

Title

Adoption of online teaching during the COVID-19 Pandemic: A systematic analysis of changes in university teaching activity

Abstract

Since the beginning of the COVID-19 outbreak in Spring 2020, universities around the world have quickly adopted online teaching as an emergency measure. Informed by activity theory, the present qualitative case study aims to better understand the nature of the rapid institutional transition and its impact on academics' pedagogical experiences during this period. A multiple set of qualitative data was collected in a national university in South Korea that rapidly made the online transition, following government directives in February 2020. This article provides useful accounts of the changes that occurred in interconnected teaching activity systems at the university while adopting online teaching, highlighting the complex factors underpinning individual academics' experiences. The sudden shift in institutional teaching activities and conditions created a range of contradictions that were experienced as dilemmas by academics, the main subject of the activity systems. The results demonstrate that two groups of university faculty, separately identified as novice online teachers and expert online teachers, faced different dilemmas and challenges. An essential lesson learned from this analysis is the need for a more holistic, realistic, and sensitive approach to emergency teaching scenarios that may enable educational institutions to better respond to such emergencies in the future.

Keywords: Emergency online teaching; activity theory; teacher identity; university teaching; South Korea; COVID-19

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1. Introduction

Under the COVID-19 outbreak, universities and schools around the world have suspended face-to-face classes to prevent the rapid spread of the virus among students and staff. This sudden disruption to face-to-face education reshaped pedagogical practices and led to the rapid adoption of online teaching among universities (Lee et al., 2021; Lederman, 2020). Subsequently, academics working at universities, at the frontline of those changes, faced enormous levels of pressure and disturbance to their professional roles and practices (Watermeyer et al., 2020). For those without sufficient knowledge or experience for effective online teaching (Rapanta et al., 2020), this sudden transition was particularly challenging.

In normal circumstances, designing an online course follows a systematic instructional design process with careful consideration of the unique characteristics of target learner groups and the chosen instructional medium (Reiser, 2001). That is, the design process often starts with an analysis of students' needs and prior experiences, as well as a range of instructional methods, and strategies are reviewed to find the optimal approach to teaching particular content to the target students (Brown & Green, 2019). Such a process involves collaborative efforts of a course team (e.g., academics, instructional designers, technicians), and the product includes multiple learning objects (e.g., lecture videos, assignments, discussions) that meet different criteria set by (inter-)national quality assurance metrics and regulations (e.g., accessibility, copyright regulations).

During the rapid adoption of online teaching in response to COVID-19, however, systematic instructional design procedures and team-based support for course development and preparation were unavailable. Instead, individual academics were given the challenge alone to teach online with a limited level of support and guidance from their university—the task was even more difficult in this situation where they were remotely working from home. Due to the huge discrepancies between the normal pedagogical approach to online teaching and that necessitated by COVID-19, some researchers have made a conceptual distinction between the two and labelled the latter 'remote teaching' (Hodges et al., 2020). The authors suggest remote teaching limits itself to teacher-centred knowledge transmission—mainly focusing on providing lectures without having learner-centred activities or learner-to-learner interactions in place.

The present authors' observations of colleagues' online teaching experiences during the Pandemic, too, show that most academics recorded hour-long lecture videos using the

same teaching materials that were previously developed for face-to-face instruction and uploaded the recordings on university-provided online platforms. Some, instead, organized a series of live sessions during which they replicated their face-to-face teaching without making careful adjustments to the online settings. The present article aims to make sense of the nature of the rapid institution-wide online transition and its impact on academics' pedagogical experiences during this period. It emphasizes the critical fact that academics' experiences are not independent and autonomous but primarily shaped by their previous teaching practice and strongly influenced by institutional structures and policies. Thus, the nature of the specific challenge faced by individual academics should be understood in a broader historical and institutional context (Lee, 2018b).

To provide accurate accounts of academics' experiences adopting online teaching as emergency measures, this qualitative case study employs a systematic approach informed by activity theory. Using key notions of activity theory, the article documents a range of 'dilemmas' and 'contradictions' experienced by two groups of academics, identified as novice online teachers and expert online teachers during the Pandemic at a large national university in South Korea. A set of institutional documents that describe the rapid online transition at the university in Spring 2020 were reviewed by the authors. Fourteen faculty members with different online teaching experiences prior to the Pandemic were also interviewed. The study locates those academics as the main subjects of the teaching activity systems and illustrates how their teaching activities were shaped through the dynamic interplay between different elements of the activity systems.

The three research questions that guided this analysis are as follows:

- RQ1. What did individual academics' teaching activities look like prior to the COVID-19 crisis?
- RQ2. How did individual academics adopt and experience online teaching activities during the COVID-19 crisis?
- RQ3. What were the major dilemmas and challenges experienced by individual academics during the COVID-19 crisis?

2. Literature Review

Before the COVID-19 crisis, there were a minimal number of publications on the adoption of online teaching as emergency measures. For example, Czerniewicz et al. (2019) systematically analysed 16 academics' experiences of using blended and online teaching to address educational disruptions caused by student protests in South Africa between 2015

and 2017. Their analysis revealed that academics' activity during the disruption period was ruled by a conflicting set of formal rules (a university's decision to adopt online education), informal norms (pedagogical principles drawn on from face-to-face teaching), and non-formal demands (student protestors' demand for 'free decolonial quality education', p.15).

Two more relevant examples can be found: one (Mackey et al., 2012) reports on the experiences of adopting blended learning in response to the Canterbury earthquake in New Zealand in 2010, and the other (McNaught, 2004) presents a case of introducing distance learning during SARS (Severe Acute Respiratory Syndrome) in Hong Kong in 2003. Both articles demonstrate complex working relationships rapidly enacted that created unanticipated challenges and tensions among university members when the new pedagogical practices were enacted. To address the newly emerging challenges, in McNaught (2004), a SARS Task Force was formed, including representatives from administrative, academic, and student communities who then brought diverse, often conflicting, needs and goals of different groups into the decision-making processes. Mackey et al. (2012) observed that individual academics, while quickly moving their teaching activities online after the earthquakes, sought pre-existing resources and continuous support from other staff and organizations (both internally and externally).

There is fast-growing COVID-related literature that provides some useful insights to the present study. Bao (2020) writes about her observations on emergency online teaching at Peking University, where 44,700 students study online during the Pandemic and points out the importance of maintaining students' learning concentration and engagement online. She offers five factors that influence effective online learning experiences: effective instructional design, adequate instructional delivery at the appropriate pace, timely feedback and guidance from teachers, and high-quality student participation in learning activities. She also adds that a contingency plan for any unexpected technical issues must be prepared to support all the above points. Rapanta et al. (2020) also collected online education experts' perceptions on the global online transition during the Pandemic and stress the importance of the effective design of online learning activities, which increases teacher presence, and an assessment and feedback mechanism for successful online teaching.

It is also possible that the effects of moving courses online during an emergency would have varying effects on different demographic groups of the student population. For example, it might be the case that postgraduate students would fare better than

undergraduate students in online learning contexts because undergraduate students have been shown to possess lower critical thinking ability and a higher propensity to procrastinate than postgraduate students, both of which could impede learning progress in online courses (Artino Jr & Stephens, 2009). On the other hand, a study by Lee et al. (2021) found no difference in the satisfaction levels of undergraduate and postgraduate students with online instruction as a result of the Pandemic. Nevertheless, prior studies have noted that instructors should acknowledge the differences in characteristics between undergraduate and postgraduate students when creating social learning opportunities (Tucker & Abbasi, 2016), as postgraduate students tend to seek deeper levels of learning, requiring more planning and preparation on the part of the instructor when designing activities (Holzweiss et al., 2014).

Dhawan (2020) conducted a SWOT (Strengths, Weaknesses, Opportunities, & Threats) analysis of online teaching in the context where universities have no choice but to move online. The article argues that the flexible and accessible nature of online learning is the best strength, which provides opportunities for pedagogical innovation and skill development to the higher education sector. Nevertheless, technological difficulties, time management issues, and a lack of readiness for online learning are identified as weaknesses of online teaching, which may accompany varying challenges such as the digital divide and inequalities among different groups and a lack of personal support. Adnan and Anwar's (2020) survey of Pakistani students' (n=126) perspectives on online learning supports Dhawan's analysis by highlighting that the vast majority of students do not have adequate access to Internet technology and financial resources. The students also shared concerns over a lack of face-to-face interaction with their teachers and peers.

All of the previous accounts of emergency online teaching stress the dynamic nature of academics' practice (Bozkurt & Sharma, 2020). That is, online teaching is a form of institutional practice, which is subject to a complex set of institutional rules and largely influenced by institutional structures, facilities, and relationships. Watermeyer et al. (2020) also report the results of a survey of 1148 academics that highlights the different challenges that academics experienced during the emergency online migration of their practice (e.g., increased workload, decreased working conditions, and disturbance of confidence and trust). The authors suggest that academics were 'bruised by their experiences of emergency online transition' (p. 637) and state that academics' responses are 'a story of trauma in the face of Pandemic' (p. 637). The present qualitative study, with theoretical and

methodological rigour, closely examines academics' experiences of adopting online teaching during the Pandemic. That is, this study aims to fully make sense of the stories of (bruised) academics and institutional conditions that shaped their (traumatic) experiences by employing activity theory.

3. Theoretical Approach

To systematically analyse changes in university teaching activity during the COVID-19 Pandemic, we employ activity theory as our theoretical framework (Engeström, 1999). Activity theory strives to conceptualize complex relationships between collective endeavour and individual action (Kaptelinin & Nardi, 2006). By doing so, it enables educational researchers to locate individuals' practice in a broader institutional context (Bligh & Flood, 2017). Activity is a form of collective and sustained human effort: the related *actions* (time-bound pursuit of goals) and *operations* (unpremeditated adjustments to circumstances) are used to carry the activity out.

The fundamental unit of our analysis is the *activity system* (Engeström, 1999). As Figure 1 depicts, an activity system model is a set of interlocking, mediated relationships between constituent 'elements' oriented towards a particular *object*. The model's purpose is to understand the complex interactions and mutual influence among these elements. *Subjects* (central human actors) and *communities* (the wider group of stakeholders) are working on the object. Those relationships are mediated by *artefacts* (whether more or less material), *divisions of labour* (wherein people adopt different roles), and *rules* (which fall along a spectrum from the explicit to the implicit).



Figure 1. An illustration of activity system.

Activities do not exist in isolation but instead form concrete and changing relationships with other activities. When mapping such networks, a focused activity is adopted as the ‘central activity system’ with neighbouring activity systems mapped in relation to that vantage point (Figure 2). Examples of neighbours include activities that i) influence subjects and communities involved, ii) produce artefacts and rules of the central activity system, iii) use the outcomes from the present activity, and iv) inspire change in the central activity (i.e., culturally more advanced activity). In the subsequent analysis, we position teaching activity as the central activity and map its near neighbours to illustrate the core links on which it depends in order to function.

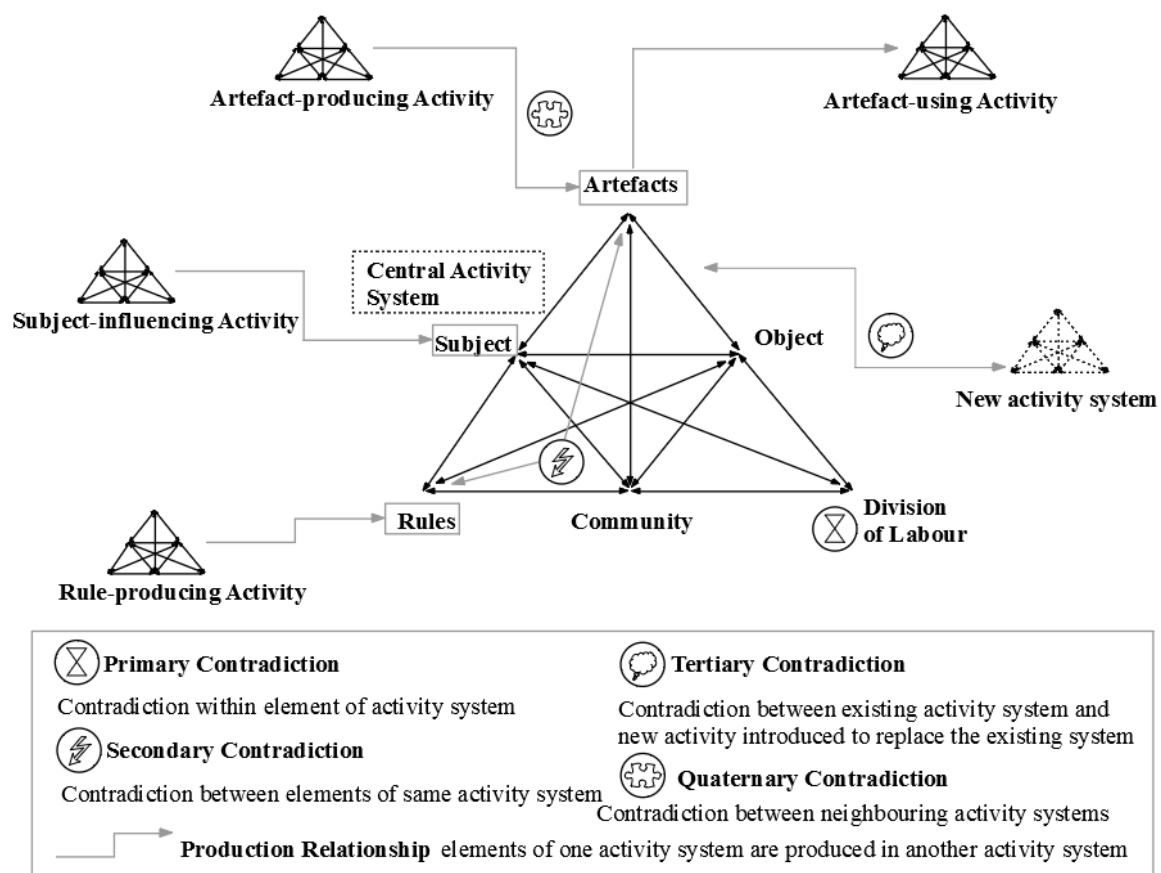


Figure 2. A network of activity systems and four types of contradictions.

The systems develop historically, with current forms arising from antecedents and further developing into new forms. The engine of activity development is often *contradictions* within activities that human subjects, who experience them as *dilemmas*, strive to overcome. Contradiction is a key notion of activity theory, referring to structural tensions and conflicts that develop over time within and between activity systems

(Engeström, 2001). Activity systems attempt to resolve contradictions, thereby reshaping their activities. Such attempts to resolve contradictions often inspire innovation so that contradictions may drive change, while equilibrium is difficult to achieve and often fleeting. In this process, activity systems may also inadvertently create new contradictions (Cole & Engeström, 1993; Kamanga & Alexander, 2021).

Analysis using the activity system model typically highlights four types of contradictions (Figure 2). Primary contradictions are those within elements of the activity system (most commonly, value system conflicts), while secondary contradictions are those between different elements. Tertiary contradictions are those existing in moments of change within the activity (tensions between old and new versions of the activity), while quaternary contradictions are those existing between an activity system and a neighbouring system in the network. In the analysis that follows, we map contradictions in teaching activity (and between the teaching activity and its neighbours) to illustrate multiple tensions that influence academics' experiences of online teaching practice.

Thus, activity theory allows us to position disparate aspects of university teaching activities during the COVID-19 Pandemic within a coherent whole, understand that whole as a dynamic system full of dilemmas and contradictions, and compare how the system changes before and after the adoption of the contingency measures. Other authors have successfully deployed similar frameworks to illustrate the dynamics of teaching and learning in ways that we hope to emulate in the present paper. For example, Ashwin (2009) aimed to conceptualize teaching-learning as a holistic, dynamic environment. Bligh and Coyle (2013) deployed the activity system model to examine technology use in a postgraduate education setting. They demonstrate that how a new technology is used is determined not only by the properties of the technology itself but by the surrounding social structure. Blin and Munro (2008) used the model to study the frequent failure of attempts to introduce new technologies to existing teaching practices. Joo (2014) focused on the contradictions arising where a distance education institution adopted new efficiency-oriented instructional delivery models.

4. Methodological Approach

This qualitative case study conducts an in-depth analysis of the dilemmas experienced by university faculty when adopting emergency online teaching. Employing an analytic tool drawn from activity theory (Engeström, 1999), the present paper illustrates the complex

historical and institutional structures and associated dynamics that have constructed academics' experiences. Multiple sets of qualitative data were collected from the Korea Advanced Institute of Science and Technology (KAIST), a large national university located in Daejeon, South Korea.

4.1. Context

KAIST was established in 1971 with a vital political agenda to educate a new generation of talented scientists and engineers who could drive Korea's development forward (KAISTIO, 2020). KAIST has been highly successful with this mission, and in recent years, it has expanded its mission to include global goals of educating, researching, and leading 'in innovations to serve the happiness and prosperity of humanity' (KAIST, 2020c). As of March 30, 2020, KAIST had a student population of 10,504 (KAIST, 2020b). The vast majority of KAIST students major in science and technology subjects, although they complete an extensive core curriculum that includes a wide variety of courses from humanities and social sciences.

4.2. Participants

Fourteen faculty members were selected and invited to a semi-structured interview, using a purposive convenience sampling approach (Creswell, 2014). The second author of the present paper, also a faculty member of KAIST, initially invited a mixed group of eight academics regarding their gender, position, teaching subject, and previous online teaching experiences. Six more academics, recommended by the initial group of interviewees as potentially critical informants, were further invited and interviewed by the second author. All interviews were conducted via teleconferencing, in order to maintain social distancing during the Pandemic, and lasted between 40 minutes and 90 minutes. All interviews were conducted in English.

Given that English is a medium of instruction in a large number of courses offered at KAIST and most faculty members are fluent in English communication, the present authors did not experience any communicative challenges or ethical problems caused by this particular linguistic choice. Most interviewees (11 out of 14 had never taught online before the Pandemic, although their levels of technological skills and experiences varied. The remaining three had taught blended courses using the flipped classroom model (as detailed in the following section).

Table 1

Demographics and Teaching Experience of Interview Participants

Participant	Gender	Age	Origin	Teaching Subject	Previous Online Teaching Experiences
1	Male	50s	International	Sciences	N
2	Female	40s	International	Sciences	N
3	Male	50s	International	Sciences	N
4	Male	30s	Local	Sciences	N
5	Male	50s	International	Sciences	N
6	Female	40s	International	Sciences	N
7	Male	40s	Local	Sciences	Y (blended courses)
8	Female	50s	Local	Sciences	Y (blended courses)
9	Male	40s	International	Sciences	N
10	Female	30s	Local	Humanities	Y (blended courses)
11	Male	30s	International	Humanities	N
12	Female	40s	Local	Humanities	N
13	Female	40s	Local	Humanities	N
14	Male	60s	International	Humanities	N

4.3. Data Collection

This study analyses three datasets. The first dataset includes institutional artefacts documenting the adoption of emergency measures produced since the first COVID-19 outbreaks in South Korea (February 2020). Both publicly available documents (e.g., university bulletins on websites) and internally circulated documents (e.g., staff emails, notices, handbooks) were collected.

The second dataset was collected by conducting semi-structured interviews with fourteen participants after the Spring 2020 semester (July 2020) to capture their semester-long experiences with emergency online teaching. The interviews were guided by two sets of open-ended questions, which concern experiences at the course and institutional levels, respectively. The authors were granted permission to conduct these interviews through an Institutional Review Board at KAIST, and all fourteen participants voluntarily signed a consent form to have their responses recorded and included in the present research. The individual interviews were followed up with four informal monthly meetings, to which all interviewees were invited. These meetings aimed to ascertain changes and developments in the participants' experiences in the following Fall 2020 semester (September through December 2020) and to allow participants to share their reflections and evaluations on their practice more openly and honestly.

The last dataset includes the second author's fieldnotes. The second author observed and recorded both his own online teaching practices and those of his colleagues. He also wrote his immediate feelings and thoughts on the university's rapidly changing emergency teaching measures and situations. The three datasets together effectively capture the complexity of academics' experiences and challenges during the COVID-19 outbreaks.

4.3. Data Analysis

The collected data were analysed using a deductive coding approach grounded in the chosen theoretical framework. That is, the models, drawn from activity theory (see Figures 1 and 2 above) were used to guide the authors' repetitive reading of the data. To answer the research questions, the authors collaboratively sketched teaching activity systems with neighbouring systems that illustrated individual academics' teaching activities before and during the COVID-19 crisis. A set of contradictions, both within and between activity systems, were then identified in the illustrations, which show challenges and dilemmas experienced by two different groups of online teachers.

As a result of the visualization process, the authors further developed a coding protocol with codes and categories regarding the identified contradictions and dilemmas. Each author conducted a coding task on the shared dataset and drew potential themes from their coding outcomes. The themes were brought back to the group, discussed, and finalized. The first author drafted the first version of a complete description of the activity systems, and the other authors iteratively and collaboratively revised the draft illustrations.

We completed our data analysis by drawing two graphic representations of activity systems (one existed before and the other emerged after COVID-19, as shown in the following section). The key themes will be presented and discussed by making direct references to those figures.

5. Results

5.1 Teaching Activity Systems Prior to the COVID-19 Pandemic

To achieve the stated university objectives of creating world-class scientists and engineers to help Korea develop and solve global problems, KAIST focuses on providing high-quality courses and outstanding research environments. Before COVID-19, over 90% of course offerings were delivered face-to-face, which typically involved a faculty member who is a disciplinary knowledge expert delivering lectures using PPT, answering questions, and leading group discussions. These rather traditional teaching activities embrace the *object* of offering high-quality courses, which are defined as those in which knowledge dissemination from teacher to student is successfully achieved. In this previous activity system, the *subjects* were individual academics who exerted their agency independently when creating and delivering their courses. These academics often received the help of teaching assistants who were generally paid out of a departmental fund or from a government assistantship. It is important to note that these academics were perceived as knowledge experts rather than teachers at KAIST before the Pandemic. Their authority within the institution came from their scholarly reputation outside the institution (in fact, many of them are nationally and internationally renowned scholars), not from their pedagogical effectiveness.

Although there were no fully online credit courses before COVID-19, KAIST offered courses in flipped (or blended, a mixture of online and face-to-face) format, and these were referred to as 'Education 4.0' courses (KAIST, 2020a). The Education 4.0 initiative (hereafter, Edu 4.0) began with curriculum reforms in 2012 along with establishing KAIST Vision 2031. The initiative specifically aims to decrease traditional lectures and increase student engagement in interactive learning practices via a flipped learning environment (Fanguy et al., 2021; Horn, 2014). The small number of academics who took part in the Edu 4.0 initiative (including Participants 7, 8 and 10 in this study) created lecture videos for the online component of their courses and met face-to-face with the students once or twice per week for collaborative learning sessions. Edu 4.0 teaching activities also shared the same

object of offering high-quality courses. However, unlike the traditional lecture-based courses, the Edu 4.0 courses focused on facilitating students' active learning.

As shown in Figure 3, while individual academics were the *subjects* who exerted their agency over the content of their teaching, course development and operation involved a broader community of support staff (including dedicated teaching assistants) and advanced technological facilities (Figure 4). Those academics also received generous support from the Center for Excellence in Learning and Teaching (CELT) for designing and developing active learning materials on a one-to-one basis. As Participant 7 mentioned, some of these Edu 4.0 courses were further offered as massive open online courses:

I heard of Edu 4.0, and I was fascinated by the idea. So, I started right away, recording my lectures with the help of the CELT. So, I think I was one of the early adopters of using Edu 4.0 methodology in my teaching... And then, [the recording] was released on [the massive open online course platform] Coursera in 2018 and 2019.

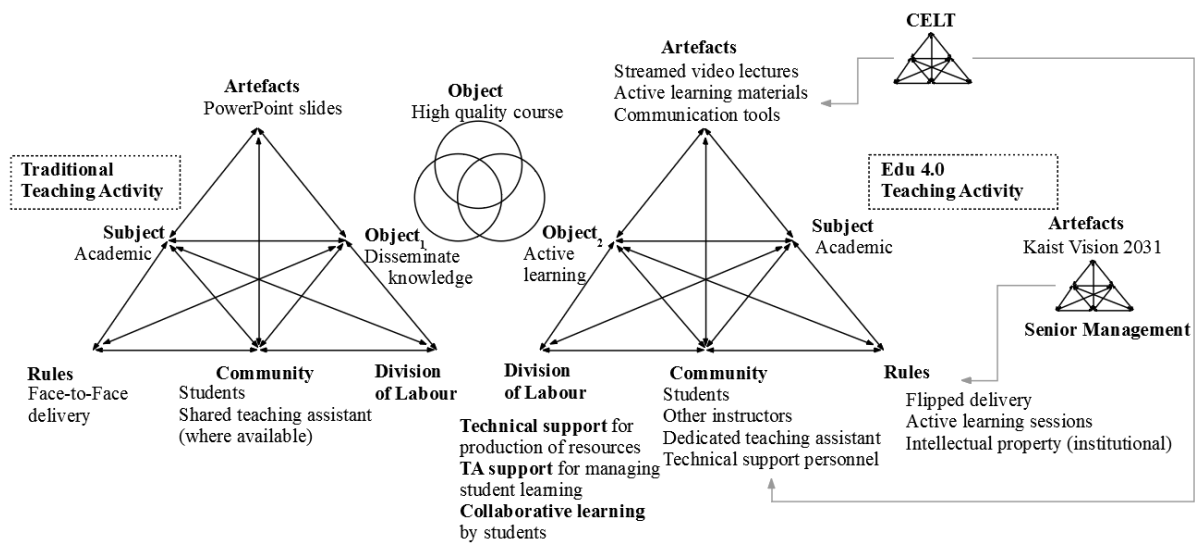


Figure 3. An illustration of KAIST teaching activity systems prior to COVID-19.



Figure 4. Video recording studio operated by technical support staff.

5.2 Online Teaching Activity Systems during the COVID-19 Crisis

The first case of COVID-19 in Korea occurred on January 20, 2020, with the rate of infection increasing through February and March (Korean Center for Disease Control, 2020). The Korean government responded by announcing that all K-12 schools and universities would have to postpone the March 1st start of the semester by at least two weeks (Park & Lee, 2020). Following this, on February 27, 2020, the Provost of KAIST sent out an email to all academics and students to notify them of the university's decision to comply with the government's request and move all courses online for at least the first two weeks of the semester. The email indicated that the faculty could provide live sessions using teleconferencing software or pre-recorded online video lectures. The task initially appeared to be simply a matter of giving a few introductory lectures on Skype (or recording them). However, on March 20, the university announced that all teaching would proceed online indefinitely. Participant 6 recalled the first two weeks of the transition as follows:

Before this, [I had] almost zero experience with online teaching... but I kind of saw it coming because the coronavirus situation was getting bad. So, I was thinking, oh yeah, we probably need to start with online. But my original anticipation was the situation is probably going to get better by midterm and then get back to regular teaching in the second half. So, I pushed some of the more difficult topics to the second half. But then, the university said the second half is also online, and there was no more excuse to postpone the difficult things. I had to [teach online].

Academics were then tasked with creating an entire online course overnight and found it vastly challenging. Many interviewees in this study recalled feeling frustrated and apprehensive at this moment, mainly due to their lack of basic skills for online teaching. For

example, Participant 14, who stated ‘almost everybody was better at technology than me,’ felt the given task was ‘intimidating because it was an area that [he] had very little experience and technical skill’ to produce quality teaching. Participant 4 also had limited experiences with using technology for teaching before (in his words) ‘this COVID craziness’:

Almost nothing. I just [did] things by email... if I gave a lecture and I would find maybe a short video that accents the topic... then I would put that in my slides, and then that was it!

Thus, when he received the announcement, he continued explaining:

I wasn’t sure what would be best... And then I thought, let’s just convey things by email. What I mean is PowerPoint slides and then a voice file. So, I actually, I didn’t end up using... what is it called? Not a Skype, but... Zoom, Zoom! I didn’t use Zoom... I was afraid of Zoom.

With the March 20 declaration, therefore, serious concerns rapidly emerged across the university that many faculty members were not prepared for a full semester of online teaching. Consequently, this online migration of instruction would dramatically decrease the quality of courses, failing to achieve the *object* of the previous teaching activity system (i.e., offering high-quality courses). To address these concerns, thereafter, CELT created a handbook for online courses and provided a software license for Zoom. The handbook suggested a new online teaching activity envisaged by the university’s senior management team, who attempted to replicate some elements of the previous Edu 4.0 courses (not those traditional lecture-based courses). This envisaged model of online teaching encouraged academics to form a learning community to work together. More specifically, those expert online teachers who had participated in the Edu 4.0 initiative were asked to support novice online teachers who had never experienced flipped formats of course delivery.

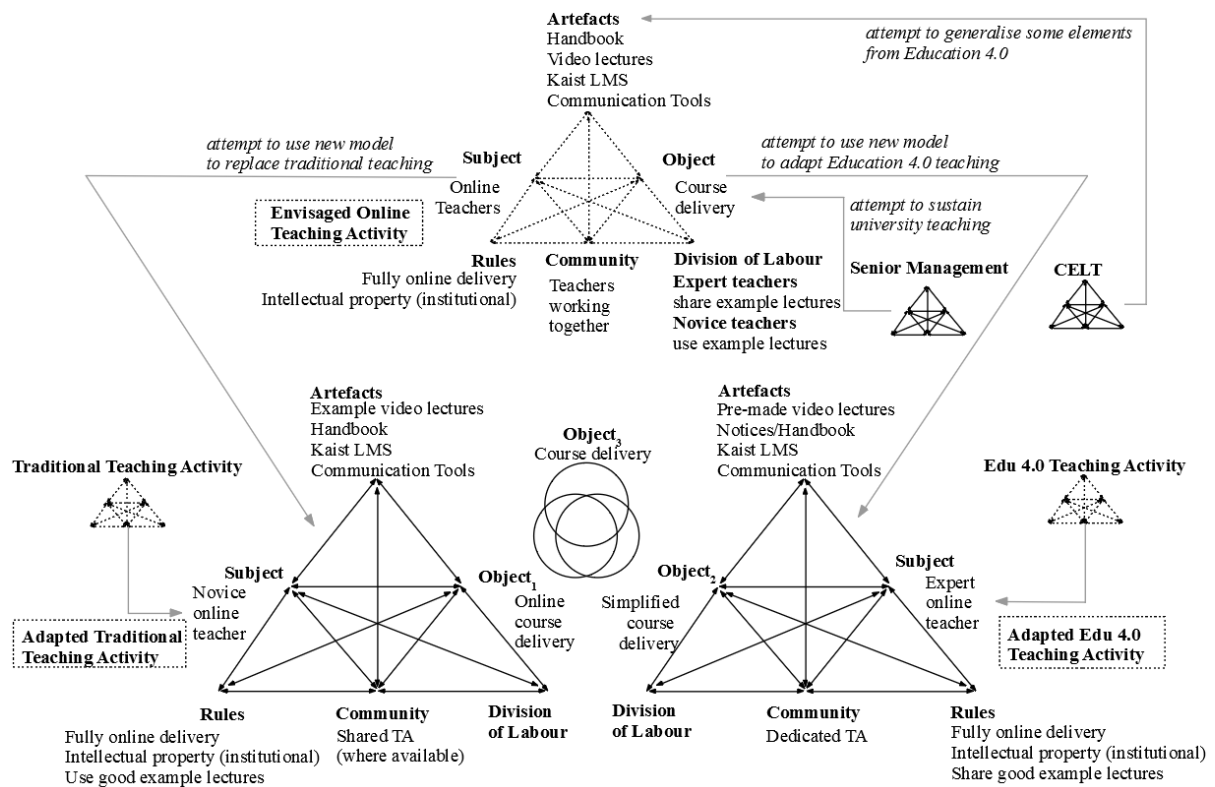


Figure 5. An illustration of KAIST teaching activity systems after COVID-19.

5.2.1 An Adapted Traditional Teaching Activity

Adopting online teaching as the COVID-19 emergency measure dramatically shifted the previous teaching activities at KAIST. The complexity of the shifts is well-captured in Figure 5. All academics experienced significant changes in their identities and practices. However, the experienced changes were largely influenced by each academic's previous teaching practice before COVID-19; that is, there were ongoing relationships between the pre-COVID activity system and the during-COVID one. Most academics, without prior online teaching experience, became the main *subject* of the adapted traditional teaching activity (on the left side of Figure 5) with a new identity of 'novice' online teacher.

Many of them, respected subject-matter experts with multi-year teaching histories, found this sudden identity shift disconcerting. As discussed in the previous section, Participant 14, a well-known faculty member in his 60s, felt intimidated by online teaching, and Participant 4, another respected scientist in his 50s, was afraid of using Zoom. Similarly, Participant 9, who had taught Computer Sciences for over a decade at different universities, mentioned, 'I hadn't felt that level of uncertainty about what the semester would hold since the start of my career many years ago'. The immediate *object* of these

‘novice’ teachers’ activity system became simply or desperately to deliver ‘courses’ online, not ‘quality courses’.

5.2.2 An Envisaged Online Teaching Activity System

As mentioned earlier, in collaboration with CELT, the senior management team tried to support those novice teachers by creating and proposing a somewhat idealistic scenario, derived from the previous Edu 4.0 teaching approach (see the envisaged online teaching activity in the middle-top of Figure 5). However, neither technical and pedagogical resources necessary for producing high-quality learning materials nor the dedicated staff (i.e., CELT members and teacher assistants) available in the previous Edu 4.0 teaching activity systems were provided. The envisaged activity system recommended that expert and novice teachers work together as a supportive community where expert teachers share their pre-made video lectures with novice teachers teaching similar content. This was an attempt to minimize the labour and resources needed for novice teachers to sustain the university’s teaching activity while maintaining its minimum level of quality of their online teaching. However, it did not work out as envisaged.

Participant 4, a novice teacher, did not reach out to his expert colleagues:

I didn’t have any person holding my hand. So, I was like really intimidated by the Zoom thing... Everyone is struggling with their own work. So, ‘I’ll try to manage on my own.’ That was the kind of feeling I had.

Although Participant 3 found having an informal conversation with his (in his words) ‘close friend’ helpful, his experience was not too different from Participant 4’s:

My department... most of us were in the same situation. We were first time teaching online. And so, we could share our experience for the first two weeks and see which way makes the situation better. But, I didn’t get advice from very experienced people.

In addition, most novice teachers felt hesitant to use video lectures made by others and subsequently decided to produce their own lecture videos (or teach classes on Zoom).

Even though [the video lecture] is the topic I need to teach, what I think should be taught [is different], and it’s not your style, you can’t really [give up] your teaching style. Although there are books, I didn’t opt for a book that other people would

probably grab. I wanted to kind of make my own textbook [and lectures]. (Participant 4)

Subsequently, despite the collegial and efficient *object* set up by the university, it became a simple decision within each teacher's activity system: 'Shall I lecture synchronously on Zoom or asynchronously by recording video lectures?' (Participant 13). Each teacher made a different decision based on their own reasoning. For example, Participant 3 searched the Internet and found a specific app called 'whiteboard'. Using the app on his iPad, he recorded his hand-writing of mathematical equations on the tablet screens while narrating, which was for him just like 'explaining everything on the whiteboard'—not far different from lecturing in the classroom.

Others used video capturing software such as Camtasia (which was suggested in the CELT handbook), with their faces shown in a small window in one corner of a screen showing presentation slides. Many less technologically-inclined novice teachers, however, found it particularly challenging to learn new software. Such technological challenges prompted them to utilize software they were more familiar with, such as PowerPoint, enabling them to record their voice over the slide presentation. Thus, the quality of the produced videos, *artefacts* of the adapted traditional teaching activity system, varied. Nevertheless, none of them met the quality of the Edu 4.0 videos, which had already been circulating and were recommended for use by the university.

5.2.3 An Adapted Edu 4.0 Activity System

Even though the transition was seemingly more straightforward for those academics who had experience with teaching flipped courses, such 'expert' online teachers were not free from the pressure of moving online. They also had to provide online alternatives for the collaborative face-to-face elements of their flipped courses. Arranging and facilitating group work online turned out to be too complicated for both teachers and students in an already drastic and distressing educational scenario. Participant 10, who took part in the Edu 4.0 initiative, recalled the first few weeks of the online transition:

I was trying to figure out what, how do I... what steps I need to take to make this [flipped class] an online class? Do I need to, how much, or what kind of changes do I need to make to the existing courses? I thought the biggest question that our school actually asked us was: 'Is it going to be asynchronous or synchronous?' And I decided that one of my classes would be asynchronous because it was a writing intensive

class. So, I thought that students could use more time to think about their writing instead of being in class. Because when we meet in class, we would do a lot of activities, but they were interactive activities. I didn't think that would work online well, and it would have been very challenging to find a way to make the same activities work online.

Just as Participant 10 did, most of these expert online teachers chose to simply replace collaborative activities with new video lectures that they needed to record on their own, without the benefit of the video recording studio shown in Figure 4 (which was closed due to the virus outbreak) and without the video editing team or instructional designers at CELT (which was overwhelmed with wider tasks related to online migration). The loss of access to these facilities and support caused the quality of the new video lectures to degrade noticeably, as shown in Figure 6 (note that the individual in the figure is not a participant in this study).

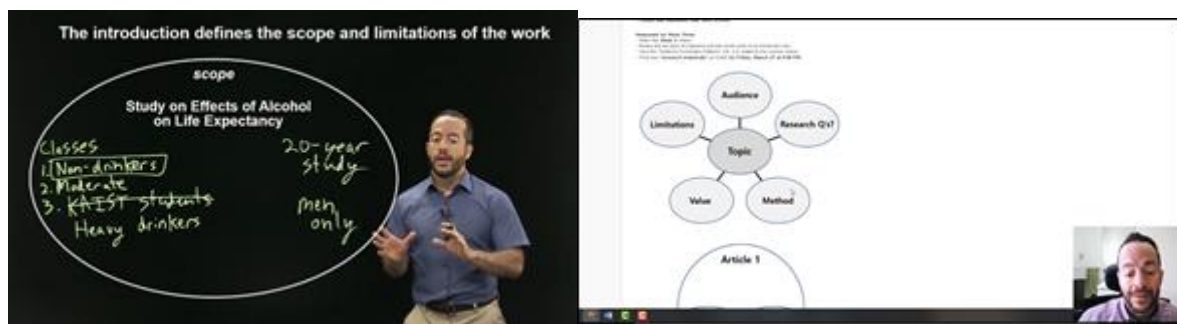


Figure 6. Screenshots of a video made before COVID-19 (left) and after (right).

Although these individual academics were identified by the university as 'experts', they did not view themselves in the same way. The sudden loss of 'previously available' support also hit Participant 8 harshly:

Well... I thought it would be good to talk to others and see what others were going to do and how... but I didn't really talk to other people because I didn't really see them anyway. People were trying to figure out whether they were going to actually come to school or not. And even if they did come, because we weren't using physical classrooms, there was less chance of us running into each other... and I thought everybody, everybody was probably busy trying to set up their own classes as well... we were all just in our offices doing our online classes.

Her reflection also suggests that she did not provide advice to novice online teachers (more precisely, no one asked for her advice), despite her roles envisaged by the university.

5.2.4 Students in the Activity Systems

One significant change noticed across all three post-COVID activity systems is the absence of students. While teachers' roles and responsibilities were strengthened and emphasized, there was almost no discussion on students' contributions. In pre-COVID activity systems, active learning participation of students, as one of the main actors of the community, was greatly stressed (particularly in the Edu 4.0 activity system). However, as academics, with their heightened teacher identity, became a solo *subject* responsible for sustaining university teaching activities, students turned into passive recipients of online teaching. That absence was directly experienced and felt by online teachers themselves, as Participant 11 mentioned:

You're making videos instead of actually interacting with students... the course is basically the same, that the difference is I don't get to give immediate feedback, and students can't give me immediate feedback. It's basically the same... but removes that interaction right there.

Most online teachers, especially those who initially chose to record their lectures, were 'missing the interaction with students and sort of gaining some energy from that interaction' (Participant 10). Thus, toward the end of the semester, most participants (n=13) added Zoom live sessions in their course (at least once) to check in on students and restored a minimum level of interactivity with their students. Participant 3 also added Zoom sessions "in the end":

In the end, I had to make a video first and then upload it to the system and see students real-time, not for the lecturing, but for the discussion and getting questions from them.

He also spent a lot more time on recording his lectures for the following reasons:

I had to give details for everything since it is difficult to know what students know. Recording took so long. I spent more time, at least triple, preparing to lecture... no actually, making videos compared to the ordinary teaching in the classroom.

With added Zoom live sessions, unlike what the envisaged activity system tried to achieve with regard to the efficient division of teacher labour, online teachers experienced and performed the ever-most labour-intensive teaching activities in Spring 2020.

5.3 Emerging Dilemmas and Challenges in Online Teaching Activity Systems

All teachers eventually completed their teaching online in Spring 2020. However, as described in the previous section, a range of contradictions arose as emergency online teaching activities emerged, both within and between different online teaching activity systems, each centring around i) novice teachers' adapted traditional teaching activities, ii) the university's envisaged online teaching activities, and iii) expert teachers' adapted Edu 4.0 teaching activities. Some contradictions were rather historical—emerged between previous teaching activity systems and emergency online teaching activity systems. Figure 7 visualizes those emerging contradictions at KAIST during the COVID-19 Pandemic, which will be discussed below.

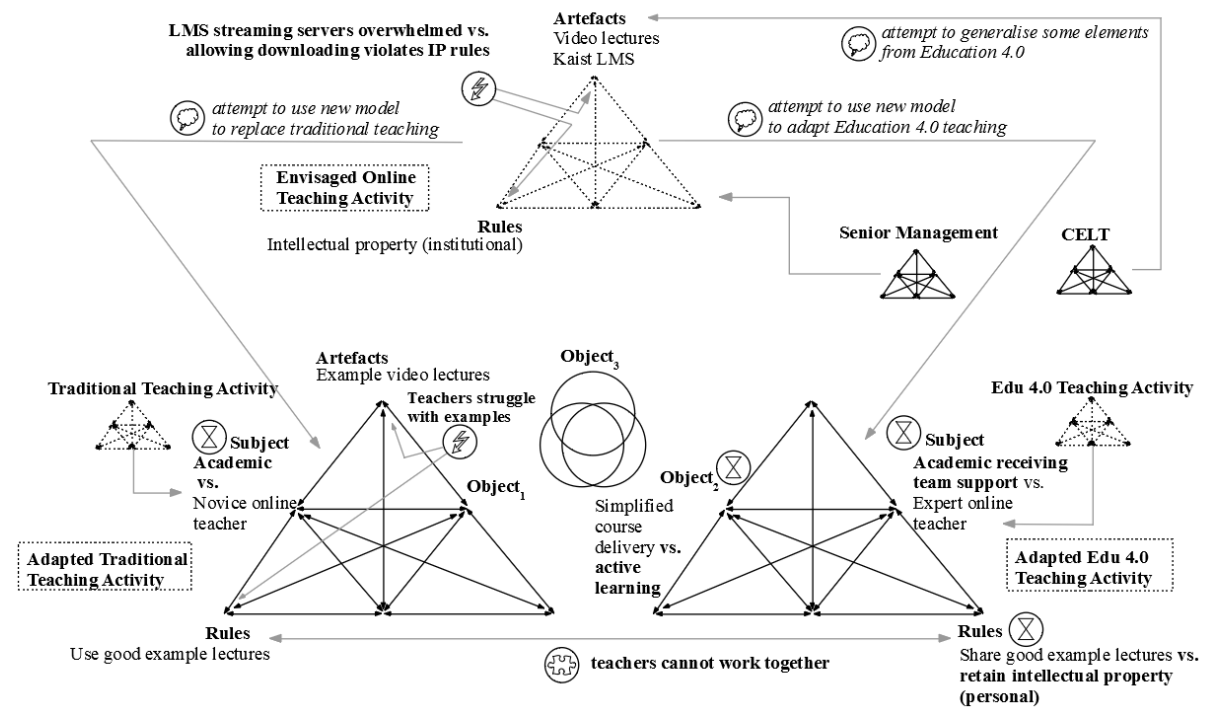


Figure 7. Emerging contradictions in emergency online teaching activity systems.

5.3.1 Technology Capacity and Intellectual Property

As academics were rapidly producing and uploading materials for their online courses, the university server was quickly overwhelmed by thousands of simultaneous video uploads. Subsequently, KAIST Learning Management System (KLMS) experienced

continuous crashes and untenable uploading times. Originally, KAIST did not allow students to download videos (but allowed streaming within KLMS) to protect intellectual property and avoid mass dissemination of video contents outside the institution. Such existing rules that regulated students' engagement with video content were not fully reviewed and accommodated amid the quick changes. As a result, a *secondary contradiction* between the elements (i.e., artefacts and rules) within the envisaged online teaching activity system immediately emerged in the form of technology capacity issues.

Simultaneously concerned about the poor-quality video production, CELT re-suggested that academics consider teaching classes using Zoom to avoid overloading the university's server. KAIST also asked academics to upload videos in downloadable rather than streaming format to reduce the uploading and streaming time. However, the long-established institutional culture protecting intellectual property could not be changed overnight, and many academics expressed their concerns over the wide dissemination of their videos without their knowledge. Shortly after, a pop-up message was included on KLMS informing students upon log-in that students must not share the video lectures contained on the site. Before the Pandemic, when KLMS was capable of streaming all uploaded lecture videos, the intellectual property rules were automatically executed by the technology infrastructure. However, during the Pandemic, this responsibility was moved to the student body.

5.3.2 Teacher Community and Collaborative Teaching

Unlike the previous situation where the traditional teaching activities and Edu 4.0 activities were completely separated as two unlinked activity systems, the two systems established a definite relationship mediated through the envisaged online teaching activity system with a shared object of 'course delivery' to avoid the cancellation of the semester. The objects of the two activity systems were now much more closely related than in the 'before-COVID' scenario. As described earlier, the university's envisaged notion of a supportive 'community' among teachers (i.e., expert and novice online teachers working together) was somewhat mechanically interpreted by academics who were rushed to create video lectures—as expert teachers share their well-developed video lectures, and novice teachers use them in their courses.

In the adapted activity systems, therefore, expert online teachers were often called upon for guidance by their respective departments and individual colleagues, which put

substantial demand upon them. Simultaneously, expert online teachers were also under pressure to transfer face-to-face components of their course online. Therefore, most ended up simply sharing their lecture videos with their colleagues (even though they felt hesitant to do so in the interest of maintaining exclusive possession of their materials), as this became the most expedient way to satisfy both of these demands. On the other hand, novice teachers found it different to utilize the example materials shared by expert teachers because such examples were developed based on a particular pedagogical model (Edu 4.0) that was not readily applicable in ‘knowledge dissemination’ settings. Many also resisted using the lecture videos of other teachers due to their sense of ownership of their own teaching.

As a result, a set of *primary and secondary contradictions* emerged within both the adapted Edu 4.0 and the adapted traditional teaching activity systems, particularly around multiple rules that simultaneously but contradictorily dictated their online teaching activities. In a broader context, the expectation set by the senior management team within the envisaged online teaching activity system resulted in a *quaternary contradiction* between the two adapted systems: one is economically sending help despite strongly felt reservation, while the other is receiving help in a form they cannot (are not willing to) accept.

5.3.3 Pedagogical Quality and Teacher Identity

Ultimately, our observation suggests that the exclusive focus on video production at the early period of the Pandemic led to a failure in implementing the envisaged online teaching activity while reinforcing the original objective of the traditional teaching activity, ‘dissemination of knowledge’. The object of the adapted online teaching activities, ‘delivering courses’, is reasonable given the constraints imposed by the situation. However, this objective could be problematic and disappointing to the teachers, who generally see themselves as knowledge agents, playing a crucial role in the university’s stated mission of fostering creative talent in science and engineering to solve global problems. Instead, these academics are now merely trying to record videos and maintain the required contact hours to avoid the cancellation of the semester.

As discussed above, it did not take long for both teacher groups to notice that the loss of face-to-face interactions with students was a significant problem, causing a considerable sense of dissatisfaction with their teaching activities. This dilemma can be conceptualized

as a *tertiary contradiction* between the previous activity systems—where teaching activities were organized and performed through direct contact and intellectual conversations between academics (knowledge experts) and students (future experts)—and the adapted activity systems, where academics became online teachers producing teaching materials. As a result, most teachers eventually offered Zoom sessions to resolve this dilemma and feel connected to their students. The university's envisaged activity system did not successfully facilitate these changes—not only in terms of assuring pedagogical quality but also reducing teachers' labour.

With added Zoom sessions, many teachers in this study reported that the quality of their teaching was much improved, although the level of student interactivity achieved by each teacher varied. Unsurprisingly, there were some differences between undergraduate and postgraduate courses regarding teachers' perceived sense of interactivity during Zoom sessions. Teachers' pedagogical experiences with a relatively small number of postgraduate students (less than 20 students) were much more positive than their experiences with large undergraduate courses (more than 50 students). Previous literature confirms these observations. For example, Orellana (2009) demonstrates that teachers perceived class sizes of 15.9 optimal for interactive learning in online courses with a higher level of interactivity at the postgraduate level than at the undergraduate level (Orellana, 2009). Nevertheless, given that most interviewees were teaching both undergraduate and postgraduate courses in Spring 2020, this potential undergraduate-postgraduate gap does not bear much impact on our current discussion in this paper.

6. Discussion

With very little warning or time, universities around the world were forced to devise and implement strategies to convert face-to-face classes into online instruction (Bozkurt & Sharma, 2020). Whether online or face-to-face, university teaching activity is a genuinely complex task that involves multiple elements of interlinked activity systems (Ashwin, 2009). To complete the task, diverse subjects with different objects interact with each other and contribute to the process, which creates a range of challenges and dilemmas experienced by those subjects even in normal circumstances (Kaptelinin & Nardi, 2006). It has been arguably more challenging for both individual academics and institutions to quickly adopt online teaching during the COVID-19 Pandemic. The present study, therefore, aims to provide an insightful look into the complexity of emergency online

teaching and institutional dynamics underpinning individual academics' teaching experiences in one institution.

At KAIST, the rapid adoption of online teaching as an emergency measure has brought about the emergence of three different online teaching activity systems during the Spring 2020 semester. Each activity system has been grown out of its preceding activity system that existed prior to the COVID-19 crisis—as each was named 'adopted' traditional and 'adopted' Edu 4.0 activity system in the present article. The senior management team's envisaged online teaching activity system also has its own historical backdrops and shares some elements of previous activity systems, such as institutional rules (e.g., intellectual property) and pedagogical artefacts (e.g., video lectures and KLMS). Gaining such historical insights about the new activity systems—in which different human subjects pursue their own goals (actions) while adjusting to new circumstances and unexpected challenges (operations) (Engeström, 1999)—has provided a rich explanation of individual academics' online teaching experiences and related dilemmas.

As demonstrated by KAIST's case, emergency online teaching activities are driven by multiple human subjects' object-oriented actions, which are also mediated by different interlocking elements constituting activity systems (Bligh & Flood, 2017). For example, novice online teachers' action (i.e., recording and uploading video lectures) was initially mandated by the KAIST's emergency measure and subsequently guided by their perceived object, previous teaching approaches, technological competencies, and pre-existing institutional rules. When faced with a series of dilemmas, where conflicts arose between their intended actions and other elements of the activity system, both novice teachers and other members of institutions (i.e., expert teachers and senior managers) altered their actions and related rules. That said, novice teachers' adapted traditional teaching activity system did not exist in isolation but formed concrete and changing relationships with other activity systems.

One of the first operations observed in the KAIST's case was that the senior management team changed the institutional rules of emergency online teaching activity from recording and uploading video lectures to using Zoom and providing live lectures. On the surface, this alternation was mainly caused by the technology capacity issues, which seem to be common challenges many universities faced during the initial period of adopting online teaching as an emergency measure (see Shih et al., 2021). Although offering live lectures can be simply discussed as a convenient solution to the failure of technology, it is

important to acknowledge the mediating effect of other elements on such alternation within the KAIST context. To begin with, the intellectual property rules from the precedent activity systems are deeply entrenched in the institutional culture and individual academics' mindset at KAIST—a leading research institution in science and technology where knowledge advancement is everyone's primary concern. This culture, arguably stemmed from disciplinary knowledge practice (Rockman, 2020), was not adequately considered when the senior management team developed the emergency online teaching policy. That is, it was not only a failure of technology but of policy.

Our analysis, however, suggests a stronger driving force behind the alternation—concerns over the pedagogical quality, which was differently manifested in the senior management team's and academics' narratives. While the senior management team (and CELT) was concerned about the poor quality lecture videos produced by novice online teachers, most academics (both novice and expert teachers) were worried about the sudden loss of 'direct' contact with their students. The object of the online teaching activity systems (i.e., delivering 'courses' online) created a fundamental contradiction with the object of the previous teaching activity systems (i.e., delivering 'quality courses' or developing future leaders in science and engineering). To resolve this contradiction, the senior management team reconfigured the emergency online teaching policy and most academics, after all, adopted Zoom sessions, even though this adoption doubled their teaching hours and efforts.

Such observations provide important insights into the current social and educational debates on academics' readiness for online teaching (or technological competencies, see Lee & Lee, 2020; Rapanta et al., 2020). In those debates, academics are often simply identified and categorized as novice online teachers or expert online teachers in a relative manner. In KAIST's case, such binary categorization of online teachers was initially devised in the senior management team's envisaged activity system to support novice teachers' rapid adoption of online teaching. One of the support mechanisms envisaged was to create a teacher community and foster collaborative teaching relationships among the members. This mechanism tends to be well-supported by literature that has stressed the importance and effectiveness of teacher community for teacher professional development (Lee & Brett, 2015, 2018a; Chai, 2019). Nevertheless, our observations highlight that building a supportive teacher community takes time and effort. During the Pandemic, both 'demoted' novice and 'promoted' expert teachers were under massive pressure; thus, such attempts only enabled

content-oriented teacher interactions (i.e., sharing educational materials) rather than genuine teacher collaborations.

While even the materials shared by expert teachers were not used by novice teachers, the envisaged roles and responsibilities assigned to the divided teacher groups created the subsequent contradiction in novice teachers' adopted traditional teaching activity system—a primary contradiction within the subject element of the activity system. The academics who were highly experienced teachers in face-to-face contexts and accomplished scholars with extensive expertise in their subject matters suddenly faced the prospect of becoming a novice. The adapted activity system involved more complicated and fast-changing relationships among internal elements and with neighbouring activity systems, including their expected collaboration with expert teachers, most of whom had a shorter academic and teaching career. Being asked to immediately perform a challenging task (i.e., teaching online for the first time) as the main subject of the system, but simultaneously being projected as a novice who would receive help from those expert colleagues, created the conflicting identity issue.

Nevertheless, it is crucial to remember novice online teachers' active embracement of Zoom sessions, despite their initial fear, to resume direct contacts and interactions with their students and meet their own standards of quality teaching. It is also worth mentioning that those teachers' commitment to quality teaching was very positively received and responded by their students. As we published elsewhere (Lee et al., 2021a), the student survey results at the end of the Spring 2020 semester at KAIST suggest that students were overall satisfied with the quality of teaching and particularly appreciative of teachers' efforts to reach out to them. Such outcomes clearly question the binary view on teacher identity, primarily associated with the teacher's technology competencies. In light of these findings, university administrations must find ways to support teacher practice and rightly acknowledge the pedagogical expertise and dedication of those teachers.

Watermeyer et al. (2020) also argue that academics' long-established roles and identities were all dismantled during the Pandemic, so the potential damages caused by the disruption could be multidimensional and traumatic to some. On the other hand, academics as active agents continued to change and alter their practice to resolve those disruptions and minimize potential damage. Thus, researchers need to put more systematic effort to develop a comprehensive understanding of the challenges experienced by individual academics and the changes created by those academics. In this sense, previous research that

conceptualizes those challenges as rather fixed and static ‘weaknesses’ (see Dhawan’s (2020) SWOT analysis) may not effectively capture the complexity of the situation. Universities also need to be aware that each institutional decision will disturb the pre-existing relationships one way or another. In this sense, suggestions narrowly oriented towards individual academics’ instructional and pedagogical strategies (see Bao, 2020; Rapanta et al., 2020) can be limiting and even dangerous.

7. Conclusion

As the COVID-19 Pandemic draws to a close, universities must now reflect on to what extent their roles and missions have been altered during the Pandemic and decide to what extent they will (must) return to their former teaching systems. As faculty members return to the bricks and mortar classroom, it is worthwhile to consider whether there have been lasting changes to their roles and identities. Also, as online teaching experience gained during the Pandemic occurred under an emergency situation, it differs in important ways from more established online teaching practice. How applicable are the knowledge and experience gained from the emergency online teaching during the Pandemic to both novice and expert online teachers’ post-pandemic pedagogical practice? Will academics labelled as ‘novice’ during the Pandemic regain their ‘experienced’ or ‘expert’ identities within the university once face-to-face courses resume? Have universities’ attempts to coordinate sharing and mentorship between more and less experienced online teachers led to any enduring collaboration between them after the Pandemic? Such questions remain for future research once the Pandemic has ended. However, the present study has shown the effects of one university’s plans to deal with emergency online teaching during the Pandemic and its subsequent effects on the institution and its faculty members. It is hoped that the examination of the contradictions that emerged between the university’s online teaching activity systems will be of use to other university administrators during this and future crises that cause massive institutional change.

Data Availability Statement

The data that support the findings of this study are not publicly available due to privacy or related ethical restrictions.

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