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The Design of Teaching and Learning Platform to Support Exchange Learning for Elementary and Middle Schools in Korea

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***Abstract*—The education sector needs to improve education quality after the post-pandemic and subsequent decline in educational attainment. Additionally, there has been a heightened reliance on private education, coupled with the projected inflection point of 2070, when the global population will decline. Various solutions have been developed and implemented to support changing educational environments and teaching methods. However, despite these efforts, the problem of a widening educational gap between urban and rural students persists. This is due to difficulties accessing educational resources caused by long distances between schools, and there is an increasing demand for practical measures to make education more inclusive. In this case study, we analyzed the building and operation of a teaching-learning platform. We interviewed stakeholders to prepare a preemptive response to social issues that education will face in the future. Through this, we derived considerations for an exchange learning-based teaching-learning platform (that supports teachers' exchange learning lesson designs) and proposed a design plan platform. The results of this study are expected to minimize the learning gap between urban and rural areas, support the development of educational programs that consider students' interests, and adjust the educational difficulty to a suitable level for each student. It is also believed to help develop and utilize an AI-based, learner-customized learning platform.**

***Keywords*— EdTech; public education; exchange learning; learning platform.**

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I. INTRODUCTION

The societal challenges expected to arise from a declining population are no longer problematic for a few select countries. The world has been in a demographic decline since World War II, and this trend is expected to accelerate with the global population decline inflection point in 2070 [1], [2]. According to the UN Department of Economic and Social Affairs (UN DESA), in April 2023, India's population of approximately 1.43 billion will surpass China and become the world's most populous country in 2023 for the first time since the 1959-1961 famine [3].

China's population was estimated at around 1.412 billion in 2021 and about 1.175 billion in 2022 [4], so a drop of about 850,000 people in 2022 may seem insignificant when considering China's total population (currently around 1.4 billion). Significantly, the world's population is expected to decline, and the Shanghai Academy of Social Sciences team predicts that China's population could reach 500 million by 2100 [5], [6].

A country's population fluctuates due to immigration, deaths, and births. The recent acceleration of demographic decline and aging due to declining fertility rates has raised fears among many countries and economists. A shrinking and aging population leads to increased spending on pensions and social welfare, and a decline in young people leads to slower economic growth and innovation. A declining population can also lead to fewer people being able to fulfill military service obligations, reducing a country's global influence [2], [7], [8], [9].

In addition, the declining and aging population is decreasing the number of education administrators, leading to difficulties in accessing educational resources (even in the era of the Fourth Industrial Revolution, where knowledge is a competitive advantage). This difficulty in accessing educational resources leads to a gap in education, which weakens a country's global competitiveness [10], [11]. In our digital society, as represented by the Fourth Industrial Revolution, it is necessary to develop human resources and improve the quality of education so that national competitiveness no longer depends only on resources or

technology and so that schooling can emerge as a critical factor determining a country's future [12].

The need to improve the quality of the educational environment is increasing, and Korea is facing severe educational problems, such as a decline in the school-age population, a decline in primary education caused by the pandemic, and a high dependence on private education [13], [14], [15]. In particular, the decline in the school-age population in rural areas, which has been caused by a continuation of the low birthrate trend (and the migration of people to large cities due to issues such as employment and further education), is causing a crisis in the existence of rural schools. This decline is accelerating rapidly, especially in rural schools [16]. As the number of rural schools closing has been increasing, there have been concerns about the decline of local communities and the labor force. These factors make the decline of the school-age population a major social problem [17]. Social issues related to the declining school-age population have become one of the biggest challenges facing education in South Korea. In rural areas, the outflow of population due to the closure of schools is accelerating, and school management is facing various limitations, including the inability to recruit new students, the merger of schools, and the need to increase teachers' subject expertise [18]. In addition, the new situation requires a new online class model [19]. For these reasons, the Korea Ministry of Education is struggling to find a way out of the crisis. It is working to create a multifaceted education system with a long-term perspective by utilizing IT in education [20].

A. Defining 'Exchange Learning'

The definition of exchange learning is still not clear in relevant laws and regulations, so it is referred to by various names depending on the academic regulations, such as 'experiential learning', 'off-campus experiential learning', 'mutual learning', 'exchange learning', and 'co-curricular programs' [21]–[23]. In this paper, we define exchange learning as the mutual sharing of educational programs between schools and conducting research on building teaching-learning platforms to support it. Exchange learning, as described in this paper, is the exchange of educational programs between schools and classes to cultivate good character and understand the cultural characteristics of other regions through various academic and experiential activities in a new environment or a form of learning that is carried out unilaterally in different schools and classes.

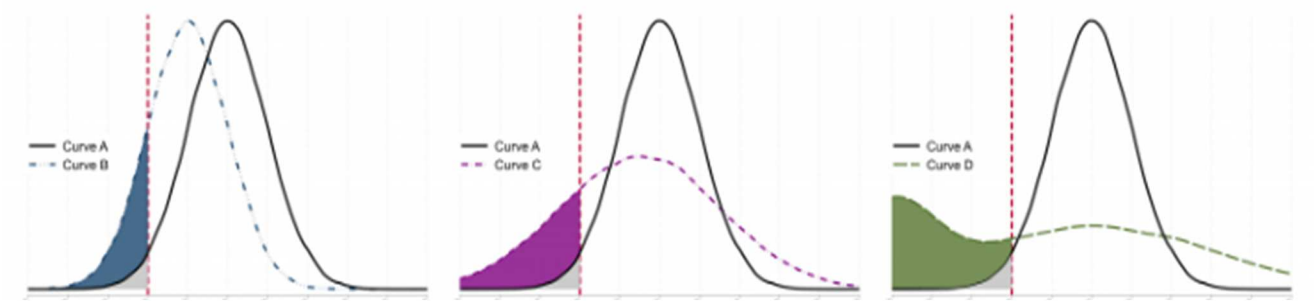
B. Characteristics of Rural Schools

There is a significant disparity in the composition of schools in Korea (e.g., in the number of schools, class sizes, and enrollment between metropolitan and rural areas), and the regional location of schools affects the supply and demand of educational resources (including teachers) needed to run curriculums [23]–[26]. The continuous decline of the school-age population in rural areas and the decline in new students entering schools has led to their closures, increasing the 'district area' (the geographical area that a school must serve). Increasing distances between schools due to school closures caused by the decline in the school-age population and the growing problem of rural depopulation exacerbate the difficulties in supplying educational resources.

This gap in the supply and demand of educational resources for rural schools is caused by the increasing distance between schools due to the declining population of rural areas, and this phenomenon is expected to expand globally as the global population declines.

C. Learning Gap Trends between Metropolitan and Rural Students

In this study, we analyzed the literature relating to learning gap trends in Area A (located in the metropolitan area and northeast of Korea) to identify these trends in students based on the distance between schools in the area. Region A is characterized by its mountainous terrain, which makes the distance between schools particularly long in Korea, and the difficulty of interaction between regions. Compared to the Seoul metropolitan area, this region has shown a learning gap between students that deviates from the general pattern of change after the pandemic. The learning gap between middle school students in Area A and middle school students in the Seoul metropolitan area is shown in Fig. 1 [28], [29].



1) Learning gap trends among middle school students in Area A

2) Learning gap trends among middle school students in the Seoul Metropolitan area

3) Trends in learning gaps during crises (reference)

Fig. 1 Comparing Learning Gap Trends

1) After the pandemic, the region as a whole experienced a decline in primary education assessment grades, 2) but not a decline in the median percentages, while middle school students in the metropolitan area experienced a significant decline in the median percentages with a simultaneous increase in A and E grades. 3) These findings differ from previous trends, such as the 1997-98 Asian financial crisis, in which school enrollment dropped sharply and dropouts increased during crises [27], [28]. This can be interpreted as a

result of unequal access to educational resources based on regional characteristics and the COVID-19 pandemic.

In addition, when the digital transformation of the education sector is being emphasized [29], a teaching-learning platform service that supports the same online educational environment regardless of geographic location can be applied to bridge this learning gap. In addition, the exchange learning-based teaching-learning platform needs to be designed as a system for sharing teaching methods to reduce the imbalance in the supply and demand of educational resources.

To run a systematic and consistent curriculum at all school levels, it is necessary to secure more training time and time for preparation [30], [31]. The need to improve the quality of education due to the teacher shortage may be addressed by increasing the number of subject matter teachers with subject-specific expertise. However, in rural schools, there are frequent cases of teachers' refusal to accept assignments, which creates difficulties. Therefore, the researchers of this paper conducted a study to propose a teaching-learning platform design to reduce the learning gap according to the student's residence area and to prepare a teaching method-sharing plan for teachers in the teaching-learning platform.

II. Materials and Method

This paper proposes a teaching-learning platform design based on exchange learning for sharing teachers' teaching methods. For this purpose, we analyzed a case study of building a teaching-learning platform in Korea. We derived the requirements for it through interviews with education officials who are currently utilizing teaching-learning platforms.

A. Constructing a Teaching-Learning Platform- A Case Study

Korea's educational policy is based on supporting students' individual growth, designing career paths for self-directed growth, and preparing for changes in the academic environment. It sets future-oriented teaching, learning, and assessment innovations as essential directions to strive towards. In response, local school boards in Korea strive to provide customized information for each user and build an EdTech ecosystem by operating AI-based education services that reflect local characteristics. They also prepare to deliver innovative learning experiences through complementary AI digital textbooks. However, while existing teaching and learning platforms are optimized to support students' customized learning and offer various contents to learning, the process for exchanging teaching methods between school-to-school and classroom-to-classroom is lacking.

To support exchange learning, the Korea Educational Development Institute (KEDI), an education policy research institute in South Korea, built and operated an online collaborative curriculum: 'Classroom on Dot.' The 'Classroom on Dot' service is used by 17 provincial education departments in South Korea, and the service is operated through cooperation and collaboration between schools to offer small classes and enrichment courses that are difficult to offer in individual schools due to low enrollment or teacher shortages [32]. Since the learning management system within the teaching-learning platform is a basic system for online classes, providing shareable and reusable learning activities, resources, and learning outcomes across various learning management systems is challenging for online education [33]. Although 'Classroom on Dot', analyzed above, operates online collaborative courses based on video lectures for a small number of students, it was found that it does not support the utilization of various EdTech tools.

B. Teaching-Learning Platform Stakeholders (FGI)

The researchers of this paper, who work as EdTech Systems Integrators (SI) in system building and education consulting, determined that the actual use of 'Classroom on Dot' is low through existing approaches. They conducted an FGI with representative stakeholders with experience building and operating a teaching-learning platform to derive requirements for a teaching-learning platform to support exchange learning. The FGI aims to obtain helpful information related to research objectives or to discover unexpected results through surveys [34].

1) Research subjects: Five interviewees were selected as representative research subjects from among practitioners with experience in building and operating teaching and learning platforms, local education office officials, and schoolteachers. The research subjects were selected because they are continuously involved in t revitalizing local schools.

2) Questionnaire construction: An FGI was conducted to derive requirements for building an exchange learning-based teaching and learning platform in this study. The questionnaire was reviewed by a group of EdTech experts, PhDs in education, and scholars from municipal education departments and was revised, supplemented, and finalized. The questions were organized as overview questions to derive requirements for a teaching-learning platform that considers local schools' characteristics and identifies the need for exchange learning support in small schools; the overview questions did not include exchange learning. The FGI used the following questions to derive requirements for an exchange learning-based teaching-learning platform.

a. How can digital technologies be leveraged to improve learning and realize the future of education?
b. What are the most critical considerations for digital-based education innovation?
c. What characteristics should be emphasized in small schools in rural areas (compared to metropolitan areas)?
d. What should be considered in future education to improve students' academic performance and support teachers' teaching?
e. What are the barriers to digital education transformation in rural schools?
f. What are the other needs for digital education transformation?

3) Interview results: The researcher conducted and recorded FGI interviews with faculty-learning platform stakeholders. Afterward, the recordings were listened to and transcribed several times, and the focus was on categorizing the same opinions and disagreements during the general coding procedure. During the analysis of the results of the FGI, the researchers' anticipated need for an exchange

learning-based teaching and learning platform was confirmed. The main contents of the need for an exchange learning-based teaching and learning platform are shown in Table 1.

TABLE I
NECESSARY DEMANDS FOR AN EXCHANGE LEARNING-BASED TEACHING-LEARNING PLATFORM

Category	Opinion
Necessary Tools for Exchange Learning	a. Small schools need co-curricular connections between schools (experiential learning, online co-teaching, etc.). b. Small schools need community functions for inter-school exchanges. c. Small schools organize joint classes with other schools due to a lack of learning resources (time, money, physical environment). d. There is no system to support learning between small schools, so they use a combination of EdTech tools.

4) Requirements for an exchange learning-based teaching-learning platform: The researchers of this paper identified the requirements for an exchange learning-based teaching-learning platform from the interview contents, reviewed the interview contents in detail, and organized the results of the FGI analysis into four categories: system design and operation for exchange classes, content and EdTech tool linkage, student portfolio, and learning analysis. The results of the FGI coding and analysis of the interviews are shown in Table 2.

TABLE II
SUMMARY OF FGI INTERVIEW RESULTS

Category	Opinion
Designing and operating an exchange classroom system	a. Co-curricular programs (experiential learning, online co-teaching, etc.) between schools are needed. b. A function to support expert invitations, online special lectures, etc. should be built together. c. Expert 'pool management' should be done for the convenience of school administration. d. Support community features for exchanges between schools. e. Multiple EdTech tools should be available for co-teaching. f. Tools and systems that enable project-based learning for increased exploration. g. It should be able to design individual curricula to close learning gaps and educational programs for students' character growth. h. It should support the development of school-specific educational programs. i. It should be able to support not only school-to-school, but also class-to-class and student-to-student teaching. j. The platform should be easy for teachers and support their awareness of digital education.
Align content and EdTech tools.	k. It should be easy to utilize the wide variety of EdTech tools and content available in the market. l. Teachers should be able to see what they've used in the past, even if they're transferred schools. m. The school should be able to manage the materials used in the classroom. n. It should be able to provide indirect experiences through AI and digital-based educational innovation, such as utilizing metaverses. o. Since teaching materials are developed in the metropolitan area, and rural students use unfamiliar structures in their classes, teaching tools that are familiar to rural students should be developed. p. In a digital-based education environment, sharing of various educational resources should be flexible. q. Teachers have different levels of proficiency in EdTech and need training support on the usability of teaching and learning platforms.
Student Portfolios	r. Students, teachers, and parents should be able to see the same results for academic progress and counseling. s. Keep track of students' learning levels as they move from one grade to another and support personalized learning by level.
Learning Analysis	t. The teaching-learning platform should support student self-directed learning. u. It should have a system with teaching and learning methods to support student growth, such as tutoring or mentoring.

III. RESULTS AND DISCUSSION

Based on the results of FGIs with practitioners, local education officials, and schoolteachers who have experience building and operating teaching and learning platforms, this study's researchers have derived considerations for designing teaching-learning platforms and proposed an exchange learning-based design.

A. Teaching-Learning Platform Design Considerations

The researchers used the FGI responses to develop draft design considerations for an exchange learning-based teaching and learning platform. They finalized them in consultation with two edtech experts and a platform design expert.

The design considerations for an exchange learning-based teaching and learning platform, derived from the consultation with EdTech experts and EdTech platform designers, are as follows:

a. A need for teaching-learning design measures that allow teachers to lead the design and operation of educational programs.
b. The Exchange lesson design and management system for exchange learning should support community functions for sharing class openings and availability.
c. The provision of educational services that enable participation by various users, including within schools, between schools, and in community partnerships.
d. There is a need to support exchange learning services that can be experienced and interacted with based on various EdTech services, including real-time video lectures.
e. A learning management system is required for class operation. The system should provide online and offline community-based classroom creation and sharing functions.
f. EdTech services related to learning require a joint city-province platform so students across the country can utilize the same EdTech teaching tools.

g. Data linkage standards should comply with MOE guidelines (LTI, OneRoster, etc.) in consideration of future platform connectivity and scalability
h. a complete life-cycle student portfolio that provides comprehensive information by user for student growth management is needed.
i. A learning analytics foundation is needed to support students learning history management, grade/performance management, encouragement management, and learning recommendations.

B. *Configuration of Exchange Learning-based Teaching-learning Platform*

The configuration diagram of the exchange learning-based teaching-learning platform was drafted by the researchers of this paper and reviewed by platform design experts in the SI (systems integrator) field to ensure the feasibility of actual implementation. This exchange learning-based teaching-learning platform consists of an exchange class design and operation system, a learning management system, a student portfolio service, a learning analysis system, and an EdTech resource/tool linkage system. The configuration diagram of the exchange learning-based teaching-learning platform designed through the exchange learning-based teaching-learning platform design considerations is shown in Fig. 2.

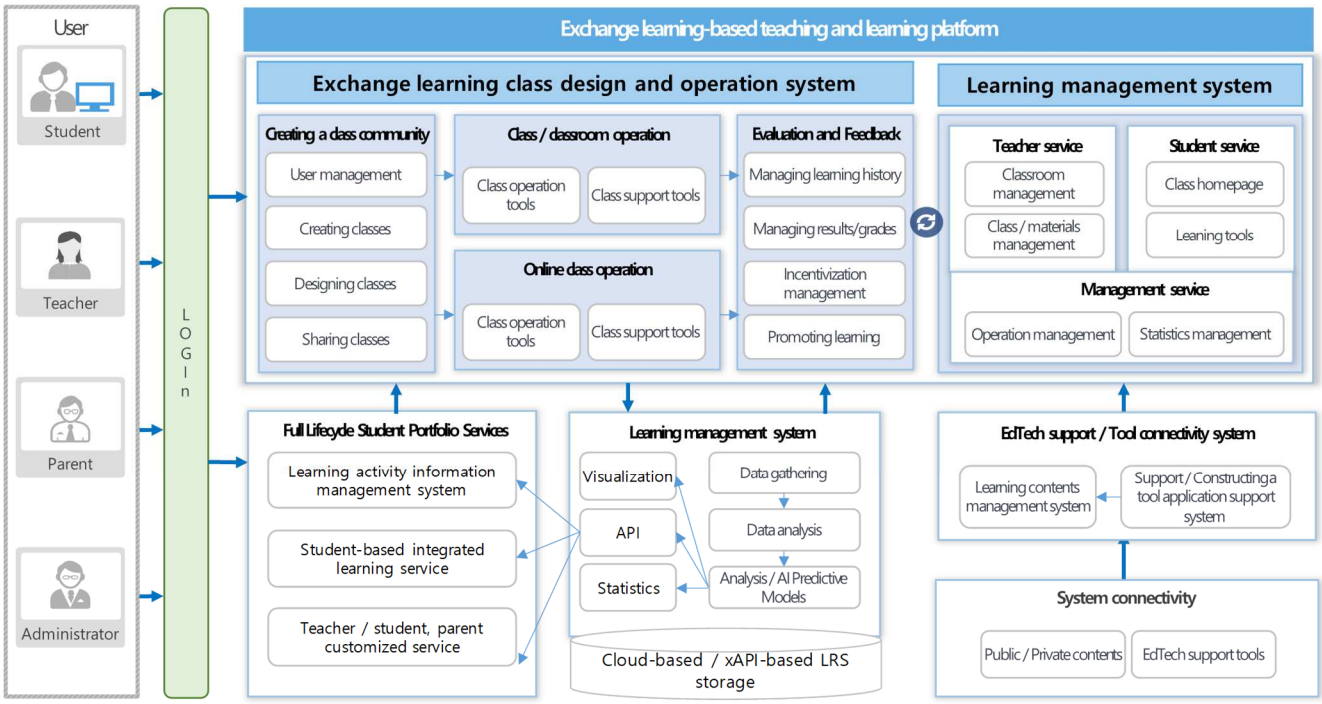


Fig. 2 Configuration of the Exchange learning-based teaching-learning platform

IV. Conclusion

This paper comprehensively examined the problem of learning gaps between regions in Korea, education policies, and the status of teaching-learning system construction by provincial education departments to present educational implications and suggestions for an exchange learning-based teaching-learning platform. It also presented a design proposal for such a platform to be developed to cope with the current problems facing education due to population decline and proactively respond to supporting changing educational environments and teaching methods.

To explore the needs and actual educational utilization possibilities of an exchange learning-based teaching-learning platform, FGI questions were drafted based on literature studies and researchers' empirical approaches, and FGI questionnaires were reviewed by a group consisting of EdTech experts, PhDs in education (along with scholars from municipal education departments). Based on the results of the FGI analysis, considerations were drawn with the advice of two EdTech experts and the cooperation of platform design experts. Finally, the design of an exchange learning-based teaching-learning platform was presented.

Recent EdTech-based teaching and learning platforms are dominated by AI-based teaching and learning systems that provide customized information to learners. However, when educational problems regarding the expertise and accessibility of educational resources are expected to deepen, the existing teaching-learning platforms that only provide learning results to learners face another challenge: teacher exchange and sharing educational resources. Providing specialized and rich materials that help learners learn correctly is also becoming an essential element of a teaching and learning platform.

In Korean elementary schools, one classroom teacher is responsible for multiple grades, with this teacher teaching all subjects [35]. As the school-age population declines, the trend of school consolidation will accelerate. The decrease in the number of schools will lead to a reduction in the number of teachers, and the number of educational materials that teachers need to prepare will increase- this workload will naturally lead to complaints about the quality of education. Therefore, future teaching and learning platforms will need advancement to support teachers' sharing of educational

materials and their teaching capabilities and to provide students with opportunities to access various academic resources. In addition, these platforms must be prepared to respond to changes in the future educational environment by converging private technology and teachers' subject expertise through efficient linkage with EdTech tools.

In the initial stage of building a teaching-learning platform based on exchange learning, it is necessary to collect student learning growth data, and the inducement of user participation is expected to provide customized information on learning outcomes by level. It is also likely that, by applying the results of this paper, the teaching-learning platform can minimize the learning gap between regions and support the development of educational programs that adjust the educational difficulty in consideration of each student's level and interests.

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