

Educational Material for Artificial Intelligence and Novels

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ABSTRACT

The term artificial intelligence (AI) is used widely by people of all age groups. Topics on AI-literacy cover our aspirations and problems that might occur when robots and humans coexist. Some problems have been considered in novels, and have been discussed using other means. In this paper, educational material considering a simple phrase, “take it”, based on the novel “Takasebune” having the theme of euthanasia, is presented as an example to motivate the study of traditional school subjects and think about the conditions necessary to coexist with robots. Considering various aspects on science, engineering and human life: the “take it” problem, is also discussed to contemplate about problems that we might confront in the future.

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1 INTRODUCTION

People have been increasing using the word AI (artificial intelligence) after Google’s Alpha Go AI defeated the world’s top human Go players between 2015 and 2017. Moreover, media broadcasts and programs have introduced the concept of AI to the people, including junior high school students. Various themes on AI have been discussed since the first AI conference was held in 1956 at Dartmouth [1]. Various lectures on AI have been taught in universities, and a survey on the lectures was conducted among educators and practitioners of AI based on the recent social changes in AI [18].

Educational material has been changing based on the emerging technologies. We can now access good educational materials via the internet[5]. Search engines have replaced encyclopedia and are being frequently used to clarify doubts or gain knowledge. The massive open online courses (MOOCs) website offers a new educational platform for everyone. Applications (Apps) for remedial educations are being used in high schools. Such materials have been created with the development of the Internet of Things (IOT), and

have produced new education tools. A company providing such apps has claimed that AI could support learning in children.

The development speed of so-called AI is so rapid that sometimes it appears that the discussions on the teaching methods and the educational contents are mixed. AI education to K-12 grades is challenging, as the level of the educational materials is not consistent among other classes, with most teachers not having the adequate experience in AI to teach students. While a discussion on AI literacy, including subjects taught at the K-12 level, is important, most materials are based on computer literacy. The preparation of good educational materials is a pressing requirement of this decade.

In this study, AI-literacy at the junior high school level is discussed using the materials that introduced RoboCup 2017 at a junior high school. In section 2, the motivations for students is introduced and participation in competitions is provided as an external motivation. In section 3, we show that introducing robotics as a topic also becomes an internal motivation to study traditional classes. Section 4 shows that a novel, “Takasebune”, provides the material to instill thought based on life. This novel provides a good case study for students planning to design robots, which might encounter a serious situation. Various other aspects of AI-literacy and scientific fictions are discussed, with a summary of the study in section 5.

2 MOTIVATION AND EDUCATIONAL MATERIALS

Motivation plays an important role in human activities. Motivation is classified into four categories: external regulation, introjected regulation, identified regulation, and intrinsic motivation. Rewards for academic performance represent external motivation, while the joy of solving problems can be considered as intrinsic motivation. Educational materials support children and motivate them to study and learn by themselves.

Competitions are a good way to enhance a child’s willingness to take on new challenges. Various competitions are held globally in the fields of sports, arts, and academies [3]. Furthermore, people compete against each other while growing up, and this competition develops their abilities. The same applies to the field of robotics, where many robot competitions have been held. For example, the DARPA’s urban challenge and grand challenge have played pivotal roles in the deployment of self-driving cars for practical use [8].

RoboCup holds a global robot competition for students, and a team must pass/clear several regional competitions to participate in the world competition [16]. Approximately 300 teams and 4,000 students participate in the local competitions every year, in Japan. The participants in the Japanese junior community are students

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who take part in the extracurricular activities of schools and science museums, or children from families that focus on education or where the parents like electrical work.

Currently, robotics has been included for educational purposes in school textbooks. Fig. 1 shows a junior robot that is being taught about in a Japanese junior-high school technical art textbook. A few projects provide educational materials to the students from the science, technology, engineering and mathematics (STEM) disciplines [12]. These educational materials explain the concepts of programming, motors, sensors, and other components to support both the students and teachers in building robots. These materials have more pages than the one-page introduction in the current junior textbooks.

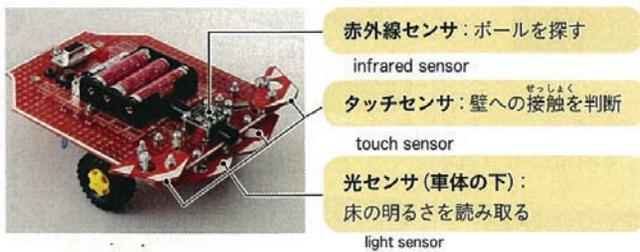


Figure 1: A robot and texts explaining sensors in a Japanese junior-high school technical art textbook.

3 INTRODUCTORY MATERIAL FOR THE FUTURE

There was an opportunity to introduce RoboCup at a junior high school when RoboCup 2017 was held at Nagoya, Japan. I not only advised the students to look around the competition, but also attempted to motivate them by discussing related AI topics. Considering a simple daily phrase, “take it”, in a living room as an example, it can be explained that robot designing is related to the educational contents learnt in classes such as Japanese (the national language), mathematics, science and other regularly-taught subjects.

The following slides ¹ were used at a junior-high school in June 2017 to introduce RoboCup and a style of society where we live together with a robot.

Slide1: Introduction to RoboCup (Fig.2)

RoboCup began in 1997 when the first competition was held at Nagoya (the 2017 RoboCup was the second time the competition was held at Nagoya). In 1997, most of robots could not follow a soccer ball; however, robots have played soccer with humans since 2007. I explained the technical developments by showing videos of the robots in 1997 and 2016 and encouraged the students think about the intelligence (knowledge) engineering principles being conveyed through the slides/talk.

¹ The original slides were prepared in Japanese. Only the text sections have been translated to English.

RoboCup 2017
2017.7.27-30 Portmese, Nagoya



Robot Programming and Curriculum in junior high school

- 1964/67: Robocup 1997:
- 1997 Dream of RoboCuppers :
- 2002/03: What human thought in this 20 years, , 50years
- 2017: What you will think in the next decades
- 2050:

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Figure 2: Presentation slide 1 for the junior high school.

Slide 2: Take IT (1) from the standpoint of communication between the robots and humans (Fig.3).

The students were asked to imagine two people present in a living room and one teacup on a table between them. Next, a situation arises wherein one person says “take it” to the other person, while pointing at the teacup. Then using slide 2, the students were asked to determine the type of programs (intelligence) required to perform the “take it” task if a robot replaced the second person (Fig. 4).

Take IT(1)

- Language as s mean of COMMUNICARION
Time flies like an arrow.
- Understanding of IT
context or gesture ?
- Executing properly



Figure 3: Presentation slide 2 for the junior high school.

The simple “take it” task involves various aspects of mutual understanding between a human and robot, and execution of the task requires the implementation of the following AI topics:

- (1) Voice/speech recognition
- (2) Language understanding
- (3) Computer vision

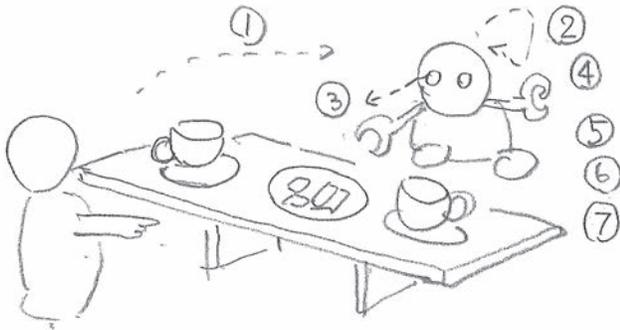


Figure 4: Imagined scene wher a person speaks to a robot.

school	grade	contents
elementary school	3	the nature of light and magnetism
	4,5	the working of electricity
	6	the use of leverage, electricity
junior high school	I	electric current and its usage
	II	movement and energy

Table 1: Japanese ministry’s curriculum guideline for science

- (4) Gesture understanding
- (5) Object recognition
- (6) Environment mapping
- (7) Manipulation
 - Path planning
 - Representation of the cup and sauce (Frame problem)
 - Motion control

The numbers of each item correspond to the numbers in Fig. 4. These topics provide some clues for the educator to teacher themes related to national language, mathematics, and science. For example,

- (1) The voice-to-text feature and computer vision provide good examples of waves and light,
- (2) Multiple grammatical interpretations of “Time flies like an arrow” can be used to teach the issues of language translation,
- (3) The interpretations of pointed objects are equivalent to tasks such as the calculation of three-dimensional coordinates,
- (4) Robotic manipulations are attractive materials of motors; electricity, and magnetism.

Table 1 shows the contents of the Japanese ministry’s curriculum guideline for science. Teacher can refer to robots as an example applications and discuss about civilization.

4 TAKE IT PROBLEM AND SERVICE ROBOTS

Slide 3 discusses the human-related topics and slide 4 addresses the robot ethics.

Slide 3 Consider IT(2) from the standpoint of literature to evaluate law and order in the society (Fig 5).

Takasebune is a Japanese novel written in 1916 and its main theme is euthanasia. This novel has been adapted into Japanese textbooks in junior high school, where students are taught topics on Japanese and human life. The followings are the excerpts of a character’s dialogue from the book, Kisuke, the hero of Takasebune, when he saw his sick younger brother lying in bed with blood all around him [15]

My brother said, “Forgive me, brother. I’ll never get my health back. So I thought I may well end it all. Then you would be free of taking care of me. I cut my throat with a knife, but the knife got stuck. If you’d just pull the knife out, then I can die.”

:
While I was trying to think of what I could do for him, he didn’t take his eyes off my face. Then, strangely enough, his eyes told me what he wanted to say next: “Be quick.”

:
Finally, I concluded that I had to do what he wanted. “Ok, I’ll do it. I’ll pull out the knife”. When I said that, his whole face changed. He looked pleased, almost happy. If it has to be done, I thought, it should be done quickly. So I took up a position where I could pull really hard. Then I took hold of the knife and pulled.

You are supposed to design a service robot. Let us suppose that the designed service robot faced the same situation as Kisuke: If a person in front of the robot orders the robot to “take the knife”, what do you expect your robot will do? Executing that order might cause the serious harm to the person. When not following the order, what do you expect what your robot will do?

This theme is related to Isaac Asimov’s ‘Three Laws of Robotics’ [4].

- (1) A robot must not injure a human being, or allow a human being to come to harm.
- (2) A robot must obey the orders given by human beings unless they conflict with the First Law.
- (3) A robot must protect itself as long as such protection does not conflict with the First and Second Laws.

After explaining the above-described laws, the students were asked to design the service robot. This is a good material to consider law and the order of society.

Slide 4: Topics of thinking what intelligence is. (Fig. 6).

Intelligence is a key factor distinguishing the human beings from animals. To illustrate specific examples of this, thought experiments and documentations have been provided. Concretization/abstraction and deduction/induction have been explained as ways of human thinking. These

Take IT(2)

- Right and wrong to do (1916 Mori Ohgai, Talasebune (1950 Isaac Asimov, I,ROBOT))
 1. A robot must not injure a human being, or allow a human being to come to harm.
 1. A robot must obey the orders given by human beings unless the conflict with they conflict with the First Law.
 2. A robot must protect itself as long as such protection does not conflict with the First and Second Laws.



Figure 5: Presentation slide 3 for the junior high school.

four processes have been employed to show the difference between animals and humans.

Three classical AI problems are the next topics. After explaining the traditional problem presentation, the following problems, which are encountered in daily life, are discussed:

Turing test: Let consider fake news and an AI announcer. Ask the pupil whether these technologies pass the Turing test, or whether they will pass in the near future.

Chinese room: Ask the pupil whether the monkey in the room possesses knowledge of Chinese or not. When they believe that the monkey does not know Chinese, is learning by heart is a good method?

Trolley problem: Form a different perspective of Takasebune and ask the following question again - What do you think life is? The law and order in our community and society are discussed.

The right part of the slide shows a page of the Japanese Society for Artificial Intelligence (JSAI) that has introduced Astro Boy, a Japanese comic by Osamu Tezuka [2]. Astro Boy began in 1952 and depicted a futuristic world where robots live with the humans. Certain contents of this comic handle fundamental problems that AI researchers have been considering, which have led JSAI to upload the contents.

5 DISCUSSION AND SUMMARY

Educational materials for K-12 grades might play an influential role in the lives of children and our future society. Preparing good educational environments and materials are important in society. Scientific fiction material should also be involved in the educational materials to nurture the dreams of pupils and urge them to think of the problems they might confront in the future. Various issues about education should be considered.

AI, robots in 2050

- artificial intelligence
- Thought experiment
- Documentation,
- Concretization, Abstraction,
- Deduction, Induction
 - Turing Test
 - Chinese Room
 - Trolley Problem



Figure 6: Presentation slide 4 for the junior high school.

Computer literacy and AI literacy: Computer literacy refers to the ability to use computers effectively, such as using a spreadsheet program and word processing software, in addition to the search engines and e-mail. AI literacy and computer literacy overlap, which make it difficult to smartly distinguish between the two. Many good picture books and lift-the-flap books have been published as introductory materials [14][9]. These books illustrate how computers work. The nature of human intelligence is beyond the scope of these books with regards to computer literacy.

Games programming styles: Games are not a part of the school curriculum; however, they have become topics of interest since the conception of AI [17]. Many algorithms and data presentation styles have been studied, a few of which have become standard topics of computer science and AI courses. Deep Blue and AlphaGo defeated their human opponents (both of whom were champions in their respective fields) in 1997 and 2016, respectively. These are major landmarks in the history of AI. In terms of AI literacy, is it simply sufficient to know that computer programs (AI) have defeated human champions? Is it necessary to teach these algorithms, or the method of implementation?

Scientific fictions and time: In 1968, the movie, 2001: A Space Odyssey, was released. Astro Boy was supposed to be born in 2003, when the comic was published in 1952. 2001: A Space Odyssey, Astro Boy, and other scientific novels gave people hope regarding the future. However, they have not left a lasting impression after the year set in these novels passed i.e. 2001 in the case of 2001: A Space Odyssey and 2004 in the case of Astro Boy. Furthermore, sequels have been published by other authors[13], while what the original works envisioned remained in our minds.

Scientific fictions and novels: Presently, a service robot is assumed to perform specific tasks that have been programmed in advance. In the future, robots will be expected to execute tasks with a certain degree of responsibility. Takasebune has referred to such a situation. Several people have discussed various works of scientific fiction and have found them to be useful for teaching ethics

[7] [11]. Asimov's nobles, Astro Boy and other related content, handle similar topics more directly. For example, Asimov's "Robot AL76 Goes Astray" highlights issues related the themes of traffic accidents of self-driving cars[6].

Common sense and literacy of generations: People below the age of 30 form the digital native generation, who commonly use touch interfaces as well as keyboards. The children of the digital natives operate their parents' tablets naturally by touching the display panel with their fingers without being taught by anyone, and follow the practices of using keyboards for input. Apart from the interface, the usage of computers in our homes has also been changing. Animated films can be easily accessed using smartphones, and parents use such devices to pacify crying children. The current style of raising a child differs from that during their grandparents' generation. Common sense and literacy in daily life are changing with technological progress.

With or without devices and data: Voice recognitions and eye tracking devices aid communication with disabled people and the elderly. Tablets, apps, and other devices are being used to support learning. Education regarding intelligence itself appears to be independent of these devices. However, the use of new devices and data accessed through them create new activities for humans and affect the way of thinking. Thinking logically, intelligently, and emotionally are the ways of solving problems and the ways of living [10].

AI related issues would play important role when imagining the future. With respect to teaching AI, a field that is dissimilar to the traditional school subjects such as the national language and arithmetic, AI related classes have not been incorporated in the school curriculum of the K-12 grades in Japan. Furthermore, the contents and methods of teaching AI have been improved through trial and errors in the educational field. It should be pointed out that novels provide good educational material.

In this paper, the following points were discussed using the material for AI-literacy: a) motivate students, and b) to recognize that regular classes, including those on languages, mathematics, and sciences are all necessary for robotic design. Considering the execution of a simple phrase, such as "take it" in everyday life, along with a scene from the classical literary work, Takasebune, as an example, this paper discussed the ethical problems associated with the acceptance of service robots.

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