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A Pilot Study on the Impact of an Undergraduate Physical Education Course on Intellectual Image Formation

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ABSTRACT: *Physical Education (PE) is often perceived as less intellectual than other academic subjects in Japan. This study aimed to improve that perception through an undergraduate PE course and to evaluate its impact using a pre-test/post-test experimental design. Fifty sophomore students (25 males and 25 females) voluntarily participated. Perceptions of the intellectuality of PE were assessed before and after the course using two methods: a direct rating on a seven-point scale and a newly developed paper-and-pencil Implicit Association Test (iFUMIE; Hamada & Mori, 2025). While the explicit ratings showed a high intellectual image of PE at pre-test and little change at post-test for both genders, the iFUMIE results indicated a marked improvement among female participants, with only slight gains among males. Possible explanations for these mixed results are discussed in relation to gender differences in social desirability bias and participants' academic records.*

Key words: *Implicit assessment, intellectual image, Japanese undergraduates, physical education.*

1. Introduction

Physical Education (PE) is a subject taught throughout all levels of the Japanese education system, from elementary school to university. A defining feature of PE is its emphasis on physical activities conducted outside traditional classroom settings—such as in outdoor fields, indoor gymnasiums, or swimming pools—which distinguishes it from other subjects that are primarily classroom-based. Due to this distinctive characteristic, PE is often perceived as less intellectually demanding than other academic subjects (Hamada, 2018). In a survey conducted for selecting the suitable words having connotations of intellectuality and non-intellectuality, Hamada and Mori (2025) found that undergraduate students evaluated only PE as non-intellectual while they classified all the other school subjects, i.e., mathematics, language arts, music, etc., as intellectual.

To counteract the non-intellectual image of PE, Hamada (2010; 2019) developed a variety of lesson plans designed to engage students in cognitive thinking during PE activities. For example, Hamada (2019) introduced a baseball-style game for elementary school PE in which the batter throws the ball into the field, rather than hitting a pitched ball with a bat. In traditional baseball, beginners tend to focus solely on hitting the ball, leaving little room for strategic thinking. In contrast, this no-hitting variation allows even novice players to consider where to place the ball strategically from the batter's box. In addition, Moreover, players on defense also gain an opportunity to think strategically, as they are encouraged to predict where the batter will throw the ball and adjust their defensive positions accordingly, rather than simply taking positions without anticipating the ball's trajectory.

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However, the effectiveness of these instructional innovations has not been evaluated objectively. Hamada (2019) reported only anecdotal impressions from students. This reflects a common limitation in educational research: a lack of scientifically valid and reliable assessment of how instructional interventions influence students' awareness and attitudes. As Uchida and Mori (2018a) pointed out, evidence-based education remains at a minimal level within the Japanese education system.

Akita and Mori (2022) addressed this issue in their study on gender education for sixth-grade students using a pre-test/post-test design. They employed the FUMIE test (Mori, Uchida, & Imada, 2008)—a paper-and-pencil adaptation of the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) modified for younger participants (Akita, Tsushima, Saito, & Mori, 2019)—to measure students' implicit perceptions of women before and after the lesson. The study found that boys' implicit images of women improved significantly, while girls' perceptions remained consistently high. A follow-up study (Akita & Mori, 2023) showed that the improvement among boys persisted three years later.

Inspired by Akita and Mori's approach, we adopted a similar pre-test/post-test design to evaluate the educational impact of an entire undergraduate PE course developed by Hamada. Unlike Akita and Mori's single-lesson intervention for sixth graders, our study aimed to assess the impact of a full-semester course. The participants were all students enrolled in Hamada's PE course. Prior to the study, we consulted extensively with our university's Institutional Review Board (IRB) to ensure that all procedures complied with ethical standards and obtained formal approval in 2025 (Approval ID: 171).

1.1. Paper-and-Pencil Implicit Association Test for Intelligence (iFUMIE)

Akita and Mori (2022) used a modified version of the standard FUMIE test tailored for younger participants. In the present study, we required a further revision of the standard FUMIE test to assess perceptions of intellectuality, rather than simple evaluations along a good–bad dimension.

Accordingly, Hamada and Mori (2025) developed an intelligence-based version of the FUMIE test, named the iFUMIE test, by adapting the original procedure. While several attempts have been made to convert the Implicit Association Test (IAT) into paper-based formats, only the FUMIE test has been cited as "the Paper-and-Pencil IAT" in a comprehensive review marking the 21st anniversary of the IAT (Epifania, Anselmi, & Robusto, 2022).

The iFUMIE test consists of two sets of words—one denoting intellectuality (e.g., insight, cleverness), and the other denoting non-intellectuality (e.g., violence, dementia)—used in an orienting classification task. These words are printed in rows on an A3-size sheet of paper. The first row, used as a practice line, contains only the intellectual and non-intellectual words. From the second row onward, a target word appears randomly interspersed among the intellectual/non-intellectual words.

Participants were instructed to classify each word by marking "O" (a circle) for intellectual and "X" (a cross) for non-intellectual. (This marking convention—using a circle and a cross—is widely used in Japanese educational contexts.) For the target word, however, participants are explicitly told to mark it with either "O" or "X" regardless of its meaning. In this way, the perceived intellectuality of the target word is inferred from participants' automatic responses, without conscious deliberation.

Although the underlying logic is essentially the same as that of the IAT, the FUMIE test has a practical advantage: it can be administered to groups without the need for computers.

1.2. Purposes of the Present Study

Therefore, we employed the iFUMIE test to examine how students perceive the intellectuality of Physical Education (PE) before and after completing the course. The IAQ_{100} score was used as an implicit measure of students' associations with PE intellectuality. For the explicit measure, participants were asked to rate the degree of intellectuality on a seven-point scale: +3 indicating "most intellectual," −3 indicating "least intellectual," and 0 representing a neutral position.

In summary, the purposes of the present study were twofold:

(1) to implement an undergraduate PE course designed to improve the intellectual image of PE, and

(2) to evaluate the instructional effect of the course using a pre/post-experimental design incorporating both explicit and implicit measures—namely, a direct rating on a seven-point scale and the newly developed iFUMIE test, a paper-and-pencil adaptation of the Implicit Association Test (IAT).

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2. Method

2.1. Experimental Design

A pre-test/post-test experimental design was employed. The intellectual or non-intellectual image of Physical Education (PE) was assessed both explicitly and implicitly using two different procedures, administered at the beginning and end of an undergraduate PE course taught by one of the present authors. The course spanned 15 weeks, from April to July, with one 90-minute class held each week.

2.2. Participants

All 50 sophomore students (25 males and 25 females) enrolled in the PE course voluntarily agreed to participate in the study after completing the informed consent procedure. The participants were fully informed of the study's purpose, their participation was entirely voluntary, and all data were collected anonymously.

Lesson Objectives: Enhancing Students' Enjoyment and Understanding of Physical Activities Through Structured Experiences

The PE coursework in the present study was conducted in the same manner as in previous years by Hamada. The objectives of the course were as follows.

2.2.1. Helping Students Appreciate the Comfort of Physical Movement

To help students recognize the comfort that comes from physical movement, they are first exposed to discomfort. For example, in hurdle running, students initially jump over cardboard boxes placed at irregular intervals and of varying heights. Subsequently, they perform the same activity with boxes arranged at consistent intervals and of uniform height. This contrast allows students to physically experience the improvement and comfort that structured movement can provide.

2.2.2. Fostering a Sense of Enjoyment Through Exaggerated Movements

Enjoyment in physical activity is encouraged by exaggerating movement. For instance, in the high jump, students are asked to clear a height they would normally be unable to reach on their own. However, by using a springboard (rebound board), they can succeed, creating an exciting and motivating experience that highlights the fun of movement.

3. Emphasizing Game-Based Rather Than Practice-Based Instruction

Game-based, rather than traditional practice-based approach. The activities are centered around the game, rather than a traditional practice-based approach, i.e., practice → practice → game. This is because all essential elements of learning are embedded within the game itself. As students engage in repeated games, they naturally desire to improve their skills and begin to see the value of practice. It is at that moment that practice becomes meaningful to them.

The activities are centered around the game itself, rather than following a traditional practice-based approach—for example, a sequence of practice, followed by another practice session, and then a game. This is because all essential elements of learning are embedded within the gameplay. As students repeatedly engage in games, they naturally develop the desire to improve their skills and, only then, recognize the value of practice. It is at this point that practice becomes meaningful to them.

4. Modifying Game Rules to Enhance Engagement

In volleyball (a net-type game), gameplay often becomes unenjoyable due to failed serves or one-shot points resulting from unreturned serves. To address this, modified rules are introduced:

a) Underhand serves are allowed from a closer distance.

b) One catch is permitted within three touches when returning the ball.

These modifications improve the likelihood of successful serves and returns, thereby facilitating rallies and making the game more engaging and cooperative.

In baseball-type games, students first play bat-less baseball, in which they must think strategically about where to throw the ball to get on base or advance teammates. On defense, they are encouraged to read the batter's intent and consider where to get an out. This fosters the development of strategic thinking. Later, students transition to T-ball, where they use a bat but continue to apply the same cognitive strategies developed in bat-less play.

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In goal-type games such as soccer and basketball, instruction often focuses on offensive strategies. However, defensive strategies tend to be easier for students to understand. For example, effective defense can be as simple as positioning oneself between the goal and the player in possession of the ball. This allows students to begin identifying their own roles on the team.

5. Overarching Learning Objectives Across All Ball Games

The learning objectives common to all ball games are:

a) Understanding the structure and flow of the game;

b) Identifying one's role and contributing to the team; and

c) Developing strategies to respond to the opponent's tendencies.

By structuring lessons around game-based play, the overall quality and complexity of gameplay naturally increase over time.

5.1. Assessment Procedure

Two assessment procedures were administered during both the pre- and post-test periods:

(1) the iFUMIE test using the target word "体育(PE)," and

(2) an explicit rating task based on the question, "How intellectual do you consider PE as a school subject?"

Both assessments were conducted on scheduled class days, as outlined in the course plan by the instructor. To streamline the process, the rating item was printed at the bottom of the iFUMIE test sheet, allowing both assessments to be completed successively on a single sheet without interruption. (See Appendix.)

The instructor distributed the test sheets and provided instructions using a set of PowerPoint slides. Before the assessment began, participants were assured that their responses would remain anonymous. However, for the purpose of linking pre- and post-test data, participants were asked to indicate their gender and age at the top of the sheet. They were also instructed to write down their favorite animal and a two-digit number in adjacent boxes. These animal–number combinations served as cryptic codes to anonymously match test sheets across the two time points.

As for the iFUMIE test, there were 13 lines of two-kanji words printed on the test sheet. For the first line, the participants were instructed to classify the words either "intellectual" or "non-intellectual" by marking either a circle or a cross for the former and the latter, respectively, as quickly as possible in 20 seconds. This was an orienting task and served as a practice trial. From the second line, the target word, "PE," appeared randomly among the words. They were instructed to mark a circle on "PE" irrespective of their PE image for the second, fourth, and sixth lines, and a cross on "PE" for the third, fifth, and seventh lines as quickly as possible in 20 seconds each. The remaining six lines were left unused serving for preventing the final effort for the seventh line.

The iFUMIE test consisted of 13 lines of two-kanji words printed on the sheet. On the first line, participants were instructed to classify each word as either "intellectual" or "non-intellectual" by marking a circle or a cross, respectively, as quickly as possible within 20 seconds. This line served as a practice trial and orienting task.

From the second line onward, the target word "PE" was randomly inserted among the other words. Participants were instructed to mark a circle on "PE" for the second, fourth, and sixth lines, and a cross for the third, fifth, and seventh lines—each within a 20-second time limit and regardless of their actual impression of PE. The remaining six lines were intentionally left blank to reduce potential response bias, particularly *terminal effort*—a tendency for participants to exert extra effort on the final trial.

Immediately following the iFUMIE test, participants responded to the question "How intellectual do you consider PE as a school subject?" printed at the bottom of the same sheet. They selected a response on a seven-point scale: ‑3 (very non-intellectual), –2 (quite non-intellectual), –1 (slightly non-intellectual), 0 (neutral), +1 (slightly intellectual), +2 (quite intellectual), and +3 (very intellectual).

Finally, the instructor collected the completed test sheets and thanked the students for their participation. The entire assessment procedure took approximately 15 minutes and was repeated using the same format at the post-test.

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6. Results

6.1. Data-Correspondences between the Pre- and Post-Tests

One male and one female participant were absent during either the pre-test or the post-test session. To preserve anonymity while allowing us to match pre- and post-test data, we asked participants to write their favorite animal and a two-digit number on both test sheets as cryptic codes. However, this method did not work as intended. Only 17 males and 17 females (out of 25 in each group) wrote the same two codes correctly on both occasions. Therefore, we decided to analyze the data as two independent groups without pairing individual responses.

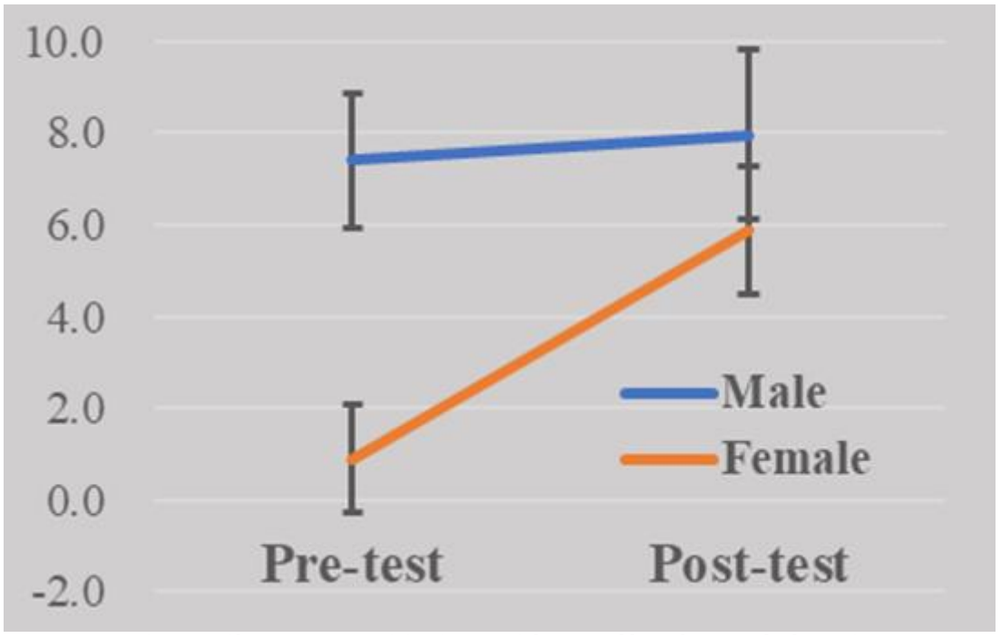

Figure 1. Changes in mean IAQ100 scores (The vertical bars show standard errors).

6.2. The iFUMIE Test Results

Twenty-five male students and 24 female students completed the iFUMIE test and the intellectuality rating during the pre-test period, while 24 males and 25 females participated in the post-test assessment. First, for each participant, we counted the number of words marked on even-numbered lines (WP; positive task, i.e., judged as “intellectual”) and on odd-numbered lines (WN; negative task, i.e., judged as “non-intellectual”). We then calculated the Implicit Association Quotient (IAQ_{100}) using the following formula: $IAQ_{100} = 100 \times (WP - WN) / (WP + WN)$.

The IAQ_{100} represents the normalized difference in performance between the positive and negative tasks, scaled to a 100-point metric. A positive IAQ_{100} score indicates that the target word was implicitly associated with intellectuality, while a negative score suggests an implicit association with non-intellectuality.

In accordance with the *FUMIE Test Administration Manual* (Ver. 2.2; Uchida & Mori, 2018b), data from two female participants were excluded because their scores exceeded the ±2 standard deviation threshold. Subsequent analyses were conducted using the remaining 48 participants: 25 males and 23 females for the pre-test, and 24 males and 24 females for the post-test.

The mean IAQ_{100} scores for the target words "PE" by gender and testing period are shown in Figure 1. On average, both male and female participants implicitly evaluated PE as slightly to moderately intellectual. Females' scores showed considerable improvement, while males' scores were high at the pre-test and gained only scarcely at the post-test.

A two-way between-subjects ANOVA was conducted on the IAQ_{100} scores, with gender (male vs. female) and testing period (pre-test vs. post-test) as between-subjects factors. The analysis revealed a statistically significant main effect of gender, $F_{(1,92)} = 7.82$, $p = .0063$, indicating that male and female participants differed in their IAQ_{100} scores. However, the main effect of testing period (pre vs. post) did not reach statistical

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significance, $F_{(1,92)}$ = 3.28, p = .0732, although it showed a marginal trend toward improvement. The interaction between gender and testing period was also not significant, $F_{(1,92)}$ = 2.09, p = .1517.

6.3. The Intellectuality Rating Results

Figure 2 presents the mean intellectuality ratings at the pre- and post-test periods. Contrary to the results of the iFUMIE test, female participants rated PE as more intellectual than male participants at both time points. However, no apparent effect of the PE course was observed in the rating data.

A two-way between-subjects ANOVA revealed a statistically significant main effect of gender, $F_{(1,90)}$ = 6.14, p = .015, indicating that females rated PE as more intellectual than males. In contrast, the main effect of testing period (pre vs. post) was not significant, $F_{(1,90)}$ = 0.97, *n.s.*. The interaction between gender and testing period was also not significant, $F_{(1,90)}$ = 0.67, *n.s.*.

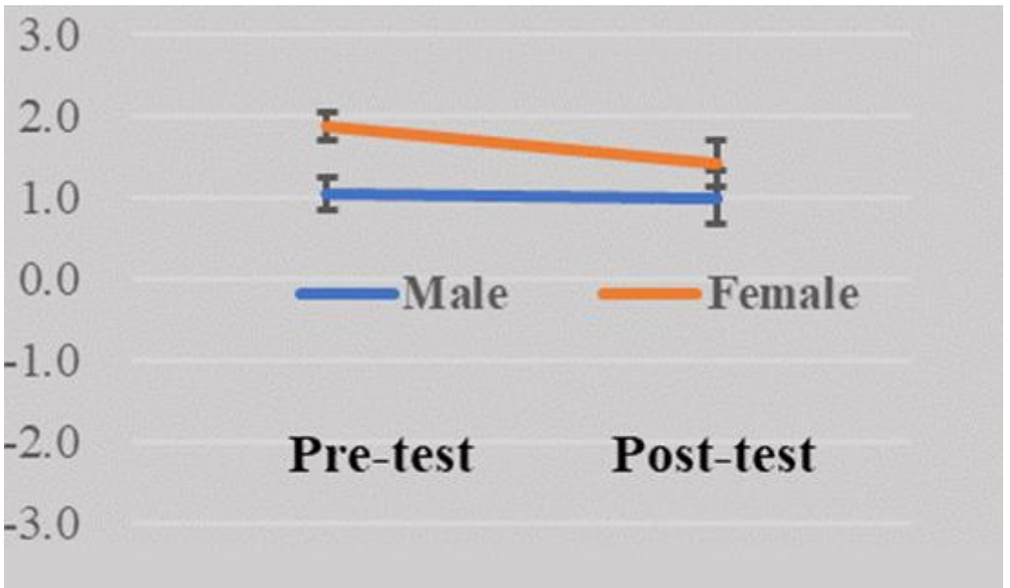

Figure 2. Changes in Intellectuality Ratings The vertical bars show standard errors).

6.4. Data Availability

The raw data and the statistical results of the present study can be downloaded in Excel format from the following URL:

https://researchmap.jp/multidatabases/multidatabase_contents/download/230813/50d04e0c23a9ba7fbb2d59744bdc196c/41110?col_no=2&frame_id=575977

6.5. General Discussion

The primary aim of this study was to improve the intellectual image of Physical Education (PE) through a semester-long undergraduate PE course and to evaluate its effects using both explicit (intellectuality rating) and implicit (iFUMIE test) measures. The results revealed a nuanced pattern: while explicit ratings of PE's intellectuality remained largely unchanged, iFUMIE scores suggested a modest improvement, particularly among female students. This partial shift implies that instructional interventions may influence students' unconscious associations with PE, even when their self-reported evaluations remain stable.

Before drawing conclusions from these complex findings, we must examine why the explicit and implicit measures yielded conflicting results. Which index better reflects reality? We must also consider why the results differed between male and female participants. While females rated PE as more intellectual than males, their IAQ_{100} scores were lower than those of males—revealing statistically significant gender differences in the opposite direction.

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6.6. Why Did Participants Rate PE as Intellectual in the Explicit Measure?

Female participants rated PE as more intellectual than their male counterparts in both the pre- and post-test assessments. The average rating among females reached as high as 1.9—nearly the second-highest value on the seven-point scale. Male participants also gave relatively high ratings, corresponding to "slightly intellectual." These results contradict previous findings from a similar cohort at the same university (Hamada & Mori, 2025), in which PE was rated as the least intellectual of nine school subjects and the only one falling below the neutral point, indicating a non-intellectual image.

In this study, participants were asked directly, "How intellectual do you consider PE as a school subject?" immediately after being informed of the study's purpose. Thus, their responses may have been influenced by social desirability bias (Richman, Kiesler, Weisband, & Drasgow, 1999). This bias may also explain why females rated PE more highly than males. Prior research has shown that female students tend to be more responsive to educational environments that emphasize reflection, communication, and collaborative strategy (Meece, Glienke, & Burg, 2006)—elements intentionally incorporated into the course. Moreover, several studies suggest that females are more susceptible to social desirability effects (e.g., Chung & Monroe, 2003; Hebert, Ma, Clemow, Ockene, Saperia, Stanek, Merriam, & Ockene, 1997).

6.7. Why Did Male Students Show High IAQ_{100} Scores at Pre-Test?

Assuming that explicit measures were influenced by social desirability bias, another question arises: why did male participants show high IAQ_{100} scores even at the pre-test stage? If their scores had initially been as low as those of the female participants, the intended course effect would have been more evident. Unfortunately, we overlooked the fact that some participants had already taken elective PE courses partially taught by the same instructor in their freshman year.

All participants were sophomore education majors pursuing teaching credentials for elementary schools. We selected a required PE course taught exclusively by Hamada in the sophomore year to ensure instructional consistency. However, it became apparent that some students had previously been exposed to the intellectual aspects of PE through omnibus-style elective courses during their freshman year, in which Hamada was one of several instructors. This prior exposure may explain the unexpectedly high IAQ_{100} scores observed at the beginning of the course. Because the data were collected anonymously, we were unable to identify which students had received such prior instruction.

If this interpretation is correct, the elevated IAQ_{100} scores at pre-test may reflect the cumulative effect of prior instruction rather than invalidating the results. Future studies should replicate the experiment using naive participants or by linking results to academic records.

6.8. Methodological Limitations and Future Directions

Several limitations must be acknowledged. First, the sample included students with prior exposure to similar course content, undermining the study's capacity to isolate the course's effect. Second, due to incomplete cryptic coding, only 68% of participants could be matched between pre- and post-tests, requiring analysis as independent groups rather than paired samples. This may have reduced sensitivity to within-subject changes. Third, while IAQ_{100} scores did trend in the expected direction for both genders, the effects narrowly missed statistical significance. A larger sample size may yield clearer effects.

Future research should replicate the current study with a larger sample of participants whose academic backgrounds are clearly documented. Improved cryptic coding systems are also needed to enable precise matching of individual data across pre- and post-tests. Although it may be difficult to completely eliminate social desirability bias from explicit measures, refining the wording of rating items may help reduce its impact.

6.9. Toward Evidence-Based PE Instruction

Finally, this study also highlights a broader issue in Japanese educational practice—the relative scarcity of evidence-based approaches. As Uchida and Mori (2018a) noted, evidence-based education remains underdeveloped in Japan. This study, although modest in scope, represents an attempt to bridge that gap by evaluating instructional effectiveness using both subjective and objective data. By combining pedagogical innovation with systematic assessment, the study offers a small step toward a more evidence-informed approach to PE curriculum development.

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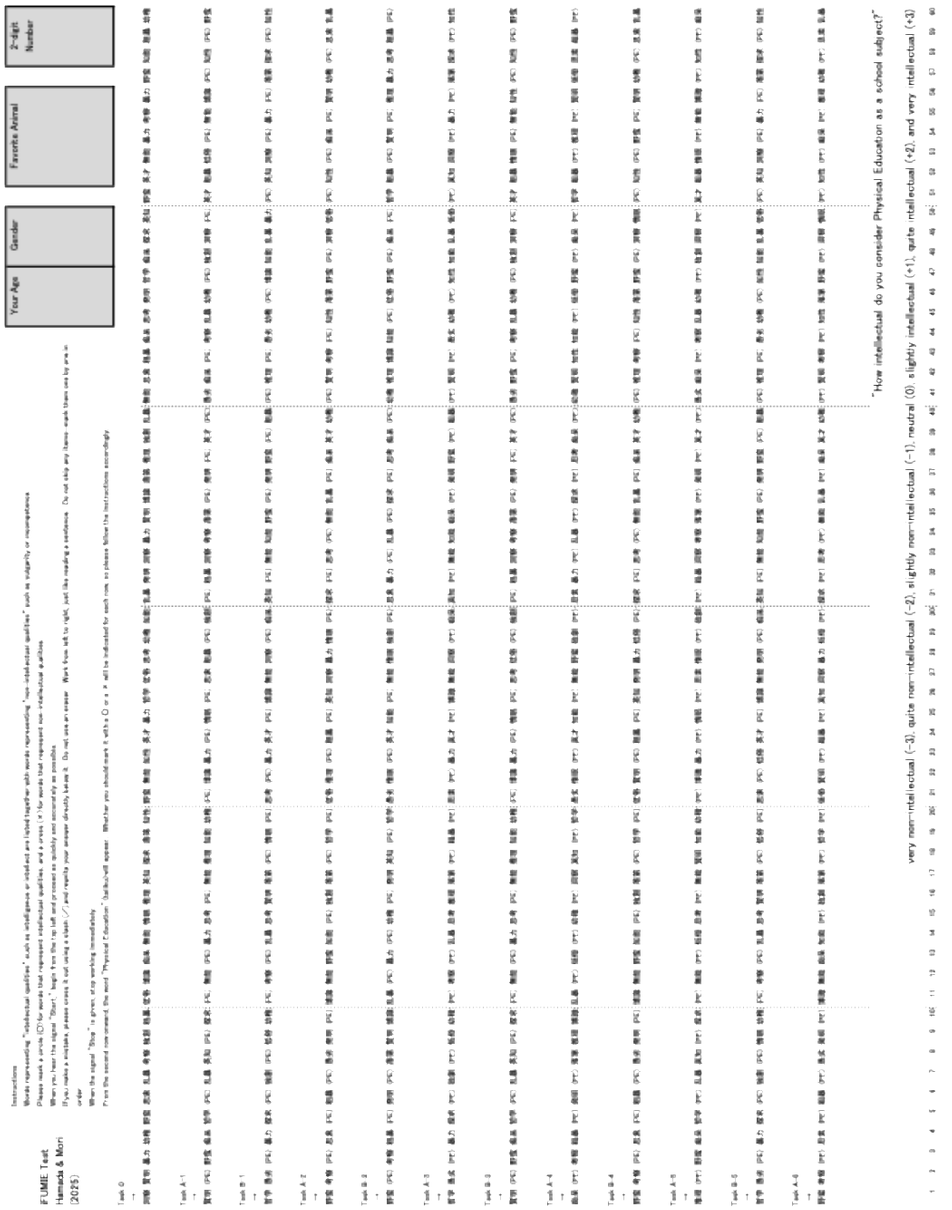
Appendix: Sample iFUMIE Test Sheet Featuring the Target Word 体育 (PE) (The intellectuality rating question was added at the bottom of the sheet.).



(To be placed horizontally with the right side facing down during administration.)

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