Predictors of Motivation Instability During Synchronous Online Classes: Reproducibility of Study Results via Multi-Group Analysis

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Abstract This study investigated the relationship between motivation instability and its predictive factors in synchronous online classes. Perception of class content (perceived interest, difficulty, and utility), sleepiness/fatigue, and learning anxiety were predictive factors. Data from 78 and 72 students, respectively, were collected from an online survey conducted at the beginning (Group 1) and end of the semester (Group 2) at University A, and data from 50 students were collected from an online survey conducted at University B (Group 3). A multi-group analysis of the three groups was conducted using structural equation modeling. Our model constructed equality constraints between Groups 1 and 2 for all path coefficients, while those in Group 3 were freely estimated. The results showed that sleepiness/fatigue, learning anxiety, and perceived difficulty of class content correlated positively with motivation instability. However, the relationship between motivation instability and its predictive factors varied between groups.

Keywords motivation instability, synchronous online classes, reproducibility, multi-group analysis

1. Introduction

1.1 Motivation Instability in Learning

In 2020, because of the COVID-19 pandemic, many universities shifted to conducting classes online[1]. Universities will likely continue to offer online classes along with face-to-face classes. Although many studies have focused on face-to-face classes, the learning process in an online classroom setting needs to be investigated in greater detail. It is also essential to identify how university students can engage in effective learning in this environment.

Motivation is an important factor that defines learning[2]. Many educational psychology studies have shown that motivation leads to active learning and improved performance[3]. To date, research on this subject has mainly focused on the level of motivation. However, in recent years, researchers have begun to note the ‘instability’ of motivation, which is distinct from motivation levels. Motivation instability is a concept that demonstrates the magnitude of fluctuations in motivation within a set period[4]. Some studies have examined the relationship between motivation instability and learning behaviors. Okada et al.[5] explained that the greater the motivation instability, the more a person tends to procrastinate on assignments. Moreover, Umemoto and Inagaki[6] posited that low levels of motivation instability play a vital role in the use of deep-processing strategies, such as memorizing learning content by linking it to existing knowledge. In other words, the stability of motivation appears to be an essential factor for effective learning.

Motivation instability can reveal the learning process from a perspective other than motivation level. Umemoto and Inagaki[7] revealed that a learner’s strategy of regulating their own motivation during the learning process is more related to motivation instability than motivation level. Previous studies on motivation regulation have shown that the use of such strategies promotes active learning and high performance[8]. Umemoto and Inagaki’s study[7] has also led to the proposition that these relationships are mediated not by motivation level, but by motivation instability. In other words, by focusing on motivation instability, it is possible to examine learning engagement through a process different from that adopted in conventional motivation research.

Research on educational technology has examined the role of motivation in learning. For example, it has

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been shown that orientation towards e-learning in online courses has a positive effect on motivation for continuous learning\[^9\]. In addition, the promotion of motivation has been examined from the viewpoint of instructional design\[^10\]. However, no research has been conducted on motivation instability in online classes or online learning. Students who take online classes do not usually have teachers or friends nearby and must study independently for many hours using a computer or smartphone. Consequently, their motivation may fluctuate more than it would in face-to-face classes. Therefore, it is vital to examine learning support in online classes from the perspective of motivation instability. As mentioned previously, motivation instability has unique characteristics that differ from those applicable to motivation level, which has primarily been studied to date. Examining motivation instability in online classes and online learning may contribute to the development of educational technology.

### 1.2 Predictive Factors of Motivation Instability

What factors cause motivation to fluctuate in an online classroom setting? By clarifying these predictive factors, we can examine the types of perspectives required to minimize fluctuations in motivation in online classes and promote active learning based on stable motivation.

Wolters\[^11\] identified three factors that reduce motivation in the self-regulation research field: boredom (lack of interest), difficulty, and lack of immediate relevance or importance. In other words, students’ motivation decreases if they are uninterested in the content of learning, if the material to be learned is difficult, and if it is not of immediate relevance. Moreover, the importance of learning content to students is based on its perceived usefulness for their future careers and daily lives. The perceived utility of learning content is an important factor that influences motivation\[^12\]. Therefore, this study focused on factors that predicted motivation instability, such as perceived interest in learning content, difficulty, and utility.

The interest and utility value of learning tasks have been shown to enhance persistence in learning\[^13\]. In other words, there is a possibility that a learner who perceives interest in and the usefulness of a learning task can maintain stable motivation while learning. The complexity of the task increases the learner’s cognitive load\[^14\], and this cognitive load may hinder attention and concentration on the task. In other words, it may be difficult for a learner who perceives a learning task to be cognitively demanding to stay focused on the class and engage in learning in a stable way. We hypothesized that the less interested a student is in the learning content of a class, the lower their perceived utility, and the more they perceive the learning content to be difficult, the greater the fluctuation in motivation.

This study also explored sleepiness and fatigue during online classes. During such classes, teachers cannot effectively keep track of the students’ statuses, and classes tend to become unidirectional, from teachers to students. Therefore, in online classes, students tend to learn more passively than in face-to-face classes\[^15\]. In the unfamiliar environment of online classes caused by the COVID-19 pandemic, university students must study independently for long periods of time, staring at their computer screens or smartphones. These conditions are especially liable to make them feel sleepy and fatigued. Several studies have investigated the sleepiness/fatigue experienced in class while learning\[^16\]–\[^19\]. For example, Nakashita and Yatougo\[^17\] showed that dozing off during class was negatively related to motivation for learning at a university, and Boksem et al.\[^18\] showed that mental fatigue was related to low motivation. Thus far, researchers have investigated the relationship between fatigue and the understanding of learning content\[^19\]; however, few studies have investigated how sleepiness and fatigue are related to motivation in online classes, and it is important to investigate this relationship in order to identify the learning process that occurs during online classes. In addition, sleepiness and fatigue are known to cause decreased concentration and attention\[^20\]. In other words, it is considered difficult for learners who experience sleepiness and fatigue while learning to focus their attention on the class and engage in stable learning. Therefore, we hypothesized that the more an individual experiences sleepiness and fatigue during class, the more their motivation will fluctuate.

In this study, we also explored learning anxiety during class. Online classes implemented during the COVID-19 pandemic differ sharply from familiar face-to-face classes, which involve learning together with teachers and classmates in a classroom. Consequently, students feel extremely anxious about learning in an online setting. Nagai and Kaneko\[^21\] showed that in online classes conducted during the COVID-19 pan-
A questionnaire link, prepared using Google Forms, was sent to students at the end of each target online class through the learning management system (e.g., manaba) at two different universities which asked them to answer the questions online. University A is a private school located in the Kansai region. At University A, three classes were selected as the targets of our study. Attendance at these three classes was mandatory in order for students to obtain a teacher’s license. A different subject was taught in each class; however, the content of all classes was related to school education and they were taught by the same teacher. University B is a national school located in the Kyushu region. At University B, we selected one elective class. This class was on a specialized subject offered by a university department that covered psychology-related content. Synchronous classes were conducted using Microsoft Teams (University A) and Zoom (University B) in accordance with each university’s teaching schedule. The classes adopted a lecture format, and there were no pair activities, group discussions, or presentations.

The first survey was conducted at the beginning of the semester in October 2020 and targeted both universities. We obtained data from 78 students (Group 1) at University A (10 first-year students, 54 second-year students, 14 third-year students, and one student who gave no answers). We also obtained data from 50 students (Group 3) at University B (two first-year students, three second-year students, 16 third-year students, and 29 fourth-year students). The response rates were 70% and 52% of enrolled students in Groups 1 and 3, respec-
atively. The second survey was conducted at the end of the semester in January 2021 and targeted University A only. We obtained data from 72 students (Group 2) (nine first-year students, 53 second-year students, nine third-year students, and one student who gave no answers). The response rate was 64% and the number of participants who overlapped between Groups 1 and 2 was 51. Participants from University A belonged to the Faculty of Foreign Studies and participants from University B belonged to the Faculty of Education.

At the top of the questionnaire web page, we explicitly stated, “There are no correct or incorrect answers. You may choose not to answer certain questions.” Participants were given information regarding the research study and provided written informed consent for their participation. Moreover, the participants were informed that there were no negative consequences for withdrawing from the study at any point. Participants did not receive any reward for participating and the survey was anonymous.

2.2 Content of the Survey

The same variables were measured during the first and second surveys. For items (1), (4), and (5), participants were asked to give their answers on a 5-point scale from “1: Does not apply at all” to “5: Applies very well.” Items (1), (4), and (5) are presented in full in the appendix.

(1) Perception of the content of the class: Based on the measurement of task-specific perceptions (utility and difficulty) in Tanaka and Murayama[26], we created items to measure the perceptions of interest, difficulty, and utility of the class content (two items each).

(2) Sleepiness: We measured the degree of sleepiness during class by using the Visual Analog Scale (VAS), which has been employed in previous studies such as that by Fukuichi et al.[16],[27]. We asked the participants to describe their degree of sleepiness during that day’s class on a numerical scale, rating “I was very awake” as 0 points and “I was extremely sleepy” as 100 points.

(3) Fatigue: As with sleepiness, we measured the degree of fatigue during class using the VAS, which has been employed in previous studies, such as that by Fukuichi et al.[16],[27]. We asked the participants to describe their degree of fatigue during that day’s class on a numerical scale, rating “I was not tired at all” as 0 points and “I was extremely tired” as 100 points.

(4) Learning anxiety: We modified and used the items formulated by Ito and Shinto[28] to measure anxiety about learning during class (six items). In that study[28], learning anxiety was measured not for university students, but for junior high school students. However, after discussions between the authors, the content of the items was deemed to not be limited to the learning of junior high school students, but to be applicable to learning in general. Then, a third-party psychologist checked the item contents and confirmed that there was no problem with administering the items to university students. Therefore, the validity of the scale was ensured.

(5) Motivation instability: We modified and used the items developed by Okada et al.[5] to assess motivation instability during class (five items).

3. Results

3.1 Composition of Subscales

We calculated the correlation coefficients of the two items using all the data regarding the students’ perceptions of interest, difficulty, and utility of class content. The results showed that the perceived interest in class content was .48 (p<.001), the perceived difficulty of class content was .62 (p<.001), and the perceived utility of class content was .40 (p<.001). Therefore, we composed each variable using the mean of the two items in each category.

Logarithmic transformation was performed for sleepiness and fatigue. Thus, since the current data contained “0,” we used Yamamura[29] as a reference and added 0.5 to all of the data before performing the logarithmic transformation. Since the correlation between sleepiness and fatigue was high (r=.69, p<.001), we created a variable called sleepiness/fatigue that consisted of the mean of the two items.

We used past studies as references and calculated the alpha coefficients for learning anxiety and motivation instability. The results showed that the alpha coefficient was .83 and .85 for learning anxiety and motivation instability, respectively. Since we obtained sufficient values for both items, we created variables consisting of the additive averages of those items. Table 1 shows each variable’s mean, standard deviation, and
the number of participants whose data were analyzed according to their group.

One-way analysis of variance (ANOVA) was performed to examine the differences in mean values between groups for each variable (Table 1). The results showed significant differences in the perceptions of class content and sleepiness/fatigue. For perceived interest, the results of multiple comparison (Holm) showed significant differences among all groups, with Group 3 having the highest values and Group 2 having the lowest. For perceived utility, the results of multiple comparisons showed significant differences among all groups, with Group 3 having the highest values and Group 1 having the lowest. For perceived difficulty and sleepiness/fatigue, the results of multiple comparisons showed significant differences between University A (Groups 1 and 2) and University B (Group 3), and the values of the former were higher than those of the latter.

To investigate the inter-variable relationships in each group, we performed a correlation analysis. As shown in Table 2, motivation instability was positively related to sleepiness/fatigue, learning anxiety, and perceived difficulty of class content in Group 1. In Group 2, motivation instability was positively related to sleepiness/fatigue and learning anxiety. In Group 3, motivation instability was positively related to sleepiness/fatigue and negatively related to perceived interest in class content.

3.2 Multi-Group Analysis

A multi-group analysis using structural equation modeling was performed to investigate the relationship between each variable in the three groups. The three groups’ perceptions of class content, sleepiness/fatigue, and learning anxiety were used as predictor variables, and motivation instability was used as the criterion variable. Covariance was anticipated among predictor variables because a model similar to the multiple regression analysis was constructed to make it easier to compare the path coefficients from the predictors to motivation instability. Missing values were processed using the full information maximum-likelihood method.

This analysis compared the four models using the study of Nozaki and Koyasu as a reference. The first model freely estimated all parameters without establishing any restrictions between groups. The second model constructed equality constraints between Groups 1 and 2 for all path coefficients, and those in Group 3 were freely estimated. The third model constructed equality constraints between the three groups for all path coefficients and the fourth model constructed equality constraints between the three groups for all path coefficients and error variances. The inter-group equality constraints were strengthened from the first to the fourth models.

To decide which model to adopt, we compared the Akaike Information Criteria (AIC) of the four models. They were 2627.65, 2621.21, 2624.65, and 2624.68 from Model 1 to Model 4, respectively. Next, based on the smallness of the AIC, we compared the goodness of fit of Model 2 (CFI=1.00, RMSEA=0.00 [90% CI: 0.00–0.14], SRMR=0.03) and Model 3 (CFI=0.95, RMSEA=0.10 [90% CI: 0.00–0.18], SRMR=0.05). Hu and Bentler recommended a model with CFI above 0.95, RMSEA less than 0.06, and SRMR less than 0.08, which was followed in this study. Based on the goodness of fit, we adopted Model 2.

Table 3 presents the results of the analyses in

**Table 1. Variables’ mean, standard deviation, the number of people analyzed according to the group, and results of ANOVA**

<table>
<thead>
<tr>
<th>Variables’ mean, standard deviation, the number of people analyzed according to the group, and results of ANOVA</th>
<th>Group 1 (University A at the beginning of the semester)</th>
<th>Group 2 (University A at the end of the semester)</th>
<th>Group 3 (University B)</th>
<th>F</th>
<th>η²</th>
<th>Multiple comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived interest in class content</td>
<td>4.04</td>
<td>0.52</td>
<td>78</td>
<td>3.85</td>
<td>0.67</td>
<td>72</td>
</tr>
<tr>
<td>Perceived difficulty in class content</td>
<td>2.86</td>
<td>0.75</td>
<td>74</td>
<td>2.75</td>
<td>0.74</td>
<td>72</td>
</tr>
<tr>
<td>Perceived utility of class content</td>
<td>3.79</td>
<td>0.65</td>
<td>78</td>
<td>4.01</td>
<td>0.55</td>
<td>72</td>
</tr>
<tr>
<td>Sleepiness/fatigue</td>
<td>2.79</td>
<td>1.65</td>
<td>75</td>
<td>3.14</td>
<td>1.38</td>
<td>66</td>
</tr>
<tr>
<td>Learning anxiety</td>
<td>1.89</td>
<td>0.58</td>
<td>77</td>
<td>1.96</td>
<td>0.64</td>
<td>71</td>
</tr>
<tr>
<td>Motivation instability</td>
<td>2.60</td>
<td>0.88</td>
<td>77</td>
<td>2.54</td>
<td>0.93</td>
<td>70</td>
</tr>
</tbody>
</table>

**p<.01, ***p<.001**
Model 2. In Groups 1 and 2, motivation instability was positively related to sleepiness/fatigue, learning anxiety, and perceived difficulty of class content. In Group 3, motivation instability was positively related only to sleepiness/fatigue. A statistical test of the difference in path coefficients between Groups 1 and 3 was performed. The results showed that the differences in path coefficients from perceived interest in class content and learning anxiety to motivation instability were significant (z = 2.15, p < .05; z = 2.05, p < .05, respectively).

4. Discussion

4.1 Predictive Factors for Motivation Instability in Synchronous Online Classes

The results of the multi-group analysis using structural equation modeling showed that sleepiness/fatigue was positively related to motivation instability in all groups. These results support our hypothesis. Previous studies have shown that sleepiness/fatigue is related to low motivation levels\[17]. \[18\], but the results of this study showed that it is also largely related to the instability/fluctuation of motivation. These studies indicated that the more students experienced sleepiness and fatigue during online classes, the greater their motivation instability, making it difficult to learn with stable motivation. The process by which sleepiness/fatigue relates to motivation instability may be mediated by motivation regulation. Motivation regulation is the process by which individuals regulate their motivation during learning to enhance their efforts and persistence\[32\]. Strategies to regulate motivation suppress the instability and fluctuation of motivation\[7\]. Therefore, due to sleepiness and fatigue during online classes, students may not be able to regulate their motivation well, which in turn may increase their motivation instability. Researchers have noted that sleepiness and fatigue lead to a reduction in cognitive function during learning\[10\], which coincides with the possibility that they may hamper the effective use of strategies to regulate motivation. Alternatively, if individuals experience little sleepiness or fatigue, even if instability/fluctuation of motivation has occurred, they can manage it by effectively using motivation regulation strategies, thus stabilizing their motivation.
Next, a positive relationship was observed between learning anxiety and motivation instability in Groups 1 and 2. This result signifies that the greater the level of anxiety experienced during class, the greater the motivation instability. These results support our hypothesis. Previous studies revealed a negative correlation between learning anxiety and self-efficacy\textsuperscript{[23]}, suggesting that learning anxiety causes a decline in motivation. Our study showed that learning anxiety may be related not only to motivation levels, but also to the degree of instability and fluctuation. Since emotions are regarded as volatile, in that they continuously change over time, there is a possibility that changes in emotion are linked to changes in motivation.

Therefore, reducing sleepiness, fatigue, and learning anxiety during online classes is key to suppressing motivation instability. Although it is challenging to keep track of students’ reactions during online classes, it may be possible to use strategies designed to keep fatigue and learning anxiety low. For example, this may be done by paying attention to the speed of the class and frequently answering the students’ questions because social support reduces anxiety\textsuperscript{[33]}. Previous studies have shown that active rest, such as stretching, reduces sleepiness and fatigue\textsuperscript{[34], [35]; thus, it may be helpful to encourage students to engage in light exercise between online classes. In addition, encouraging students to drink beverages for refreshment may also help to reduce sleepiness and fatigue. Through these efforts, motivation during class may stabilize and lead to proactive learning.

Perceived difficulty in class content was positively related to motivation instability in Groups 1 and 2. This result supports our hypothesis. However, the beta values were small. It has been pointed out that when the value of the path coefficient is small, the relationship between the variables should be interpreted with caution, even if that relationship is significant\textsuperscript{[36]}. Moreover, perceived interest and utility were unrelated to motivation instability. If we combine the results of our study with

Table 3. Results of multi-group analysis in Model 2

<table>
<thead>
<tr>
<th>Criterion: Motivation instability</th>
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<tbody>
<tr>
<td></td>
<td>B</td>
<td>95% CI</td>
<td>SE</td>
</tr>
<tr>
<td>Group 1 (University A at the beginning of the semester)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived interest in class content</td>
<td>0.20</td>
<td>[−0.06, 0.45]</td>
<td>0.13</td>
</tr>
<tr>
<td>Perceived difficulty in class content</td>
<td>0.20</td>
<td>[0.01, 0.38]</td>
<td>0.09</td>
</tr>
<tr>
<td>Perceived utility of class content</td>
<td>0.01</td>
<td>[−0.21, 0.24]</td>
<td>0.12</td>
</tr>
<tr>
<td>Sleepiness/fatigue</td>
<td>0.17</td>
<td>[0.08, 0.26]</td>
<td>0.05</td>
</tr>
<tr>
<td>Learning anxiety</td>
<td>0.46</td>
<td>[0.23, 0.68]</td>
<td>0.11</td>
</tr>
<tr>
<td>R²</td>
<td>.31</td>
<td></td>
<td></td>
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</tbody>
</table>

Group 2 (University A at the end of the semester)

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<tr>
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<tbody>
<tr>
<td>Perceived interest in class content</td>
<td>0.20</td>
<td>[−0.06, 0.45]</td>
<td>0.13</td>
</tr>
<tr>
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<td>0.20</td>
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</tr>
<tr>
<td>Perceived utility of class content</td>
<td>0.01</td>
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<td>0.17</td>
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</tr>
<tr>
<td>Learning anxiety</td>
<td>0.46</td>
<td>[0.23, 0.68]</td>
<td>0.11</td>
</tr>
<tr>
<td>R²</td>
<td>.23</td>
<td></td>
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</tr>
</tbody>
</table>

Group 3 (University B)

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Perceived interest in class content</td>
<td>−0.41</td>
<td>[−0.89, 0.08]</td>
<td>0.25</td>
</tr>
<tr>
<td>Perceived difficulty in class content</td>
<td>0.05</td>
<td>[−0.18, 0.29]</td>
<td>0.12</td>
</tr>
<tr>
<td>Perceived utility of class content</td>
<td>−0.14</td>
<td>[−0.53, 0.26]</td>
<td>0.20</td>
</tr>
<tr>
<td>Sleepiness/fatigue</td>
<td>0.13</td>
<td>[0.01, 0.25]</td>
<td>0.06</td>
</tr>
<tr>
<td>Learning anxiety</td>
<td>−0.02</td>
<td>[−0.43, 0.38]</td>
<td>0.21</td>
</tr>
<tr>
<td>R²</td>
<td>.27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* \( p < .05 \), ** \( p < .001 \)
the views of researchers such as Wolters[11] and Kera
and Nakaya[12], the perception of class content being
difficult, useful, or interesting is mainly related to
motivation levels, so there is a possibility that it is not
closely related to motivation instability. However, the
results of the statistical test of the difference in path
coefficients indicated that the relationship between
perceived interest and motivation instability differed
among the groups. The relationships between the per-
ception of class content and motivation instability may
vary depending on the themes and topics covered in
class and the degree of specialization. Therefore, further
investigation is necessary.

The results of the multi-group analysis showed that
the relationships between motivation instability and its
predictive factors were similar in Groups 1 and 2. This
signifies that inter-variable relationships, such as those
shown in our study, changed very little from the begin-
nning to the end of the semester in the targeted classes at
University A. This suggests that the results are repro-
ducible and that the observed inter-variable relationship
may be generalized within a limited range.

However, the results also showed that the relations-
ships between variables differed between Universities A
and B. In particular, the values of the path coefficients
from learning anxiety to motivation instability were sig-
ificant only in Groups 1 and 2, while these values were
significantly different between University A (Groups 1
and 2) and B (Group 3). These differences may be based
on the availability of class selection at the universities.
Previous research has shown that intrinsic motivation
(e.g., learning because it is interesting) is higher and
that controlled motivation (e.g., learning because it is
a rule and because people around me tell me to do it)
lower in classes that allow free choice than in classes
that do not[37]. Autonomous motivation, including
intrinsic motivation, has been shown to lead to adaptive
learning, while controlled motivation has been shown to
lead to maladaptive learning[38].

The class at University B that was targeted in this
study was an elective class. Therefore, the students
chose the class based on their own interests and con-
cerns, and they most likely had a relatively positive per-
ception of the class. This is consistent with the results
of the ANOVA in this study which showed that per-
ceived interest in and utility of class content in Group
3 were higher than in Groups 1 and 2. If students have
a positive perception of the class itself, even if they feel
anxious while learning during the class, anxiety may be
less likely to negatively relate to their learning moti-
vation. At the same time, since the classes at University A
that were targeted in this study are required to obtain a
teacher’s license, students were more likely to take the
classes for reasons not related to choice for learning. In
addition, as indicated by the ANOVA, the course con-
tent at University A was perceived to be more difficult
than at University B. Students may have thought
that the course content was relatively difficult, but that
they had to avoid getting bad grades in order to obtain
a teacher’s license. Thus, when learning is based on
negative perceptions, such as a sense of obligation, it
may be more likely that anxiety experienced in class
will be associated with motivational instability. Further
studies are needed to examine how the availability of
class selection affects motivation and engagement in
online classes.

4.2 Future Tasks and Challenges

This study investigated the relationship between moti-
vation instability and its predictive factors based on
synchronous online classes. However, there are sev-
eral limitations and future challenges. First, this study
alone cannot determine whether the results obtained
are unique to synchronous online classes. Therefore,
it may be necessary to examine whether the positive
relationship between sleepiness/fatigue and motivation
instability found in this study can be observed in asyn-
chronous online classes and face-to-face classes as well.
Moreover, it is important to clarify the extent to which
the intervariable relationships obtained in this study
apply. Second, in addition to the predictors discussed
in this study, it is also important to examine other pre-
dictors related to motivation instability in synchronous
online lessons. For example, previous studies have
shown that personality (e.g., Big-5 personality traits)
affects e-learning[39]; thus, it may be necessary to clar-
ify what type of personality traits influence motivation
instability in synchronous online classes in comparison
to asynchronous online classes. Third, we could not
investigate the relationship between motivation insta-
Bility and students’ learning behaviors and performance
in online classes. Future studies will be necessary to
investigate whether motivation instability inhibits or
promotes certain types of learning behaviors and per-
formance in online classes. Finally, through future lon-
ant to use studies such as that by Okada [40] as references were related to changes in their self-esteem. It is important changes in cooperative learning within individuals analysis, the author found that the autonomous motivation and during a two-and-a-half-year period. Using a multi-level model and to examine the direct correlation between changes in emotions such as learning anxiety, which are liable to vary over time, and changes in motivation during class.

Acknowledgments
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References


Appendix

Perceived interest in class content
1. What I learned in today’s class was interesting.
2. Compared to other classes, the content of today’s class was very interesting.

Perceived difficulty in class content
1. What I learned in today’s class was difficult.
2. Compared to other classes, the content of today’s class was difficult.

Perceived utility of class content
1. I thought that what I learned in today’s class would be useful for daily life and the future.
2. Compared to other classes, I thought the content of today’s class was useful for daily life and the future.

Learning anxiety
1. I became anxious while learning in today’s class.
2. I was able to study with peace of mind in today’s class. (reverse coded item)
3. I was worried while learning in today’s class.
4. I felt calm while learning in today’s class. (reverse coded item)
5. I was anxious and uncomfortable while learning in today’s class.
6. I was able to learn comfortably in today’s class. (reverse coded item)

Motivation instability
1. My motivation for learning was extremely changeable during today’s class.
2. My motivation for learning changed considerably from one moment to the next during today’s class.
3. My motivation for learning changed constantly during today’s class.
4. There were moments when I was very motivated, and other moments when I was not motivated at all, during today’s class.
5. I thought that my motivation for learning remained almost unchanged during today’s class. (reverse coded item)

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