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CASE REPORT / ACTIVITY REPORT

UDL using ICT for Inclusive Learning;
Learning Support for Students with Diverse Learning Styles, Including Students who Need Special Support

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ABSTRACT

The use of ICT is said to be an effective learning support tool for children with disabilities. In addition, though the learning styles of individual are different and vary among individuals, these differences are considered important because of their influence on the academic achievement of individuals (Baderaddin, 2015). Lessons using ICT are said to be effective for any learning method. However, in Japan, it has been found that there are issues with improving reading comprehension and ICT utilization, including that "In the field of school education, the number of local governments and schools that are introducing tablet PCs is gradually increasing, but compared to other countries, the current situation in Japan is that the utilization of ICT is progressing slowly"(Ogawa, 2017).

This study implemented the teaching method of UDL using ICT in the classroom and verified whether it was effective as an inclusive learning teaching method. According to student's evaluation of the lessons by questionnaire, results showed that UDL classes are effective for them. Particularly on questionnaire items ② Overall satisfaction, ③ I want to recommend it to other students, ④ I understood contents of the lesson well, ⑥ English knowledge improved compared to before (until last year), ⑦ Class difficulty is appropriate, ⑧ Class pace is appropriate, ⑨ the voice is clear and easy to hear, ⑩ the letters on the sheet are easy to read, and ⑫ Materials (textbook, workbook, PC only) are appropriate, 100% of responses were positive.

As a result, it was found that UDL-style lessons utilizing ICT are effective for students with special needs and various ways of learning.

＜Key-words＞
inclusive education, universal design learning, ICT utilization

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I. Introduction and Objective

1. Utilization of children and ICT equipment that need special support

According to a survey conducted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) (2012), 6.5% of the students enrolled in regular classes need special support in terms of learning, particularly the 2.4% of those who have difficulty reading and writing.

According to Okamura, Nishimura, Koga et al. (2013), regarding learning for children with developmental disabilities, the ability to visually associate information is highly effective because of their strong ability to understand information visually. It is recommended that tools such as mind maps and ICT equipment be utilized. In addition, regarding the use of ICT equipment in special needs education, MEXT (2010) stated in the *Guide for the Informatization of Education*, "For the students who need special assistance, it is a useful device that can be used to improve or overcome difficulties in learning or life and enhance the effectiveness of teaching by using it according to the stage, etc. "

In addition, Kagata, Yoshida & Sakaue (2016) said, "ICT equipment is an important tool as a rational consideration for learners who have difficultly to read and write, and effective learning requires special support. It is expected that the burden of learning will be reduced for all, including those who study, and that understanding of the learning content can be promoted. From this, it can be considered that ICT equipment, which is flexible for children with disabilities, will be an effective tool for their learning."

2. Diverse learning styles and effects of ICT utilization

Every student has their own way to learn and their learning styles are different. Learning styles are divided into three sub-types: visual, auditory and kinesthetic/tactile, and this learning theory is called the VAK. In recent years, the VAK learning styles have become quite popular, perhaps due to their simplicity (Pinchot & Paullet, 2014). Willis & Hodson (1999) said that using the VAK theory determined that 29% of elementary and high school learners are visual learners, 34% are auditory, and the remaining 37% are kinesthetic learners. If teachers modify their teaching methods, they can create a classroom environment suitable for all types of students' learning preferences, and they will present materials that appeal to the visual, aural, reading/ writing and kinesthetic learning styles of students (Gregory, 2005). "Learners differ in the ways that they perceive and comprehend information that is presented to them. And providing options for representation is essential." "In properly prepared digital materials, the display of the same information is very malleable and customizable. (Rose & Gravel, 2011).

Therefore, teaching by utilizing ICT is an effective alternative and allows for classes to be tailored to all students with different learning styles.

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3. UDL using ICT for inclusive learning

In the USA, educators used Individuals with Education Act (IDEA) to find ways to better serve students with disabilities from the 1970's to the 1990's. IDEA was amended to legally require individualized education plans (IEPs) to give students access to the curriculum in general education classrooms as well as an increased focus on regular education placement (Hehir, 2009). Universal Design for Learning (UDL) is now incorporated into IDEA.

The No Child Left Behind Act (NCLB, 2002) mandates that 100% of students demonstrate adequate yearly progress, meaning that students should meet their state's academic achievement standards (Nevin, Falkenberg, Nullman et al., 2013).

UDL makes a district's curriculum, materials, and school environment more accessible and usable by all students from different backgrounds and with different learning styles (Meyer & Rose, 2002).

In addition, David H. Rose and the three principles of UDL cite "Various methods for presentation," "Various methods for action and expression," and "Various methods for action" as fundamental. Regarding this, Hall, Meyer & Rose (2012) said that "UDL is a framework that enables inclusive teaching design." In this way, UDL was created in the United States for the purpose of inclusive education. UDL can be an effective curriculum tool for not only children with disabilities, but for all children with diverse learning patterns.

Furthermore, in UDL teaching methods, Hall, Meyer, Rose (2012) said, "Teaching methods and materials are flexible and variable, and they are just right between access, challenge and support. It has to be a good balance and allow an individual learner to achieve their goals in the optimal way". "Digital text holds great promise in extending reading and writing skills that are difficult to read. The text is variable and flexible". In this way, ICT utilization classes in UDL are considered to effective teaching methods for students of various learning types, including students who need special support.

Therefore, the purpose of this study is to practice the UDL teaching method using ICT in the class and verify whether the teaching method is effective as an inclusive learning teaching method.

III. Methods

1. Research period

During the one-year period from April 2018 to March 2019, we provided learning instruction using ICT based on UDL in English classes (105 times in a year) during three days a week (each class 50 minutes).

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2. Subjects

The students were from a regular high school with 5 classes per grade. Class 2A included 25 students (18 boys, 7 girls), Class 2B included 24 students (18 boys, 6 girls), and Class 3A included 23 students (15 boys, 8 girls). In addition, in Class 2A, a student attended a separate room due to selective mutism, Class 2B included a student with ADHD (student b), a hearing-impaired student (student c), a foreign student (student d), and a student with ASD / LD (student e), and Class 3A included a student with ADHD (student f).

Analysis of 72 learning styles, including 6 students (students a, b, c, d, e, f) who needed support, was conducted using the "Learning Style Checklist" by Takayama & Hirata (2014). Results showed that 5% visual type, 14% auditory type, 19% kinesthetic type, 19% visual and auditory type, 10% visual and kinesthetic type, 9% auditory and kinesthetic type, and 24% almighty type. The results demonstrated that students have a wide variety of learning methods.

3. Questionnaire

The questionnaire used for the verification of the effect of this study was based on the 14-item questionnaire from Hoshino & Muta (2003), "Factors affecting student satisfaction in class evaluation by university students." This questionnaire has been confirmed to be reliable. Also, in order to evaluate the UDL learning guidance based on the above-mentioned three principles of UDL, "easy to read the letters on the sheet", "easy to do pair work and group work", "easy to understand lessons using ICT", 6 items were added: "The letters on the sheet are easy to read," "Easy pair work and group work," "Classes using ICT are easy to understand," "Classes with the same pattern are easy to anticipate," "Easy to learn and easy to understand grammar items," and "Pictures, photos and videos helped to understand the content". To avoid being evaluated by individual teachers, we omitted the item "I felt the enthusiasm of the teachers" by Hoshino & Muta (2003). The final questionnaire included of a total of 19 items (Table 1).

The 19-item questionnaire used in this study was completed by the students who took the classes. For each item, the evaluator circled the most appropriate number, where 1 = "I strongly disagree", 2 = "I disagree", 3 = "I agree", and 4 = "I strongly agree". The target students were asked to complete the questionnaire on the last day of class at the end of one school year.

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<Table 1> Surveys questionnaire

survey items	References
① I was looking forward to going to class	Hoshino, Muta (2003)
② Overall satisfaction	
③ I want to recommend it to other students	
④ I understood the contents of the lesson well	
⑤ I wanted to learn more	
⑥ English knowledge improved compared to before (until last year)	
⑦ Class difficulty is appropriate	
⑧ Class pace is appropriate	
⑨ The voice is clear and easy to hear	
⑩ The letters on the sheet are easy to read	Added based on 3 principles of UDL
⑪ Easy pair work and group work	
⑫ Materials (textbook, workbook, PC only) are appropriate	Hoshino, Muta (2003)
⑬ The tests and assignments were incorporated as appropriate	
⑭ Appropriate return of tasks and follow-up guidance	
⑮ Students had opportunities to speak	
⑯ Classes using ICT are easy to understand	Added based on 3 principles of UDL
⑰ Classes with the same pattern are easy to anticipate	
⑱ Easy to learn and easy to understand grammar items	
⑲ Pictures, photos and videos helped to understand the content	

Ⅲ. Results

1. Learning environment settings

The student's learning environment was conducted in the Language Laboratory (L.L room), which was equipped with a PC for each student, and was equipped with a screen, projector and microphone. Only PowerPoint slides, textbooks, and workbooks were used as teaching materials for the purpose of focusing and structuring learning. Furthermore, consideration was given to each student who needed individual support (Table 2).

2. Learning instruction

To develop classes that all students with diverse learning methods can understand through "Providing various methods" based on the UDL framework.

1) Various methods for presentation

Based on one of the three principles of UDL, "Various methods for presentation," we devised PowerPoint slides by combining diagrams and drawings as “scaffolds” for understanding. It was structured and patterned so that the students' concentration would not be interrupted. Specifically, we created time for introduction, deployment, summary, and reflection, so that each content ends within 5 to 10 minutes (Figure 1). In addition, the Power Point slides describe the pages of the textbooks and workbooks that students have so that they can see which page they are studying, and has a structure that matches the textbooks and workbooks (Figure 2).

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<Table 2> Overall learning environment and individual learning environment with reasonable consideration

Class	Student	Learning Environment
2A 2B 3A	All	・Language Laboratory (L.L. room), a classroom with a digital environment ・Visual teaching materials using Power Point slides ・Present all Power Point slides through projector and screen ・Presentation of contents on individual PC, making it possible for individuals to look back and learn repeatedly ・Using microphone (headset microphone) to provide equal listening opportunities for all students
2A	Student a	・Learn in the counseling room or health room ・Power Point slides: Visualization of teaching materials ・iPad: Present the Power Point slides individually and watch the class in Live ・Printer: Submit the written workbook as PDF
2B	Student b	・Easy to ask questions with the seat in front ・Secure an individual place for cool down to use when necessary
	Student c	・Communication Support System corrects sound distortion and makes it easier to hear ・Transmitter sends teacher's voice from headset microphone to device
	Student d	・If it is difficult to understand in Japanese, explain and speak in English.
	Student e	・Easy to ask questions with the seat in front ・Secure an individual place for cool down to use when necessary ・Place a seat near e's friend and ask friend to provide peer support to Student e
3A	Student f	・Provide many opportunities to speak as a group leader ・Give individual counseling regularly to avoid trouble in relationships

In addition, when learning English words, by adding an animation effect to PowerPoint, the English words are presented first and a pattern for confirming the meaning in Japanese is presented, then only Japanese is presented first and the meaning in English is presented. This made it possible to confirm understanding from through two different patterns. In each case, the words were presented one by one to focus attention. In addition to changing the color of the important syntax for grammar learning, we also employed explanatory diagrams that used arrows to visualize the teaching materials for easier understanding (Figure 3).

Furthermore, images such as photographs, illustrations, and videos were used in the PowerPoint slides so that the contents could be accessed even if the understanding of words and grammatical matters was not complete (Figure 4).

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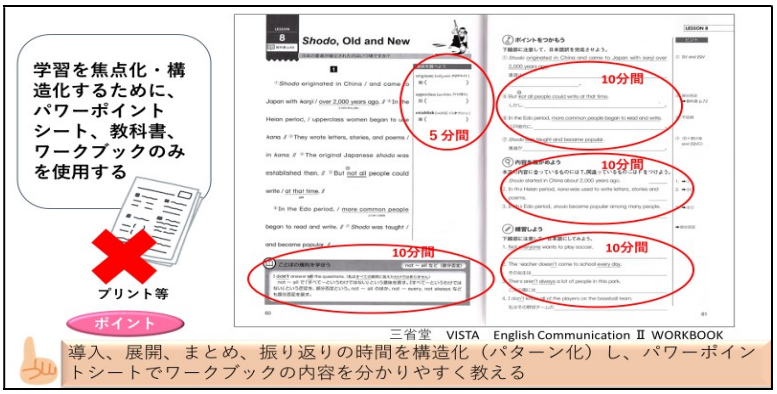
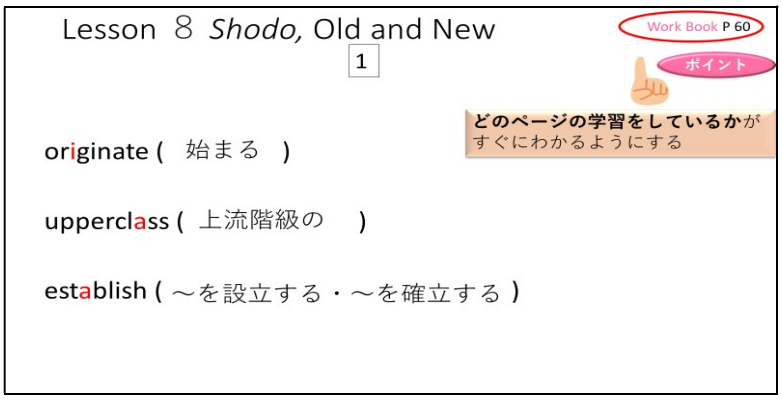
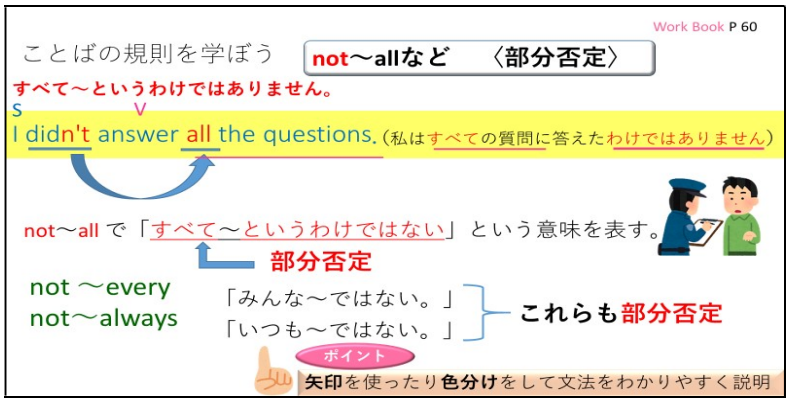


<Figure 1> Structuring time allocation



<Figure 2> UD configuration

<Figure 3> Visualization of teaching materials



<Figure 4> Utilization of images and videos

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2) Providing various methods for action and expression

Using UDL's principles to allow students to act and express their thoughts and opinions, consideration was made for friends helping each other as needed during pair reading and pair learning. Students were allowed to express their thoughts through various methods, including reading, writing, listening, and speaking. This allowed students to be able to flexibly select input and output methods according to the individual.

3) Providing various methods for initiatives

In order for the students to be interested in the learning content and to continue their learning, they were provided "various methods for their efforts" as follows. The fonts and figures on the PowerPoint slides were alternated, which made it easier for students to see. The PowerPoint slides had the same structure as the workbooks and textbooks to make it easier for students to work. Construction of learning contents was divided into short sections so that there was no interruption. Students were allowed to study freely and use the Internet on devices such as tablets and mobile phones. PowerPoint slides were designed so that answers can be given through animation to enable individual understanding and confirmation of memory. Students were provided time to repeatedly learn and reflect on their understanding in class. The learning environment was devised by to utilize speaking with a microphone so that all students can hear.

3. Questionnaire results

Throughout the year, we conducted UDL-based English lessons, and asked all target students to evaluate the lessons by questionnaire in the final lesson (Table 3).

As a result, 100% of responses were affirmative for the items ② Overall satisfaction, ③ I want to recommend it to other students, ④ I understood the contents of the lesson well, ⑥ English knowledge improved compared to before (until last year), ⑦ Class difficulty is appropriate, ⑧ Class pace is appropriate, ⑨ The voice is clear and easy to hear, ⑩ The letters on the sheet are easy to read, and ⑫ Materials (textbook, workbook, PC only) are appropriate.

Regarding other items, more than 90% of the students answered positively, "I strongly agree" or "I agree". Moreover, no student answered "I strongly disagree" in all the items.

From these, it was found that the UDL-education lessons using ICT were effective for many students with various learning styles.

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<Table 3> Results of questionnaire proportions

survey items	answers			
	strongly agree	agree	Disagree	strongly disagree
① I was looking forward to going to class	63%	33%	4%	0%
② Overall satisfaction	58%	42%	0%	0%
③ I want to recommend it to other students	50%	50%	0%	0%
④ I understood the contents of the lesson well	62%	38%	0%	0%
⑤ I wanted to learn more	58%	38%	4%	0%
⑥ English knowledge improved compared to before (until last year)	75%	25%	0%	0%
⑦ Class difficulty is appropriate	54%	46%	0%	0%
⑧ Class pace is appropriate	62%	38%	0%	0%
⑨ The voice is clear and easy to hear	67%	33%	0%	0%
⑩ The letters on the sheet are easy to read	75%	25%	0%	0%
⑪ Easy pair work and group work	63%	33%	0%	0%
⑫ Materials (textbook, workbook PC only) are appropriate	62%	38%	0%	0%
⑬ The tests and assignments were incorporated as appropriate	71%	25%	4%	0%
⑭Appropriate return of tasks and follow-up guidance	63%	33%	4%	0%
⑮ Students had opportunities to speak	63%	33%	4%	0%
⑯ Classes using ICT are easy to understand	68%	28%	4%	0%
⑰ Classes with the same pattern are easy to anticipate	58%	38%	4%	0%
⑱ Easy to learn and easy to understand grammar items	67%	29%	4%	0%
⑲ Pictures, photos and videos helped to understand the content	71%	25%	4%	0%

IV. Discussion

In Japan's educational settings, the ratio of teachers who use ICT for teaching is low. According to the MEXT (2019), the usage status of digital devices in schools is "Japan has the shortest usage time of digital devices in lessons (language, mathematics, science) and is the lowest among OECD member countries".

Hall, Meyer & Rose (2012) said, "The medium of printing is a barrier for people with reading disabilities. It is a medium that tries to handle all with one, and cannot be customized to meet individual needs". Even at the target schools of this study, the mainstream methods were paper, textbooks, and blackboards, though, there are many students with individual needs.

However, this study revealed that using ICT for all students, including those with individual needs, promotes understanding of learning. In addition, Hall, Meyer & Rose (2012) added, "A well-designed digital text is something that learners can adapt to meet the needs of diverse learners. It doesn't force you to match the text". This means that UDL classes are learner-centered classes, and can be considered to be a learning method that leads to "independent learning" required by the MEXT. According to Kagata, Yoshida & Sakaue (2016) using UDL to create classes is not a perfect solution, but allows instructors to create classes that promote student understanding and motivation to

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continue learning. And such a viewpoint based on UDL can be an effective guideline for more inclusive lesson construction aiming at creating diverse and flexible learning mechanisms.

In addition, nowadays in Japan, inclusive education is required because the number of children who need special support is increasing. According to Kagata, Yoshida & Sakaue (2016) UDL's learning guidance is "the foundation of an inclusive education system that responds to individual differences and diversity that allows children with and without disabilities to learn in the same place". Therefore, by implementing UDL in all schools, it is possible to realize inclusive education where children can learn together in one classroom without being divided into special support classes and regular classes.

Therefore, it was found in this study that UDL classes are inclusive classes for all students with various backgrounds and learning methods, including developmental disabilities, hearing impairments, and international students.

However, the limitation of this study is that the number of participating students was only 74 and it is limited to English lessons. In the future, it will be necessary to increase the number of subjects and settings to verify results.

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