Review Article

Interest Learning and Ingenuity in Toys

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With the revision of the School Education Law in 2007, Article 30 lays [(1)] out the attitude of so-called academic ability to actively engage in learning. Three pillars of qualification and ability are laid out, with the ability to move towards “Manabi” (or learning) as being one of them. When actually conducting education, it is very important for the learner to be able to be in a state in which he/she can continue learning even if the state was created by the teacher. With that mind, this paper discusses the learning environments of young children, students in America and Japan, and graduate students to show that learning takes place in an environment where the learner is comfortable, able to have fun, and have meaningfully problems to solve while learning.

Key Words : Interest learning, learning independently

1. Learning through the Use of Toys in Toddler Field Play

Those who are involved in the learning process of children aged 2 to 5, often state that it is very impressive how much children learn through playing. One of the authors of this article, Akazawa, is actively involved in the upbringing of his three grandchildren. This is an extremely tiring task, as he builds playsets at the demand of his grandchildren. Recently, one such playset was a “secret base” that took a year to develop. There were aspects of the design process that the grandchildren had trouble comprehending. This led Akazawa and his grandchildren to have conversations about the design of the secret base, express their ideas through numerous drawings, build models of the base, and overall have an intense negotiation about the construction in the secret base. While interpreting a young children’s ideas through their images and words may be difficult, the passion of which the grandchildren expresses their ideas only makes Akazawa listen more intently in an attempt to create the exact base his grandchildren hope for. Figure 1 shows the secret base.

The secret base is now a three-story building made mainly of iron pipes, plywood, galvanized iron, and closed off with a triangular roof. The first floor is on the ground, the second floor is about 1.5 meters high, and the third floor is about 3 meters off the ground. The stairs to the second floor are all handmade and the stairs to the third floor were built like a ladder and stand vertically.

Now, when the grandchildren return from nursery school, they head straight to their secret base first. Akazawa’s two-year-old grandson clings to the ladder, climbing by himself all the way to the third floor. Once there, he eats snacks while admiring the scenery surrounding the base. To deliver the snacks to the base, a pulley was attached to the third floor, which pulls a basket up with a string through the pulley. It is Akazawa’s duty to place the snack in the basket for the grandson to pull up. This method of delivery is thoroughly enjoyed by his grandson.

The children do various things during their play in the secret base that is interesting. For example, it always seems that they develop a big story. Furthermore, they make rules for one another to follow. They even have rules for their grandfather. The secret base seems to have turned into base for playing tag and hide-and-seek. Also, it seems the children are trying to expand the base on their own by collecting tree branches. The efforts to expand are sometimes not very effective and the children quickly shift to another idea. It is not an adult’s idea that the children are trying to implement, but rather their own

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free and fun idea.

Akazawa also has made swings, slides, and much more and his grandchildren have used them for more than just their intended purpose. However, the secret base is the place where the grandchildren seem most happy to play. They play until both their mind and body are tired. It is almost impossible to put into words what an observer sees, but it is very interesting and tiring to observe the children playing.

Fig. 1 Secret base.

Many of today's toys on the market can be transformed into something unique that was far from the intended purpose of that toy. Children play with vast imaginations and transform the toys into tools that help the children use their imagination to explore a different world of space. The secret base is one such example. It is a unique building to the grandson, being a very secretive place in his mind, despite it being in clear view for everyone to see. It is a place where children can be away from adults and their instructions, free to play and express themselves without the need to be careful of an over watching eye. Even in the field of school education, this is an important pillar of learning. Problems are discovered by oneself and efforts are made by oneself to solve the problem. It is wonderful and important to be able to incorporate children's own thoughts into their learning.

It is necessary to intentionally create a part of learning where thought and imagination can be used freely, just like when playing. Even for very difficult contents, such as mathematical thinking, this is important. Even for Carl Friedrich Gauss, the founder of non-Euclidean geometry, mathematical thinking would have been play for him, yet his findings are truths of today. The development of learning with even a little margin for play will be a great opportunity for both teachers and students to deepen their learning. It is necessary to devise ways to make learning interesting, and not just focus on what the students do not know or cannot do. This is the fastest way to achieve learning.

It is very good to deviate from what the teacher intended and put play into learning. This is important not just for young children, but even college students can develop from a little ingenuity and playfulness when they do their research reports. We put a degree of freedom into learning. It is important and efficient to make sure the instructor's learning syllabus is properly followed, but this does not drive at the student's emotions. Even when working on student research, it is necessary to have a environment where students can play as they like. It is important to let them discover what they find really interesting.

Tyuji Tuboi and Morikazu Toda are two Japanese scientists who published mechanical toys and ideas in their books [(2) (3)]. This has helped spur on many toys that are related to physics and mechanics, and it is important to utilize them. These toys can show interesting phenomena as a whole, and make the concept visible to children.

Akazawa uses a "Shuttle Note" to have weekly back-and-forth written communication with his mathematics students. These students often express opinions such as being happy to remember how to do something they had previously learned. but express fear about forgetting how to do it again in the future. They want to have the experience where they can say they remembered how to do something immediately. However, for Akazawa, it is not important that the students can do calculations quickly, but rather that they can show they learned how to think. It is important to think, show in writing that you are thinking, and then produce a convincing calculation.

2. Shift towards Educational Toys in the United States

Many of the same toys that children play with in Japan can also be found in the United States and most of these toys offer an uncountable amount of learning opportunities for children. For example, balls of different sizes and weights teach children about different aspects of physics. Will a heavier or lighter ball roll further? What type of ball will bounce higher before gravity pulls the ball back down to earth? It is not uncommon to see a child in either country wondering around with a magnifying glass, analyzing things the naked eye cannot see, such as skin, flowers, and insects. Play dough is common in

both countries and is great for children to develop their constructing and creativity skills. Toys help children discover new ideas, teach them how to use their imagination, how to solve problems, how to cooperate, how to think, and more.

There is no doubt that children in both countries use toys to help them create new worlds to explore. However, there has been a shift in the toy market in the United States towards toys that teach children specific skills that can be directly linked to professions or skills that are preferred today. Evidence of this shift can be found with a quick search of the most sold, or most popular, toys over the past few decades in the United States. Toys such as Koosh balls, Cabbage Patch Kids, Carebears, Ninja Turtles were best sellers in the 1980s. Ferbies, Power Rangers, Beanie Babies in the 1990s. However, in 2010 the best-selling toy was the Apple iPad, followed up by the LeapPad Explorer in 2011, a portable tablet filled with educational games. Other recent top sellers include the Barnes and Noble Nook E-reader tablet in 2012 and the 2017 Cozmo programmable robot. In America, technology-based toys are no longer being seen as mere toys, but rather as tools to aid in the education and development of important skills for the children of today.

While perfectly comparable statistics are difficult to come by, the large gap in the available statistics points to a cultural difference in the opinion about children learning from and learning about technology. In 2019, Rakuten surveyed 1000 parents across Japan and found that when it comes to toys 23% of Japanese parents would consider buying toys that teach coding principals [(4)], whereas 85% of American parents, according to the Toy Association, were encouraging, or were planning to encourage, their child to learn coding through educational play [(5)]. This difference may stem from the opinion parents hold about the importance of learning coding. In the same Rakuten survey, 37% of parents felt that coding would open future opportunities for their child [(4)]. When compared to a survey conducted in the United States by Microsoft in 2015, it was found that 50% of parents believed that learning coding and computer programming would be beneficial to their child's future employment opportunities [(6)]. This difference expands further when parents were asked about the importance of programming being taught in school. A Gallup poll found that 90% of parents in the United States believed that programming should be taught during the school day [(7)] whereas 60% of parents in Japan were worried or had some type of anxiety about their children learning programming in school [(8)]. All of this points to a large cultural difference in the comfortability of using technology as educational toys.

This cultural difference in opinion is most likely exacerbated by the availability of such toys. From the perspective of an individual who has lived in both countries for an extensive period of time, it is obvious that there is a large presence of educational specific toy stores in the United States when compared to Japan. Recently, toys marketed for STEM (science, technology, engineering, and mathematics) have been very popular in the United States. Such toys include 4M's Water Rocket Kit, Ozobot's Bit Coding Robot, Mattel's Build your own Video Game, and 4M's Crystal Growing Experiment. Julie Evans wrote about the 19 best STEM toys of 2021 [(9)], all of which are sold on America's Amazon website. The same products, or very similar comparable products, can also be found on Japan's Amazon website, but the prices as of April 2021 are often twice as expensive in Japan. These STEM toys not only have an objective, such as programming a robot, but allow children to decide the overall outcome, such as making a robot obey certain commands. This type of environment in conducive to a child's learning process by allowing them to think critically, creatively, and solve their own problems.

Japanese society's hesitation to withhold technology-based educational toys may be partially to blame for the low computer literacy rates of Japanese university students. Murray and Blyth (2011) [(10)] sounded an alarm when their survey of Japanese university students found that 85% of students had never used a spreadsheet, 78% had never used presentation software, and that students overall had very low proficiency of basic online services such as Google and Facebook. This line of research was continued in Cote and Milliner's (2017) [(11)] research, where they also concluded that computer literacy rates among Japanese university students were extremely low. Some findings included only 15% of students knowing how to convert a Word file to a PDF, only 35% of students knew how to transfer a file from a computer to a USB memory stick, 77% of students stated they had no experience or were beginners with word processing programs such as Microsoft Word, and 79% of students said they did not know how or were at a beginner level in their ability to download and install programs. Japanese students may have never had the opportunity to use trial and error as they were growing up to learn about computers and technology.

In 2018, the United States participated in the International Computer and Information Literacy Study (ICILS) with 18 other countries such as South Korea, France, Thailand, Hong Kong, Russia, and Germany. It should be noted that Japan was not a participant. The ICILS is a survey of eighth-grade junior high school students and it found that 72% of eighth graders in the United States use the internet to do research for school at least once a week, 56% are completing worksheets and spreadsheets at least weekly, and 41% are at least weekly preparing reports or essays with word processing software such as Microsoft Word [12]. While these numbers already appear higher than Japanese university students, they still lag behind countries such as Denmark, South Korea, and Finland. As we move into an ever-modernizing society, the demand for giving children the ability to develop skills that are transferable to computer usage, programming, and technology through new educational toys will only increase.

3. Learning from the OECD Brain

The following is stated in "Learning from the Brain [13]". "The emotional element has long been neglected in school education, but the problem is being improved by the recent elucidation of the emotional aspect of learning by neuroscience research." As Benjamin Franklin once said, "If you just listen, you will forget it. If you teach it, you will remember it. If you participate, it will be yours." These phrases reiterate that participation is a prerequisite for and directly linked to the motivational process by which a person takes some action or pursues a particular goal. This process may be triggered by internal or external factors, where internal factors are triggered solely by the learner's own needs and desires and external factors are external forces placed upon the learner. That is why motivation can be a problem. Motivation is primarily determined by self-esteem, and the benefits that may be gained are determined by the behavior and interest of the learner.

We show that in order to succeed in learning, a combination of motivation and self-esteem is necessary with consideration towards individual experiences. It is important for us to carefully assess the situation of children and learners and create an environment that is suitable to them.

4. Importance of Materializing and Visualizing the Learning Environment

It is important to be able to enhance each other through research. To speak to this point, and to discover what is important in learning, Yamashita likes to describe his relationship with his graduate students. Yamashita has interacted a lot with graduate students through research activities, and has seen graduate students develop both personally and mentally. The period of research is a time of significant maturation

One of the experiments conducted in Yamashita's laboratory involves the lateral vibration of a silicone rubber tube conveying fluid, shown in Fig.2. When water exceeds a certain value, a hose may flutter and produce a showering effect. This is the type of phenomena that is essentially the same as the type of research conducted in Yamashita's above research theme. Without prior knowledge, few would want to devote two or three years to this research in graduate school. It is not always necessary for graduate students to present a research theme that is interesting to them. If their supervisor tells the students about the supervisor's research theme properly, the students may feel that they should try to research it. What is important is that there is an unsolved problem and there is something interesting as well as challenging in solving the problem. The pipe system has been known as a model that realizes follower forces and is interesting from the viewpoint of non-conservative elastic stability problems. This problem has been studied by Western researchers for over 70 years and is an essential model of the complex self-excited oscillations in continuous systems [14]. Therefore, this system is the best place to test mathematical approaches and experimental techniques in mechanical engineering.

It is a little off topic, but let us think about what students should acquire in order to be successful in the future. What is needed, especially in this rapidly changing era? It is necessary to cultivate the ability to extract the essence of things, or to put it bluntly, have insight as a universal ability that does not depend on the times. As mentioned above, Professor Morikazu Toda was known for "physics toys". Sometimes the essence of physical phenomena lurks in the toy's mechanism, and it seems that there are cases where students are convinced that they understand the phenomena. In relation to this, it is necessary to use the

simplest model (essential model) that can produce the physical phenomenon of interest in research as well. We believe that the advantages of this model are not only to extract the essence of the phenomenon and make it easier to grasp, but also to cultivate insight to extract the essence. The ability to extract the essence is directly linked to the ability to deal with problems that are superficially different from the ones they have experienced.

Graduate students will take various approaches to experimentally clarify the complex vibration of pipes conveying fluid. They will make predictions from linear stability theory, compare experiments with analytical results, and improve experimental equipment. Trial and error will be repeated to find good ideas, solutions to problems, and to think and discuss different solutions to the problem. While discussing with their supervisor, graduate students often remark with a simple, “Oh, I understand”, and then proceed to get back to the experiment.

In Yamashita’s research, it is desirable that the pipe is entirely straight and to eliminate any asymmetry in the pipe system. Therefore, Yamashita’s research group asked a modeling company to create a molded pipe that was cast in a straight aluminum double cylinder from liquid silicone rubber (100,000 yen a pipe). Graduate student Mr. K. was not satisfied with the existing pipe and created a much straighter pipe after lots of trial and error. Mr. K’s pipe cost less than 1,000 yen per pipe. Using this new long and straight pipe Yamashita’s laboratory was able to observe many complex non-planar motions and even verify theoretical results with experimental results. Graduate student Mr. K. attended an international conference and presented the results. Figure 3 shows a scene from the conference dinner. By experiencing such a place, interest in academics would increase. It seems that the symposium originally means a feast. Indeed, the students have had a good experience. The result was also published in academic journal articles. The passion, patience, and potential of young graduate students can be surprising. When Mr. K. graduated, he commented to Yamashita that his mother was grateful that her son had personally matured through the master’s graduate course. There is no higher compliment a teacher can receive than this.

As teachers we guide students in their research as much as possible. We need to educate and do research on the best stage we can prepare. We have to put all our energy into it and aim for a higher level. If all goes well, and the students are satisfied, we will feel some kind of growth. Graduate students and their supervisor should be able to enhance each other through research.

Fig. 2 Photograph of a self-excited pipe vibration

Fig. 3 Conference dinner (DSTA, 2020, Poland)

5. Conclusion

There is a need to play and learn, and to be playful in difficult learning situations. A child’s play is very important. Children playing diligently and intently with their toys are something parents want to see in their child’s playtime. Today, the country is calling for digitalization, but we have to ask, have parents put a limit on the type of learning that can take place from toys? Are toys not meant to be anything more than just toys? In other countries, such as the United States, many view toys as tools that can jumpstart a child’s education. However, it is our opinion that in Japan, many view toys as distractions, preventing children from learning. A good first step to take would be to focus on making the learning environment in classrooms more interesting and immersive for students.

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