[12] of enhancement on specified converged knowledge in a form of collaboration of multiple disciplines,’ because it only depends on individual’s ability, selection of discipline, and it is just a form of unity between other discipline. A recent report by ACE+ Project[13] indicates an increase of researches utilizing converged education. However more concentrated converged education where students from multiple disciplines collaborate to solve only a single issue is necessary. A concentrated converged education is physically impossible to study in one discipline. ‘Ecology Humanities’ class is designed as one of the liberal arts courses focused on a balance between two different disciplines; science and liberal arts majors. The objectives and core competencies are as follows:

- 1) To have collaboration and co-governance for ‘producing and utilizing new ideas by multilayered perspectives.’
- 2) To understand information and knowledge from various media to examine issues and to foster an ability to utilize in a problem solving. The sub-objectives for the second were as follows:
 - a) The calibration of separated disciplines of literature and science into a converged perspective of ecology humanities was necessary.
 - b) The class needed to find a reason and resolution for a drastic change of the environment through a reasoning of ecological concept with humanities perspective and to understand global challenges in ecology.
 - c) The development of comprehension ability on converged aspects between humanities and science was needed to have interdisciplinary communication based on basic science knowledge of the nature, life of species along with humankind.

The class was designed as a concept of a “flipped” learning. The class provided the students to lead from the design initiation and execution in order to have multilayered approach from the start. To have more effective problem solving by converged perspective, the class focused on fully engaged discussions after reviewing prerequisite materials. The coaching was necessary but the professors engaged as part of the participants as well to level with the students during the discussions. The class materials for the discussions were uploaded with a contradictory perspective on the subject every week by two professors of science and liberal arts simultaneously. The professors provided interrelated subjects for the students to guide the process and discussions and to support results by the students with corresponding explanations by converged perspectives.

One of the main reasons that “flipped” learning was applied to the class was to minimize the

difficulties when cross-discipline subject was introduced. It was necessary to provide reading materials in order to achieve a voluntary design of the project and the discussions. The class was also designed by the students' requests as below:

- 1) The science and engineering students wanted to have more flexible and creative perspectives from the class apart from their disciplines.
- 2) The liberal arts and art students wanted to find a way to approach any science related subject without any difficulty.
- 3) The students had a general recognition of liberal arts classes as old-school theoretical study apart from the reality and current issues so the students' interests were not sufficient.

Below table is a course summary.

[Table 1] Flipped Learning Design (3rd week)

Title		Green Mind Earth by Liberal Arts		
Objective		‘The Omnivorous Family’ & Green Mind		
Activities				
Category		Level	Sub-activities by Class Level	
			Professor	Student
Online Class		Development of Online materials & e-campus post	Upload ‘The Omnivorous Family’ by HWANG Yun & related videos	Issue awareness of the film
		Guiding online materials & study guidelines.	Subject of discussion upload on e-campus	Uploading of opinions on meat eating
Offline Sessions	Introduction	Pre-class material check & In-class study introduction	Issue presenting: Is meat eating a problem?	Finding issues with the subject
		Team activities and study development	Class discussion: Peter Singer’s perspective & review of ‘The Vegetarian by HAN Kang	Organizing one’s opinion & Recognizing Green Mind concept
	Process	Team Building	1 team 8 members	Free selection
		Study activities by team & individual	Issue search: processed meat industry & extracting Pro vs Con	Extracting Pro & Con on processed meat industry

	End	Share and allocate study activities by team & individual	Assembling arguments & coaching on ‘The Vegetarian’ /film ‘Okja’ / Jeremy Fikkin / ‘The Omnivorous Family’	Review, Discussion & presentation on meat eating issues by ethical and environmental perspectives
		8. Evaluation	Cross evaluation by team members	Evaluation by member’s contribution
After Conclusion of Off-line Class		9. Interaction method between professor & students for reflection of In-class	Cross evaluation review	Evaluation by member’s contribution
		10. Self-evaluation by professor		

4. Result of Students Survey

Survey Result	
Target Students: 77 Survey Participants: 69 Participation Rate: 89.61%	
1. What do you feel the difference after the class? (multiple answers)	69 Participated
1) Ecological sensibility was created	49 (71.01%)
2) Motivated to think more about environmental issues	44 (63.77%)
3) An opportunity to think about biocentric equality	43 (62.32%)
4) Converged perspective was created.	23 (33.33%)
5) None	0 (0%)
2. Do you have most interesting subject in the class? (multiple answers)	69 Participated
1) Converged perspectives of liberal arts and science	32 (46.38%)
2) Ecological diet	34 (49.28%)
3) Biodiversity	38 (55.07%)
4) Climate change and environment protection	29 (42.03%)
3. Are you willing to reduce meat eating if it affected ecosystem? (Single answer)	69 Participated
1) Somewhat agreed	51 (73.91%)
2) Meat eating is necessary.	4 (5.8%)
3) Will look for alternatives	14 (20.29%)
4) Meat eating does not have negative impact on ecosystem.	0 (0%)
4. Did converged perspective help to understand the class? (Single answer)	69 Participated
1) Strongly helpful	35 (50.72%)
2) Somewhat helpful.	29 (42.03%)

3) Not helpful but necessary perspective	5 (7.25%)
4) Not helpful	0 (0%)
5. Was the class necessary in liberal arts course? (Single answer)	69 Participated
1) Yes	68 (98.55%)
2) No	1 (1.45%)
6. Why did you think the class was necessary in liberal arts course? (multiple answers)	69 Participated
1) Knowledge gain	21 (30.43%)
2) For Converged liberal arts class	33 (47.83%)
3) Practical changes were motivated on individual's life.	47 (68.12%)
4) For global issue awareness	43 (62.32%)
7. Do you agree that class presentations and discussions influenced your ecological awareness? (single answer)	69 Participated
1) Strongly.	37 (53.62%)
2) Somewhat agreed	27 (39.13%)
3) Not really	5 (7.25%)
4) Disagree	0 (0%)
8. What was the most helpful method of study in the class? (multiple answers)	69 Participated
1) Presentations and feedbacks	42 (60.87%)
2) Discussions.	38 (55.07%)
3) Professors' class materials and notes	25 (36.23%)
4) 2 professors with different disciplines	32 (46.38%)

5. Conclusions

Humans have been driving innovations throughout history with new challenges breaking away from existing reality, and education has been a key to introduce new challenges. The liberal arts education has some traditional pillars but it must have a role in serious discussions on interconnections between the society and various disciplines in converged education. The field of education needs to have an in-depth consideration on its effectiveness and it also needs to provide the students an environment to extract original values freely by themselves. As for this study on the class 'Ecology Humanities', it researched the impact on how the two converged as literaturistic writings and discussions, and provided positive problem solving approaches when inter-disciplinary communication worked within the class by the students.

Based on the result of the study, the discussions of converged subjects with multiple disciplines of the university provided positive implications for the students on understanding and problem-solving the current 'Wicked Problem' status with COVID-19. The class survey on spring semester of 2019 indicated that 92.7% of the students were positive for the converged education approach to solve Wicked Problem and 47.8% indicated that more converged classes were needed in the future. As to the question on whether converged approach of literature and science helped to understand the ecology class, 50% of the students answered strongly agreed and 42% answered agreed. 53% agreed strongly on positive impact of developing multi-layered understandings on the subject and 39% indicated somewhat agreed. Total of 69 students participated the survey.

In conclusion, it is necessary to add more converged classes in the basic liberal arts courses to

support the students in understanding multi-layered interpretation outside of their discipline in order to implement their ideas to current issues that they face every day. As a result, the survey indicated that over 90% of the students had a positive impact after being introduced to converged and interdisciplinary activities from the class. Furthermore, the students also agreed to have more converged classes in the future once they understood how to approach a 'Wicked Problem' from the "flipped" learning experience with the students with different backgrounds.

When team-teaching was applied to Ecology Humanities class, the students were provided an easy access to the converged subject in order to participate fully engaged discussions. One of the key factors of the class was to have two professors of science and liberal arts simultaneously in the class to provide converged guidelines. It supported the students to overcome hardships of understanding interdisciplinary activities and converged learning experience. It also provided an environment where the students voluntarily participate cross-disciplinary class activities.

However, the number of students decreased gradually from 129 in 2019 to 63 in 2020 due to the pandemic and it indicates the negative impact of limited access on major activities such as in-class discussions. The study found that online discussions with videoconferencing had limitations and decreased the motivation of the students resulting in decreased number of students. The study needs to investigate the impacts between online vs in-class activities. As the percentage of disciplines spread wider among the students, the liberal arts students were less than three times than the number of students from engineering and science majors. The study needs to have balanced spread of disciplines from the participants in order to have compatible students' activities and justifiable results.

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