

Innovation of the Future Education System Design: NECLAs

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Abstract

We focus on a better way of reliably achieving major innovation for future class room and education system. “Innovation” is a viable offering that is new to a specific context and time, creating user and manufacturer value. The innovation of the future education system by using the tools of Information Technology (IT) and Artificial Intelligence (AI) seems to be the tremendous growth in this field. In this paper, we have designed a classroom for the future education system that meets all the requirements for meeting the proper education requirements. The Robot as a teaching assistant with the human machine interaction system in totally IT settings classroom is designed and innovated. The innovation has been done with core principles of successful innovation ideas for achieving the creative requirements and competitive advantage for the future education system.

Keywords: *Future education system, Classroom design, Design innovation, IT, AI.*

1. INTRODUCTION

In today’s world, the innovation of the products, systems and services by the application to the various fields of IT (Information Technology) [1] and AI (Artificial intelligence) [2] are expected. The innovation related to the field of education, that we are currently focusing on was started being based on the various IT applications with an attempt to incorporate with the robot. To enhance the quality and equity in education and meet the demand of the future educational system, we aim to build an educational system model that would be useful for anyone, anywhere, anytime, and economically viable. We are also focusing on the classroom design related with the Active Learning [3] and Project Based Learning (PBL) [4], which are being influenced in these recent years.

The introduction of the latest IT equipment and application system in the classroom only doesn’t lead

to the innovation of the true education system. To introduce the classroom that is aimed with a true innovation, First we need to think about the importance and extract the current state analysis in order to activate the classroom and the communication skills by using the IT and AI systems. However, the examples showing the innovation of the classroom are hard to find. Keeping such things in mind, in this year’s “Advanced Design Engineering” course of Information and Production engineering department, we studied about the innovation design with the main theme of “Innovation of the future education system” along with the 2 graduate students from Japan and 6 from foreign countries including the ABE initiatives. In this lecture, we started from the theme setting and proceed with the variety of design process to report the application of the leading innovative future classroom using the IT and AI systems.

The system must be capable of utilizing the new technological developments for educational purposes.

In order to cope with the greatly increasing number of students, educational systems will need to find a way of bringing educational services to greater number of students without a proportional increase in man power and money. Teaching machines and computer-assisted instruction are two examples of technology available to multiply the effect of teaching. Greater use of these developments as well as the creation of others innovations, will help stimulate greater learning. This really leads us to present model classrooms named NECLAs (New Educational Design Classrooms).

2. BACKGROUND

The traditional methods of teaching have been changed with respect to the time. The time changes and the technology advances, resulting in the fact that the traditional style of education which was very effective in its time, is no longer adequate for today's and tomorrow's students. Today's children are accustomed to a fast-paced world. The proliferation of television, mobile phones and the Internet has contributed and many people now have a little tolerance for things or experiences that take time. Children reflect this trend and concentration can easily lapse, when mental stimulation is inadequate. They need individualized attention. The school of the future, incorporating ubiquitous technology, allows children to work at their own pace and get help and motivation when required.

Following the path of the developing education, the trends of Active Learning, Project Based Learning have been influenced along with the use of different ICT (Information and Communication Technologies) [5][6][7] such as Interactive white boards, Document cameras, Audience response systems, Projector etc. are in use. These tools seem to be quite attractive and useful for the education system, but still they lacks the proper implementation of the IT and AI systems for the proper human interaction either with human or with machine. Due to which still there are many students, who are not interested on their study and cannot upgrade their education level. To overcome these problems, we design a future classroom along with different teaching methodologies to IT and AI based modern and innovative future education system in a trans-disciplinary way of learning.

3. INNOVATION PROCESS

In the lecture of “Advanced Design Engineering”,

we set up a theme of innovating a future education system. The members of the classroom were divided into two groups which were named as “Innovators” and the “Co-operators”. Both teams were asked to discuss on several topics related to the theme being based on the innovation process. The innovation process was categorized into different topics being based on the “101 Design methods” [8] and “Delft Design Guide” [9].

The flow of our innovation process is shown in the figure 1. The sense intent helps us to develop a theme and understand about What, Where and How to innovate the given theme? After the mind is set, we will have a full understanding of the context or theme through the existing related theme. The buzz reports are collected from different peoples through different social media. The Buzz report helps us to aggregate feedback, track trends and take action. After the action is taken, the popular media scanning is done for understanding key cultural phenomenon through a broad look at what is published and broadcasted in popular media. After media scan, different ideas on the themes are generated and moved to the design process with the offerings, activity and the culture of the innovation theme. The ideas are then evaluated with their pros and cons using the SWOT analysis [10]. The analyzed final design is then discussed and performs the implementation.

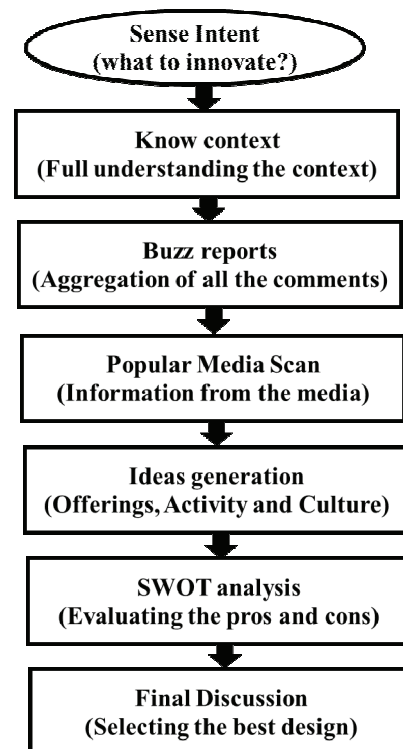


Fig.1 Flow of the innovation design process

4. PROPOSED MODEL

The proposed model for the future education system is focused on the IT enabled learning model, combined learning, interactive learning, active learning and knowledge based learning. In our innovation, we designed three different model classrooms for the future education system. The diagram showing the three model classrooms are shown in figure 2, 3 and 4.

4.1 Model classroom 1: The model classroom 1 shown in figure 2 is designed for a few numbers of students to study in a round shape format where the teacher stands at the middle of the students. The desks are set up with the LCD touch screen display, which can be used as a notebook and textbooks. All of the LCD's are connected to the teacher's computer. The 4 big screen LCD displays are set up in the ceiling for the slideshows and presentation as well as works as a board for the teacher. This model is totally based on the IT systems.

4.2 Model classroom 2: The model classroom 2 shown in figure 3 is designed in a rectangle shaped room, where a lot of students can study. This classroom consists of the humanoid robot as a teaching assistant for assisting the teacher. The robot moves from front to back of the classroom for several times to follow up the students. In this classroom, the touch screen LCD display wall, LCD Table display and microphone is used. All of the displays are connected to one another along with the robot. The artificial intelligence system is applied in the robot for the human machine interaction. The students communicate with each other by using the microphone. This model reflects the proper usage of IT and AI system in the field of education.

4.3 Model classroom 3: The model classroom 3 shown in figure 4 is designed in a semi-circle room. This model includes all the functions of the model classroom 2 including some more extra functions and applications. In this model, cameras are fixed in different parts of the room for the proper attention of the students. All the rooms are made with echo reduced walls and levitated floor. The holographic display is used for the proper visibility of the movement of the teacher from every part of the room. The microphone is used as a communication tools for asking and answering the questions. The front wall is set up with several display

screens which reflects the whole part of the lecture or class. The humanoid robot used here is set up with the human machine interaction tools to interact with the students and recognize their understanding level and interest in the study. The robot to be used in this model has several offerings as shown in figure 5. Similarly, the software visualization of the robot T.A interaction is shown in figure 6. This model can also be said as the best model for our innovation as it includes all the required elements for the future education system classroom being based on the IT and AI system. So we planned to pick up this model as our proposed model.

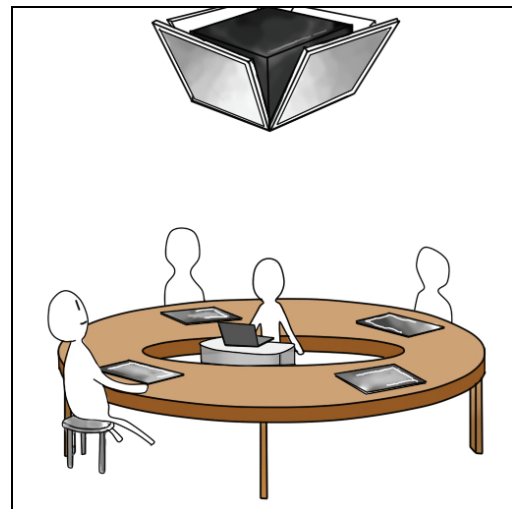


Fig.2 Proposed innovation classroom model 1

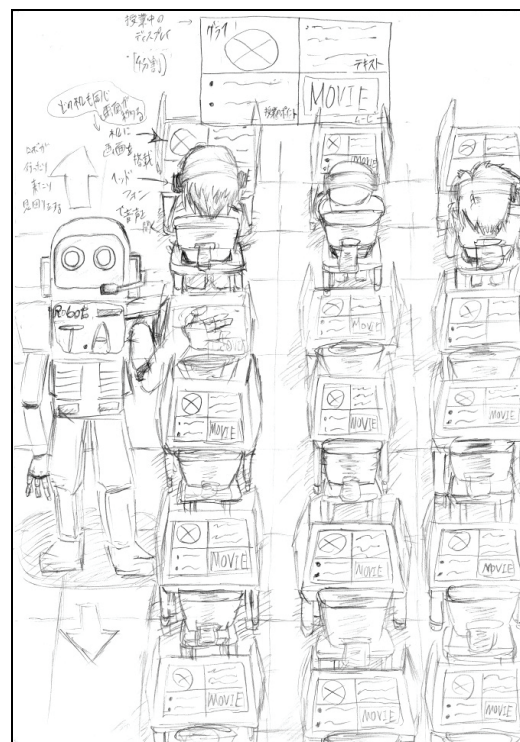


Fig.3 Proposed innovation classroom model 2

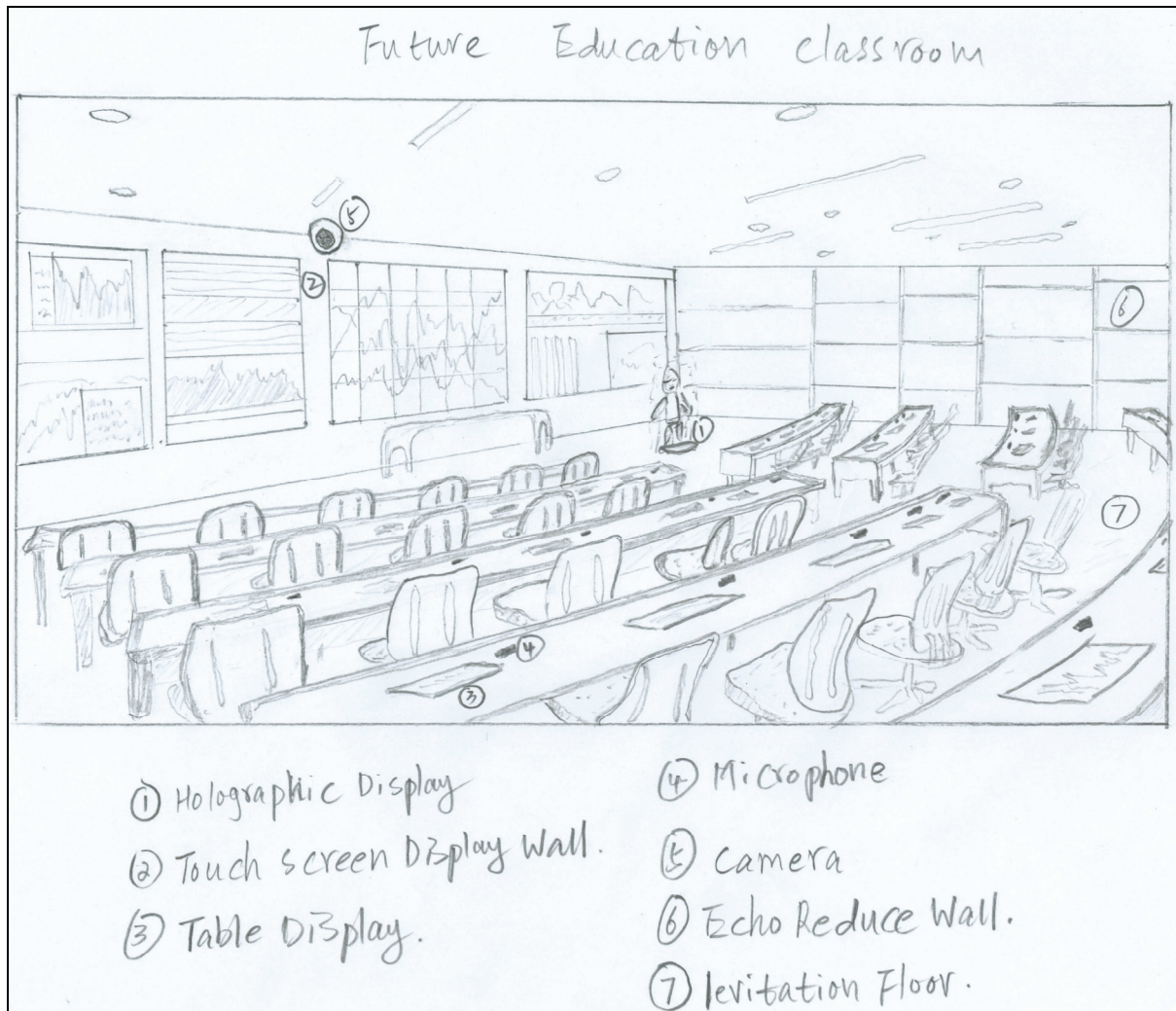


Fig.4 Proposed innovation classroom model 3

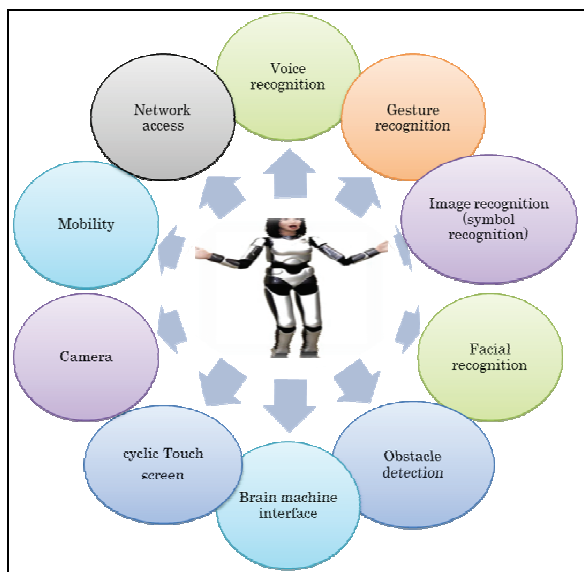


Fig.5 Offerings of the Robot Teaching assistant

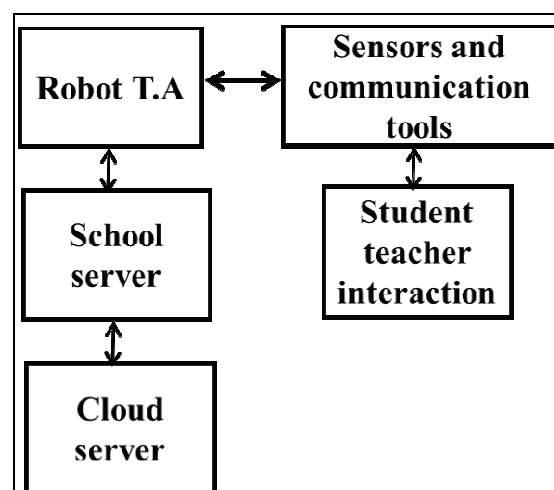


Fig.6 Robot TA interaction

5. SPECIFICATIONS AND MAJOR COMPONENTS

Rapid advancements in technology, and heightened awareness and expectation are what cause the most pedagogical change. In order to take advantage of these changes, teaching spaces must be able to utilize new technologies and have classroom “flexible enough to accommodate different teaching styles”.

As laptop and tablet computers become cheaper in the near future instead of copying handouts and exams to give students they will be pushed online to students. All students will have an adapted study space, eliminating textbooks heavy backpacks and locker while also making a cleaner classroom environment.

The major components and the system requirements of the proposed innovation design are Robot, AI Technology, Holographic display and the communication tools.

5.1 Robot (Humanoid robot): The humanoid robot for example “Pepper”, “Nao” etc. seems to be the best component for the future education system and classrooms. We choose humanoid robotic have human appearance, teach students looks like human teacher, easy to interact with students feelings and students tools, intelligent navigation with the class room and assist students problem like human teachers. The system configurations of the humanoid robot are Hardware, Sensors and Software.

The hardware components of the Humanoid robot are actuators, microcontrollers and mechanical structured body. The sensors that work under different obstacle detection, image recognition, face recognition, classroom map detection, voice recognition, gesture recognition and Human Machine Interface comes under the sensor configuration. The software required is focused on artificial intelligence system to make decision for the teaching activity of the robot.

5.2 Artificial Intelligence (AI tech.): While we’ve yet to create self-aware robots like those that pepper, we have made smart and often significant use of AI technology in a wide range of applications including Education, Where it’s expected to make big changes such as;

- AI can automate basic activities in education like grading.
- Educational software can be adapted to student needs.

- It can point out places where courses need to be improved.
- Students can get additional support from the AI tutors.
- It can change the role of the teachers.
- AI can change where students learn, who teaches them and how they can acquire basic skills.

5.3 Holographic display: Advancements in technology continue to change educator’s teaching approaches. Many of the chalkboards that once adorned our school walls have been replaced with projection screens or interactive white boards. In some classrooms, tools like these are being used to bring remote students, teachers, or guests into the classroom as virtual guests. On the horizon is the next step forward in this evolution – the use of holographic display. The expected changes using the holographic display are:

- Have experts illustrate processes live, in person, in 3D.
- Connect geographically remote classrooms.
- Deliver lectures to multiple classrooms, anywhere, at the same time.
- Remote attendance.
- Remote access.
- A whole new dimension to instructional content.
- Go ‘back in time’ in 3D.

5.4 Communication tools: The communication plays a vital role in each and every field as well as in the field of education. Advancing with the technologies, the communication tools are also developing gradually. In our proposed future education system designed classrooms, the latest IT related communication tools are planned to be used. The communication tools are Tablets, Smart phones, Interactive white board, Electronic paper, Microphone, Headphones, cameras, LCD Projectors, speakers, translator etc. All of these tools are used by the students and teachers in the school and the research center during the lecture session for the proper communication. These communication tools are proposed to be used because these all tools are technology oriented educational system that supports the active learning, PBL and knowledge based learning.

6. EVALUATION (SWOT analysis)

The term evaluation is the very important topics for giving life to the innovation. We have evaluated our proposed future education system innovation by using

SWOT analysis method. SWOT analysis is a useful technique for understanding the strengths and weakness, and for identifying the opportunities and threats of one's innovation. By using the SWOT analysis, we came up with the following evaluation.

6.1 Strength: The strengths of our proposed innovation are:

- Technology oriented educational system
- Active learning system
- Motive students for education
- Uniform standard education since the source of the data is the same
- Unlimited data storage
- Students have chance to do laboratory works by themselves
- Creates opportunities for work
- One teacher can teach (cover) wide range or a lot number of students.
- Environment, features, classroom design, libraries can be designed technologically oriented.
- Trusted source
- Effective for repetitive tasks
- Can address students with special need.
E.g. physically unable students

6.2 Weakness: The weaknesses of our proposed innovation are:

- It is very expensive due to which everybody may not afford this education system.
- The human to human relation or interaction is less in contrast to the human machine interaction.

6.3 Opportunities: The opportunities of our proposed innovation are:

- Multi-language teaching.
- Strategic alliance of national and international institutions.
- Increase of information technology materials provider.
- Web-education

6.4 Threats: The threats of our proposed innovation are:

- Harassment and breaking of the robot at school.
- Might have a chance for the data's to be corrupted.

- Complain from parents because of robot teacher.
- Less chance of job opportunity for human teachers.
- Shortage of technical workers on the implemented system.
- No communication skills.
- People have to depend on the machines.

7. SCENARIO

The classroom scenario will be divided into 4 parts.

7.1 The teacher's presentation: Teacher guides their students in the preparation of multi-media classroom presentations, where a computer with presentation software can provide a single tool for augmenting lectures with outlines, slides, statistical charts and tables, images, and even video clips. We can save the in-class presentations in a web-compatible format for later review and discussion. For example presentation software (such as PowerPoint) enable instructors to embed high-resolution photographs, diagrams, videos and sound files to augment text and verbal lecture content.

7.2 The question-answer period: During this time, the students point out and note the difficult problems and topics that they didn't understand while presented by the Robot TA, or couldn't get the best solutions. The students can either record their voice or directly write the questions in their touch screen LCD in the dialog box, so that the teacher will give them the appropriate solution during the discussion time. The answers or the solution from the teacher will be the most effective in such cases.

7.3 The assignment or exam time: There are number of tools that facilitate and streamline the process of giving, collecting, evaluating, and returning student's writing. Giving and returning student work digitally allows you to streamline the process of returning graded work while also ensuring that it is secure. The student can submit their exam papers in the digital format along with their user ID and password, which really helps one's answers to be kept secured and results for the correct evaluation of the student level.

7.4 Discussion time: The discussion time may be used for "Active learning". Active learning means students

engage with the material, participate in the class, and collaborate with each other. Students don't only have to listen and memorize; instead, have to demonstrate a process, analyze an argument, or apply a concept to a real-world situation according to the teacher's experience on this field. And the system can also take profit to learn from it. The questions aroused during the question answer period are solved by this time either from the web, classmates or from the teacher. The perfect answer from is then saved in the memory of the robot for implementing it next time.

8. DISCUSSION

The three different model classrooms have been proposed during the innovation of the classroom for the future education system. The entire model classrooms are designed on the base of IT and AI systems. The proposed model classroom 3 has been approved as our final innovation as it includes all the components of the model 1 and 2 along with more extra components.

From the evaluation of our proposed model by using SWOT analysis, we understand about the strengths and weakness as well as opportunities and threat of the proposed system. This proposed model has a lot of strengths and opportunities along with the threats and weakness. To overcome up with the weakness and threats of the proposed model, we think of an idea to innovate the Virtual Avatar classroom model. The image of the virtual Avatar classroom is shown in figure 7.

The use of virtual tools like Head mount display connecting to the server and Raspberry Pi board can access the classroom activities from each and every geographical part even without going to the school or classroom. The student can get access to the classroom and enjoy each and every activity in the classroom with the feeling of being in the classroom. So, by combining the virtual avatar classroom model with our proposed model seems to be very much beneficial for the future education system.

9. CONCLUSION

In this paper, we presented a proposed model classroom innovation for the future education system. The use of the latest technology of IT and AI trends in the education system makes both teaching and learning simple and easy to understand. The proposed model is realistic and goals achievable. The proposed model

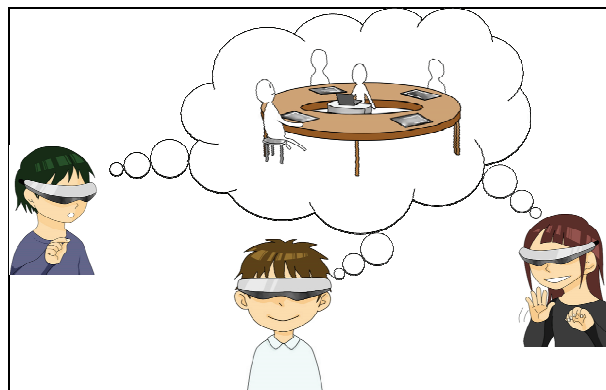


Fig.7. Virtual Avatar classroom model

connects the developing technologies with the education due to which the students don't feel bored in the classroom and their interest in study increases as they are not only studying but are playing with the technologies. This proposed model is designed to implement new technologies into the education system and focus efforts on facilitating learning instead of implementing multimedia toys and games for the students.

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未来の教育システム・デザインのイノベーション

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要旨

IT と AI の様々な分野への応用によって、製品、システムやサービスに対する innovation が期待されている。ここで注目する教育の分野でも IT の活用による innovation が検討され始めていて、ロボットを初等の語学教育に取り入れた試みもある。近年注目されているアクティブ・ラーニングやプロジェクト・ベースド・ラーニング (PBL) に活用できるようなクラスルームのデザインも注目に値する。

クラスルームに最新の IT 機器やアプリケーション・システムを導入しただけでは、真の教育システムの innovation にはつながらない。真の Innovation を目指したクラスルームを導入するためには、その前に、なぜ (why) innovation が必要なのかを考えると、現状分析により問題点を抽出すること、どんな授業形態にするかを検討すること、クラスルームを活性化するために、IT や AI を活用してコミュニケーションを活発化することなどを、検討しておくことが重要である。しかしながら、innovative なクラスルームのデザインを検討した例は、ほとんど見当たらない。

本年度の情報・生産工学専攻・システム情報工学専修の「設計工学特論」では、「未来のクラスルームに対する innovation design」をメインテーマに取り上げて、ABE イニシアティブの院生を含む、留学生 6 名と日本の院生 2 名のメンバーで、検討を加えてきた。

本稿では、最初のテーマ設定から、様々なデザインプロセスを経て、IT と AI を活用した innovative なクラスルームデザインに至る過程を報告する。

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