Utilization of Artificial Intelligence by Students in Interdisciplinary Field of Biomedical Engineering

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ABSTRACT

Students were encouraged to actively use artificial intelligence (AI) in their studies and research in the field of biomedical engineering. The study analyzed the results of reports and research projects assigned to students. The handling of copyright was a common topic among students regarding AI. In research projects, AI was often used to search for technical terms and references. AI was used to list related technologies and check the feasibility of ideas. AI was effective for self-study. AI is particularly effective in interdisciplinary fields that require a wide range of basic knowledge, and is useful for self-study of technical terms. AI was proven to be useful for students in setting research topics and writing papers.

Keywords: Artificial Intelligence, Interdisciplinary Field, Biomedical Engineering and Students.

1. INTRODUCTION

Recent advances in AI have been remarkable [1]. There are concerns about the careless use of AI in the educational field, and that learners may lose their autonomy.

In interdisciplinary fields, the basic academic fields are broad, so it takes a huge amount of time for learners to comprehensively acquire basic knowledge. With the help of AI, time can be saved.

In addition, in interdisciplinary fields, it is necessary to provide guidance from the underlying related disciplines [2]. In new fields, the guidance itself is not well established, so AI may be able to help with that.

In this study, biomedical engineering [3, 4] is taken as an example of an interdisciplinary field. In a biomedical engineering class [5], a survey on AI was conducted among students, followed by a group discussion on the use of AI [6]. Additionally, students were encouraged to actively utilize AI in their research activities.

2. METHODS

A survey was conducted among students answering the following questions:

1) Do you want to use AI (artificial intelligence)?
1-1) I want to use it proactively.
1-2) I want to use it when necessary.
1-3) I would like to avoid using it as much as possible.
1-4) I will not use AI.

2) Do you think AI will contribute to human society?
2-1) Yes.
2-2) No.

3) Do you think AI will take jobs away from humans?
3-1) Yes.
3-2) No.

4) Is the use of AI necessary for professionals?
4-1) Professionals do not need AI.
4-2) AI is essential for professionals.

5) Which do you prefer, AI answers or human (expert) answers?
5-1) Human (expert).
5-2) AI.

6) AI is being misused and should be regulated.
6-1) I agree. If it is not regulated, it will get out of control.
6-2) I do not agree. It is difficult to regulate AI. AI has more advantages than disadvantages.

7) AI (artificial intelligence) exceeds human intelligence.
7-1) I think so.
7-2) I do not think so.

8) Comment on your opinion about AI.

The students who responded to the survey were students in the Department of Mechanical Engineering at Kogakuin University in Japan: 144 first-year students (2023); 95 second-year students (2023), 60 second-year students (2024); 105 third-year students (2023), 60 third-year students (2024) taking the course Biomechanics; 53 graduate students (2023) taking the course Advanced Biomechanics.

In class, a group discussion was held on the use of AI. After the discussion, each participant was asked to submit a report on the use of AI.

Students were tasked with choosing a topic related to biomedical engineering and writing a research paper on it over the course of a year, using AI extensively, including a conversation-generating AI. They were required to clearly state the question they asked the AI, the answer it gave them, and the date.

3. RESULTS

Survey on AI
Figs. 1-7 show the results of a survey on AI.

There is a greater willingness to actively use AI in 2024 than in 2023 (Fig. 1). Nearly everyone believes AI will help humans (Fig.

2). Fewer students believe that AI will take over human jobs in 2024 than in 2023. (Fig. 3). In 2024, more students than in 2023 believe that experts are the ones who need AI (Fig. 4). In 2024, more students than in 2023 preferred AI answers over human answers (Fig. 5). Fewer students in 2024 believe that AI should be regulated than in 2023 (Fig. 6). Although more students believe that AI exceeds human intelligence, the number is not increasing from 2023 to 2024 (Fig. 7).
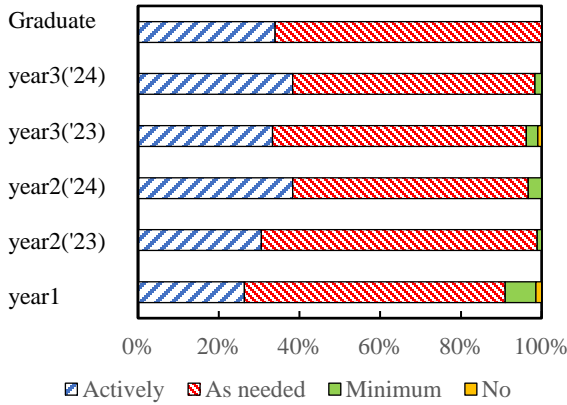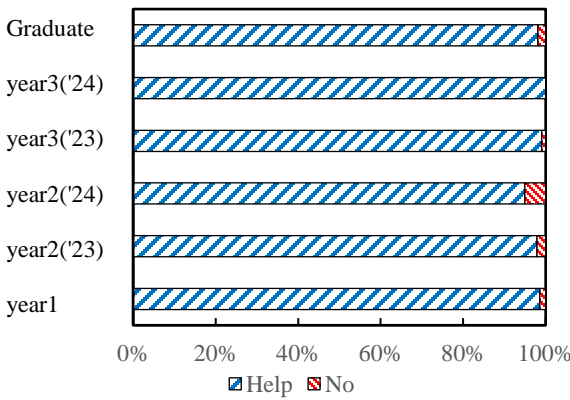

Fig. 1: Do you want to use AI?

Fig. 2: Do you think AI will contribute to human society?
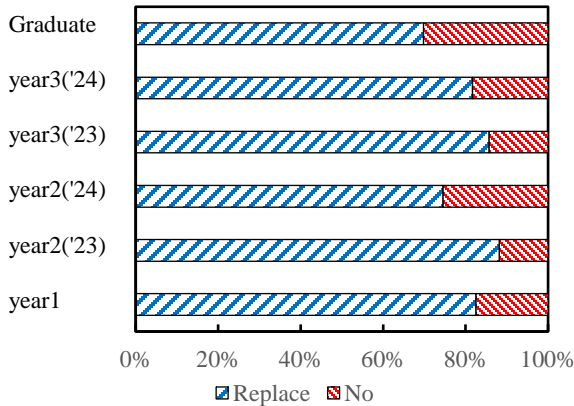

Fig. 3: Do you think AI will take jobs away from humans?
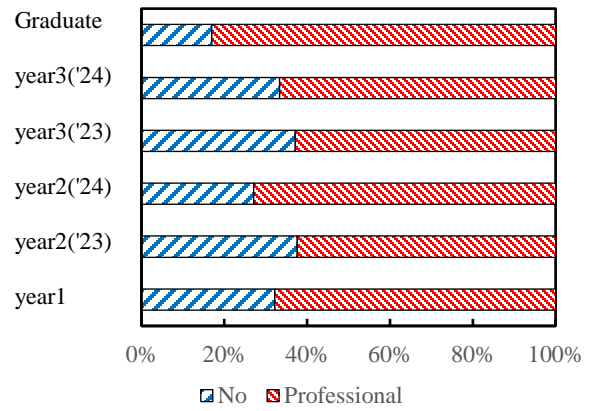

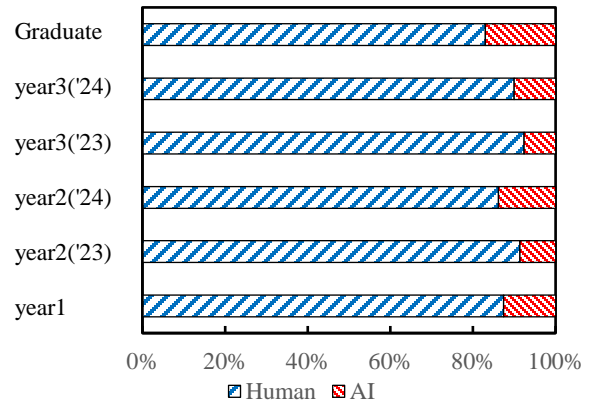**Fig. 4:** Is the use of AI necessary for professionals?

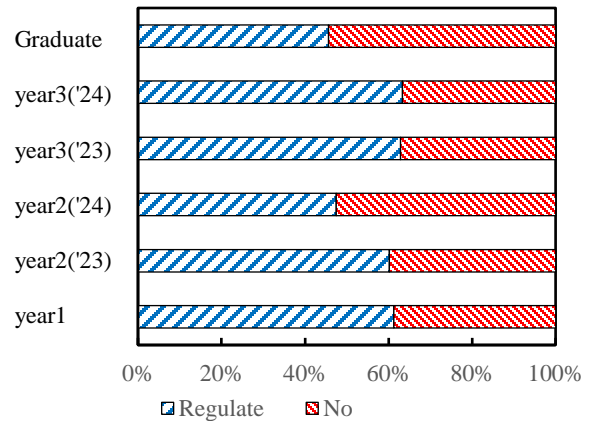**Fig. 5:** AI answers or human (expert) answers?

Fig. 6: AI should be regulated.

Group Discussion in Class

Fig. 8 shows the issues related to the use of AI discussed among students. This is data from 27 third-year undergraduate students. The percentage of students who selected each item is shown in the free text multiple answers section. More than 20% of students picked up "information security," "copyright," and "authenticity of content."
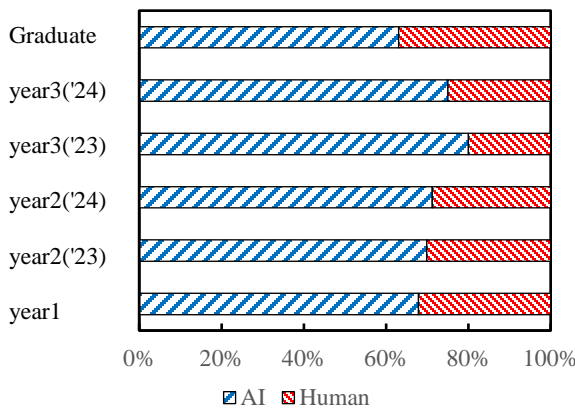
Fig. 7: AI exceeds human intelligence.

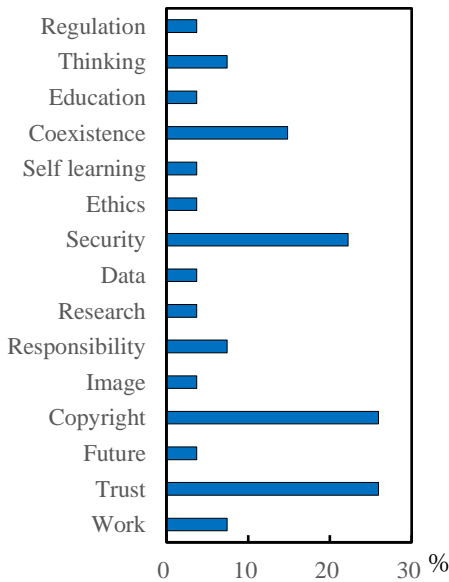**Fig. 8:** Topic related to AI [%]: $n = 27$.
1) Regulation of AI use.
2) Decline in thinking ability of AI users.
3) Use of AI in education.
4) Coexistence with AI.
5) Self-learning effect.
6) Information ethics.
7) Information security.
8) Database.
9) Use of AI in research.
10) Responsibility for information.
11) Image generation.
12) Copyright of information.
13) The future of society dependent on AI.
14) Authenticity of information content.
15) Human jobs will be taken over by AI.

Students Research Project

Before using AI, each student was free to set their own assignments. Most of the studies were not beyond the scope of imitation of past research. The reason seemed to be that students wanted to refer to interesting research they happened to come across.

Therefore, they restarted their research by using AI to categorize similar studies.

Examples of research topics are as follows.

1) Measurement of Biological Cell Deformability.
2) Control of Biological Cell Orientation on Scaffold.
3) Device for Sorting of Biological Cells.
4) Evaluation of Cell Orientation.
5) Cell Sorting Using Diagonal Bottom Grooves in Microchannel.
6) Microchannel Design for Cell Sorting by Dielectrophoresis.
7) Effect of Periodical Wall Shear Stress on Cultured Cell: Design of Couette Flow Device.

Followings are examples of how AI is used by each student.

a) AI was used to search literature (effectiveness in early cancer detection). The AI's response included the note, "Content and quality assurance excluded." AI was used to confirm the principles of material mechanics (cell strength) and fluid mechanics. AI was used to confirm the operation methods of equipment used in the research (hot plate, CTC (circulating cancer cell) testing device). AI is used to search specifications and instruction manuals. AI was used to list the advantages and disadvantages of each related technology (cell sorting method, dielectrophoresis method).
b) AI was used to obtain answers to questions posed by the teacher (quantification of orientation). The AI answered with explanations of mathematical formulas (Fourier analysis) and parameters (amplitude and phase spectra).
c) AI was used to obtain multiple answers (5 types) for assignments from the teacher. AI was used to list the types of related technologies (dielectrophoretic field generation, dielectrophoresis, electrode shapes). Errors were found in some of the answers when checked by the instructor. It was used to obtain answers regarding the target of each technique (cells to which dielectrophoresis is applied). It was used to look up the meaning of technical terms (carrier fluid). It was used to list techniques for each subject (stem cells, viruses). It was used to list the characteristics of related technology (cell sorting by magnetic field). It was used to list keywords for article searches.
d) AI was used to explain technical terms. In literature searches, "AI tends to collect data by referring only to summaries," so its usefulness for the content was limited. Sources had to be independently verified.
e) AI was used for quick reading of literature (helping with summaries). It was used to collect keywords for literature searches. It was used to get instructions on how to write a paper. It was used to confirm students' ideas (device processability, theoretical support for realization, and available background technology). It was used to explain technical terms (cell direction and cell orientation). AI was used to correct students' writing.
f) AI was used to explain technical terms. The assignment given by the instructor was converted into multiple step-by-step questions that were then used to request answers. If students do not think about how to ask questions, they won't be able to get out of the range of answers given by the AI.
g) AI was used to explain the technical content. It was used to explain technical terms. It was used to explain the

classification of technology. It was used to explain the advantages of technology. The method of collecting a single answer does not allow students to move beyond the scope of the AI's answers, making it difficult to develop into research.

Fig. 9 shows the typology of the questions that seven students asked the AI. The percentage of students who selected each item is shown in the free text multiple answers section. "Explanation of technical terms" was frequently used. Half of the students used AI for "searching documents" and "listing related technologies."
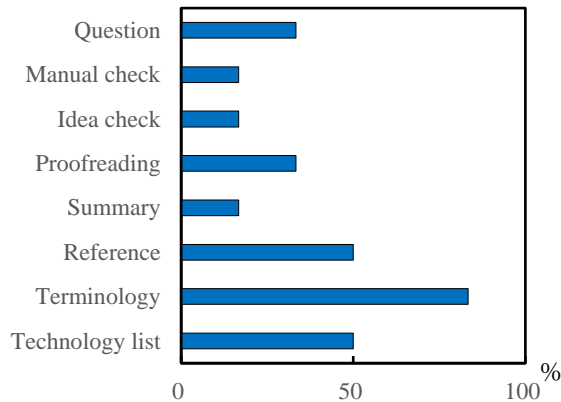

Fig. 9: Utilization of AI for research [%]: $n = 7$.
1) Answers to questions posed by the teacher.
2) Instructions on how to use the equipment.
3) Confirming the feasibility of students' ideas.
4) Proofreading the content of the paper.
5) Summarizing reference content.
6) Literature searches.
7) Explanation of technical terms.
8) Listing related technologies.

4. DISCUSSION

AI is effective at finding references using general search terms, but AI is still under development when it comes to finding references using specific search terms. AI can help students understand the content of papers. However, currently there is a limit to the capacity of questions. There were also occasional misunderstandings of the questions. Current AI has limitations in cases where capacity and speed are required, such as when creating tables. In literature searches, AI tends to collect data by referring only to abstracts, limiting its usefulness.

With the help of AI, the speed of literature search can be increased. However, unless the search method is devised, the search may only find "literature in which the student's supervisor is the author." It is difficult for AI to judge the originality and novelty of the retrieved literature.

In independent research, this can hinder your own ideas for problem setting. If students don't think about how to ask questions, they won't be able to get out of the range of answers given by the AI. With the method of collecting a single answer, students cannot go beyond the scope of the AI's answers, making it difficult to develop into research. It is effective to request AI to list answers.

In topic research, past information such as the meaning of the topic, the background of the topic, and the current status of the topic is also important. In this regard, it is expected that the use of AI will accelerate the start-up of research. Students' thinking progresses more when they search on their own than when taught by instructors. Students can learn at their own pace, not at the instructor's pace. Are teachers unnecessary? Is self-study using information networks and AI sufficient?

When asking AI for the correct answer, students need basic academic ability to judge the appropriateness of the answer from AI. If students want to investigate something they don't understand, they need basic knowledge about it. Conversely, when students confirm what they think they know, they may come up with new perspectives [7,8]. This helps them develop insight from what they already know.

AI is effective in finding out the meaning of technical terms. This is especially effective when searching for a search method is time consuming, such as in multiple fields. Along with the development of online technology [9,10], it is expected that AI will be utilized in desirable directions, including cultural diversity [11,12].

AI itself has no responsibility. AI simply accumulates and links information input by people across a wide range of space (the world) and time (history) to output answers. It is difficult to hold individual people who input information into AI responsible. It is also difficult to hold the system developers of the AI responsible. Therefore, the user of AI is responsible for the AI answers. Responsibility arises with choice and judgment. A method in which the user selects an answer from multiple answers provided by the AI may clarify the user's responsibility. Will you give up your own responsibility? Will you give up your right to make decisions?

First, we need to learn how to use AI and how to ask questions to AI. Next, we need to learn how to utilize the characteristics of AI. Paradoxically, we may need to learn how we want to be used by AI. We may need to reaffirm that there is nothing more uncontrollable than ourselves. Making mistakes and enjoying waste may be human nature. Living (resisting death) may be the greatest "futile resistance." It may be good for humans to do things that should be left to AI. Think about what you want to do now? Or leave it to AI?

5. CONCLUSION

Students were encouraged to actively use artificial intelligence (AI) in learning and research in the field of biomedical engineering. An issue with AI that was often discussed among students was the handling of copyright. In students' research project, AI was often used to search for technical terms and references. AI was used to list related technologies and check the feasibility of their ideas. Particularly in interdisciplinary fields that require extensive basic knowledge, AI has demonstrated its power in self-learning technical terms. AI was found to be useful for students in developing research topics and writing papers.

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