INTERVIEW SURVEY OF FIRST-YEAR UNIVERSITY STUDENTS ON MECHANICAL WAVE PROPAGATION: ANALYSIS OF THE THOUGHT PROCESS IN SOLVING A PROBLEM

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KEYWORDS: Physical Education, Problem Solving

This presentation reports the results of an interview survey conducted to clarify how first-year university students at University in Japan, who entered the university after completing their high school physics, understand the propagation of mechanical waves and what types of reasoning they use when solving problems.

Interview participants were recruited from students enrolled in a calculus-based introductory physics course. The content of this course is mechanics, not waves. Therefore, the students' knowledge of waves is considered to be knowledge learned in high school. The interview was conducted in a one-on-one semi-structured interview format, using a think-aloud method in which participants were asked to verbalize what they were thinking while solving problems. The questions asked in the interviews were those related to wave propagation in the multiple-choice test (Xie et al., 2021; Wittmann et al., 1999). These were questions about the propagation of waves, including how sound travels through air, the speed of waves traveling through strings, and an understanding of waveforms.

All of the students' statements obtained from the interviews were transcribed and analyzed, and it was found that questions that could be considered using the formula $v = f\lambda$ had a clear thought process, all students showed similar ideas, and the percentage of correct answers was high (over 90%). This result was similar to that of a previous study (Xie et al., 2021). On the other hand, a variety of thought processes were observed in questions where the use of formulas was not possible. As an example, the following is the result of a question in which participants had to answer "the change in the waveform of a sound emitted from a certain sound source as it travels from air to water". The knowledge required to solve this problem is that "the frequency is determined by the sound source and does not change with the medium, and that the speed of sound is faster in water than in air". The explanations of the students who answered incorrectly could be classified into three categories: (1) lack of knowledge that the speed is faster in water, (2) lack of knowledge that the frequency does not vary with the medium, and (3) use of ideas from different disciplines. Students in (1) explained by inferences based on their daily experiences, such as "It is difficult to communicate when speaking underwater" and "Underwater is likely to be more inhibiting because of its greater density". The student in (2) said, "The wavelength does not change. Both the frequency and wavelength change". and tried to derive the answer by substituting this idea into the formula $v = f\lambda$. Student (3) also used the same thinking process as in the problem of refraction of light incident from air to water (a common problem in high school physics) to explain that the speed of waves in water is slower than in air.

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Proceedings of the IUPAP International Conference on Physics Education, ICPE 2022 5-9 December 2022, page 95, ISBN: 978-1-74210-532-1.