# Relationship between Beliefs About Failure and Causal Attribution in Production Learning of Junior High School Students

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**Abstract- In this study, we attempted to shed light on the relationship between beliefs about failure and causal attribution in the production learning of junior high school students. In the experimental method, we examined the correlation between "scale to measure the beliefs about failure" and "questionnaire to investigate the casual attribution of failure in the wood processing learning" on 570 junior high school students who completed the production learning program of wood products. In the prediction before experiment, on the basis of Weiner's causal attribution theory, we predicted that more the students attribute the root cause of failure to their abilities (i.e., ability attribution), more they tend to negatively take the failure, and more the students attribute the root cause of failure to the lack of their efforts (i.e., effort attribution), more they tend to positively take the failure. As a result of the experiment, in 5 items out of 10 items of failure experience of wood processing, as predicted, significant correlation was found between "ability attribution" and "negative beliefs about failure)". However, no significant correlation was found in any of the items between "effort attribution" and "positive beliefs about failure". From the above results, it became clear that in the failure experiments of production learning, there are cases that do not fall under the existing causal attribution theory.**

**Keywords – Production Learning, Beliefs about failure, Causal Attribution**

## I. BACKGROUND

In the production learning programs in Japanese technology education, the project method has been used since long ago. The project method is a method of teaching proposed by Kilpatrick (1918), and it is learning pattern where students plan and implement on their own focusing on experimental and practical activities of production etc. in order to solve the problems [1]. In Japan, only "Technology and Home Making" taught in junior high school is the technology education in terms of compulsory education. Therefore, various production learning programs such as production of wood products are included in the curriculum on the basis of the project method (MEXT，2008a, 2008b) [2, 3]. However, production learning is always accompanied by failures. Therefore, if the method of teaching is incorrect, it may result in decline of students' motivation to learn. Hence, various studies for avoiding failures have been conducted in Japan for long time.

Miyahara et al (1977) has developed "CAI courseware" for preventing common failures in wood processing [4]. Moreover, in developing learning support system to be used in technology education, Sumi et al (2012) has summarized and classified the failure examples of students, and they have presented a framework for supporting learning [5]. There are many similar studies available (for example, Yamamoto, 1999, Kawai et al, 2004) [6] [7]. The above studies present useful support methods for preventing decline in motivation due to failure in production learning programs, and they also offer education and training methods that would accelerate assured learning of knowledge and skills.

However, beliefs about failure may be different for different students. There may be students who have negative beliefs about failure because they consider failures as "embarrassing" and "something that cannot be allowed". At the same time, there may be students who have positive beliefs about failure because they consider failures as "training that would result in future growth". Do failure experiences in production learning really result in decline in the motivation of students?

As one of the basis related to failure and motivation, Weiner's causal attribution theory is famous (Weiner, et al., 1971: Weiner, 1979, 1983, 1989) [8-11]. In this theory, it is shown that people who attribute the root cause of failures to internal and non-controllable factors such as lack of abilities tend to have low motivation to achieve, while people who attribute the root cause of failure to internal and controllable factors such as lack of efforts tend to have high motivation to achieve. In other words, students who consider lack of efforts as the root cause of their failure tend to have higher motivation to achieve their goals after they have failed. Even in Japan, in the survey conducted by Nasu (1990) regarding "Japanese, Social Science, Mathematics, Science, English" (hereinafter, "Five Subjects") for first year junior high school students, it was shown that "higher it is attributed to daily efforts, it would further foster the learned behavior", and this finding supported Weiner's theory [12]. However, there are some studies whose result do not match with Weiner's theory depending on the subject and academic year (e.g., Aikawa et al, 1985; Koizumi, 1991) [13, 14]. Ueno et al (2008) stated that "Effect of success and failure experience would be completely different depending on how one takes the goals", and they pointed out limitations to causal attribution theory [15]. However, most of the studies of causal attribution theory cover "Five Subjects", and we could not find any study related to production learning.

Production learning programs have diverse work contents and learning factors. Therefore, it is not clear whether the existing causal attribution theory can be applied as it is or not. Therefore, the author thought of verifying the relationship between beliefs about failure in production learning and causal attribution. Through this verification, we will discuss about suitability of causal attribution theory in production learning programs and the ideal way of extending support in the event of failures on the basis of causal attribution theory.

## II. METHOD

As for the contents of production learning program, we select the production learning of wood products, which is one of the most popular learning contents in the technology education in the junior high schools of Japan. Date of survey was June 201X, and the survey was conducted in four junior high schools of Japan. Table 1 shows the information of the schools covered in the survey and the valid response number of students.

Table-1 Information of the schools covered in the survey and the valid response number of students

| School | Prefecture | City | Grade | Valid response number (Boys, Girls) |
|---|---|---|---|---|
| A | Hokkaido | Asahikawa | 2nd grade | 134 (62, 72) |
| B | Hokkaido | Asahikawa | 3rd grade | 194 (92,102) |
| C | Aichi | Ajiyoshi | 2nd grade | 66 (34, 32) |
| D | Kyoto | Uji | 2nd grade | 176 (86, 90) |
| | | Total | | 570 (274,296) |

As for the method, in the junior high schools shown in Table 1, we administered a questionnaire that measures the beliefs about failure, and we conducted a questionnaire survey that finds out the causal attribution of failures. After that, we looked into the correlation between beliefs about failure and causal attribution. Details of the survey method are given below. As for the questionnaire that measures the beliefs about failure, we used "Scale to measure the beliefs about failure" of Ikeda et al (2012) [15]. Table 2 shows the scale.

Table-2 Scale to measure the beliefs about failure (Ikeda et al., 2012)

| Factor | Question Number and Question |
|---|---|
| 1st factor: Negative affective valence of failures | |
| | 6. I become concerned about failures for long time |
| | 19. When I fail, I become sad |
| | 3. When I fail, I fall into self-loathing |
| | 8. When I fail, I lose confidence |
| | 7. When I fail, I start rejecting myself |
| | 22. When I fail, I can't get over it for some time |
| 2nd factor: Learning orientation from failures | |
| | 20. Through failures, one can become stronger |
| | 17. Failures become the source of energy for moving forward |
| | 23. By overcoming the failures, once again grow |
| | 5. Failures are the biggest opportunities for growing |
| | 11. Failures basically remind you to go back to the basics |
| | 18. Growth is accelerated by failing |
| 3rd factor: Need to avoid failures | |
| | 14. One must never fail |
| | 24. Failure must not happen |
| | 9. Failure must not be permitted |
| | 10. Failure leaves a bad mark |
| | 15. People would blame you if you fail |
| | 13. Failure is pitiable |
| 4th factor: Perceived probability of occurrence of failures | |
| | 1. Failure occurs frequently |
| | 2. Failure is a daily occurrence |
| | 4. Failures cannot be avoided |
| | 12. Failures occur even if you are careful |
| | 16. Failure is common |
| | 21. Failure is something that you end up treating as natural |

The scale is made of four factors, namely "1st factor: Negative affective valence of failures", "2nd factor: Learning orientation from failures", "3rd factor: Need to avoid failures", and "4th factor: Perceived probability of occurrence of failures, and 24 items. 1st factor and 3rd factor are the negative beliefs about failure (Misawa et al., 2006) [16]. 2nd factor is the positive beliefs about failure. 4th factor is neither positive nor negative beliefs about failure. As for the survey method, with regard to the questions shown in Table 2, responds were asked to select one of the five options of "I strongly think so" (5 points), "I think so" (4 points), "None" (3 points), "I do not think so" (2 points)", and "I do not think so at all" (1 point). Questionnaire used for finding out causal attribution of failures included 10 items about failure situations in making wood products, and it was a questionnaire where the respondents were asked to select the root cause of failures from five attributions.

Regarding these 10 items about failure situations, we used "10 items of failure experiments in wood processing" given in the preceding study of Fujikawa et al (2014) [17]. Table 3 shows these 10 items. Types of causal attribution included two items of internal attributes and three items of external attributes in reference to the preceding study of Hayamizu (1997) and Miyake (2000) [18, 19]. Two items of internal attributes were "My effort was not sufficient" (i.e., effort attribution) and "My ability was not sufficient" (i.e., ability attribution), and three items of external attributes were "Task was difficult" (i.e., task attribution)", "My luck was bad" (i.e., luck attribution", and "Teacher's way of teaching was bad" (i.e., teacher attribution). As for the method of survey, with regard to 10 items of failure experiments, we first asked respondents about whether they had ever experienced failure or not. For the students who responded "I have failed", with regard to the extent of impact of the abovementioned five items of attributes on the failure, were collected responses in the scale of five of "It has significant impact" (5 points) to "It has no impact at all" (1 point).

Table-3 10 items of failure experiments in wood processing (Fujikawa et al., 2014)

| Item number | Failure experiments |
|---|---|
| #FE-01: | I made a mistake in measuring length by making line |
| #FE-02: | I could not cut straight with sawing |
| #FE-03: | Wood got split with sawing |
| #FE-04: | I could not scrape in straight line with planing |
| #FE-05: | Wood got split with planing |
| #FE-06: | Nail got bent with nailing |
| #FE-07: | Wood got split with nailing |
| #FE-08: | Traces of hammer got created on the wood with nailing |
| #FE-09: | I used incorrect component at the time of assembly |
| #FE-10: | Shape of the product got distorted at the time of assembly |

From the questionnaires given in Table 2 and Table 3, we checked the correlation between beliefs about failure and causal attribution of failures in production learning. On the basis of the existing causal attribution theory, it can be predicted that "ability attribution" is correlated with "1st factor: Negative affective valence of failures" and "3rd factor: Need to avoid failures", while "effort attribution" is correlated with "2nd factor: Learning orientation from failures".

## III. Result

### A. Beliefs about Failure

Table 4 shows the mean and multiple comparison of each factor in the "Scale to measure the beliefs about failure" (in Table 4, 1st factor: F1, 2nd factor: F2, 3rd factor: F3, and 4th factor: F4)

Table-4 Mean, SD, and multiple comparison of each factor in the scale to measure the beliefs about failure

| Factors（Cronbach's alpha) | *Mean* | *SD* | *F*-test |
|---|---|---|---|
| F1: Negative affective valence of failures (α=0.885) | 3.18 | 0.94 | |
| F2: Learning orientation from failures (α=0.879) | 3.82 | 0.76 | $F(2.28)=551^{**}$ |
| F3: Need to avoid failures (α=0.749) | 2.25 | 0.85 | F2≒F4>F1>F3 |
| F4: Perceived probability of occurrence of failures (α=0.873) | 3.88 | 0.63 | |

N=570, $^{**}p < 0.01$, $^{*}p < 0.05$, One-way analysis of variance and multiple comparison (Bonferroni)

If we compare the mean of each factor, it is clear that F2, which is positive beliefs of value with respect to failures, is significantly high compared to F1 and F3, which are negative beliefs about failure. Moreover, even F4, which is neither positive nor negative with respect to failures, is significantly high compared to F1 and F3. This trend matches with the survey results (Fujikawa, 2016) [20] of "Most of junior high school students have positive beliefs about failures". This showed that junior high school students tend to take failures in a comparatively positive manner.

### B. Causal attribution of failures

Table 5 shows the mean and multiple comparison of each causal attributions in 10 items of failure experiences of wood processing. In terms of the overall trend, average values of "luck" attribution and "teacher" attribution, that are external and non-controllable elements, were significantly low compared to other attributions. This trend is similar to the trend of eight subjects of Mathematics, English, Japanese, Social Science, Science, Music, Physical Education, and Arts as per the survey results of Hamamizu (1979) [21]. Even in the failure experiences of wood processing, just like other subjects, the results showed that there is strong tendency of attributing the root cause to "effort", "ability", "task", and the like.

Table-5 Mean and multiple comparison of each causal attributions in 10 items of failure experiences of wood processing

| Failure experiences | | N | C.A. (internal) | | C.A. (external) | | | F –test |
|---|---|---|---|---|---|---|---|---|
| | | | Effort | Ability | Task | Luck | Teacher | Multiple comparison |
| | | | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | |
| #FE-01 | Mistake in measuring length by making line | 190 | 3.28 (1.11) | 3.32 (1.16) | 3.19 (1.21) | 1.92 (1.12) | 1.71 (0.93) | F(3.63)=122** Effort=Ability=Task>Luck=Teacher |
| #FE-02 | Not straight in cutting with sawing | 317 | 3.33 (1.14) | 3.59 (1.01) | 3.79 (1.03) | 2.20 (1.15) | 1.86 (0.98) | F(3.70)=258** Ability=Task>Effort>Luck>Teacher |
| #FE-03 | Wood got split with saw | 197 | 3.36 (1.14) | 3.43 (1.11) | 3.79 (1.04) | 2.51 (1.26) | 1.84 (0.97) | F(3.29)=134** Task>Ability=Effort>Luck>Teacher |
| #FE-04 | Not straight line in scraping with planing | 239 | 3.47 (1.20) | 3.59 (1.11) | 4.04 (0.98) | 2.32 (1.19) | 1.97 (1.04) | F(3.65)=205** Task>Ability=Effort>Luck>Teacher |
| #FE-05 | Wood got split with planing | 233 | 3.45 (1.18) | 3.38 (1.20) | 3.82 (1.08) | 2.51 (1.29) | 1.88 (1.00) | F(3.57)=129** Task>Ability=Effort>Luck>Teacher |
| #FE-06 | Nail got bent with nailing | 232 | 3.25 (1.20) | 3.21 (1.18) | 3.30 (1.20) | 2.58 (1.34) | 1.89 (0.99) | F(3.63)=73** Effort=Ability=Task>Luck>Teacher |
| #FE-07 | Wood got split with nailing | 275 | 3.35 (1.12) | 3.00 (1.11) | 3.13 (1.12) | 2.51 (1.27) | 1.94 (0.99) | F(3.51)=26** Effort=Ability=Task>Luck>Teacher |
| #FE-08 | Traces of hammer on the wood with nailing | 98 | 3.51 (1.25) | 3.25 (1.19) | 3.44 (1.25) | 2.92 (1.36) | 2.14 (1.16) | F(3.73)=87** Effort=Task>Ability>Luck>Teacher |
| #FE-09 | Incorrect component at the time of assembly | 57 | 3.74 (1.17) | 3.11 (1.19) | 2.88 (1.31) | 2.60 (1.35) | 2.04 (1.13) | F(3.70)=19** Effort>Ability=Task= Luck, Luck=Teacher, Ability=Task> Teacher |
| #FE-10 | Shape of the product distorted at assembly | 219 | 3.65 (1.14) | 3.30 (1.17) | 3.61 (1.13) | 2.55 (1.33) | 1.99 (0.99) | F(3.68)=113** Effort=Task>Ability>Luck>Teacher |

C.A. : Causal Attribution, $^{**}p$<0.01, $^{*}p$<0.05, One-way analysis of variance and multiple comparison (Bonferroni)

### *C. Relationship between beliefs about failure and causal attribution*

Table 6 shows the relationship between beliefs about failure and causal attribution in failure experiences in wood processing. In this paper, even if significance is seen in the coefficient of correlation, when the absolute value of coefficient of correlation is 0.2 or below, it is considered as correlation not worthy of including the discussion (Nushi, 2005; Oshio, 2010) [22, 23].

In the first place, we focus on "ability attribution", which is expected to be accompanied with negative emotions with respect to failures. In Table 6, in five items (#FE-01, #FE-03, #FE-04, #FE-05, #FE-08) out of 10 items of failure experiments, we found significant correlation between "ability attribution" and "F1: Negative affective valence". Moreover, in three items (#FE-03, #FE-05, #FE08), we found significant correlation between "ability attribution" and "F3: Need to avoid". Accordingly, in these five items (#FE-01, #FE-03, #FE-04, #FE-05, #FE-08), it came to light that ability attribution comes with negative emotions with respect to failures, which matches with the existing theory. Moreover, in two items (#FE-03, #FE-09), significantly negative correlation was found between "ability attribution" and "F2: Learning orientation". In #FE-03, significantly correlation was found with ability attribution in "F1: Negative affective valence" and "F3: Need to avoid". Therefore, trend of negative emotions accompanying the failures is more prominent.

Table-6 Correlation between Failure Value and Causal Attribution

| Failure experiences | Factor of Failure Value Scale | C.A. (internal) | | C.A. (external) | | |
|---|---|---|---|---|---|---|
| | | Effort | Ability | Task | Luck | Teacher |
| #FE-01: Mistake in measuring length by making line | F1: Negative affective valence | .11 | .28** | .09 | .03 | .05 |
| | F2: Learning orientation | .07 | -.19** | .07 | .16* | -.06 |
| | F3: Need to avoid | .04 | .16* | .09 | .14 | .06 |
| | F4: Perceived probability of occurrence | .00 | .06 | .06 | -.15* | .04 |
| #FE-02: Not straight in cutting with sawing | F1: Negative affective valence | .15** | .12* | .09 | .08 | -.14* |
| | F2: Learning orientation | .00 | -.02 | .10 | -.06 | -.09 |
| | F3: Need to avoid | .04 | .08 | .04 | .11* | -.12* |
| | F4: Perceived probability of occurrence | .08 | -.03 | .13* | -.01 | -.06 |
| #FE-03: Wood got split with saw | F1: Negative affective valence | .11 | .35** | .13 | -.14 | .00 |
| | F2: Learning orientation | -.05 | -.26** | -.01 | -.02 | -.07 |
| | F3: Need to avoid | .06 | .24** | .11 | .00 | .03 |
| | F4: Perceived probability of occurrence | -.11 | .01 | .12 | -.05 | -.09 |
| #FE-04: Not straight line in scraping with planing | F1: Negative affective valence | .12 | .23** | .03 | -.06 | -.08 |
| | F2: Learning orientation | .09 | -.18** | .03 | -.08 | -.14* |
| | F3: Need to avoid | -.03 | .17** | .08 | .03 | -.03 |
| | F4: Perceived probability of occurrence | .00 | .00 | .06 | .00 | .03 |
| #FE-05: Wood got split with planing | F1: Negative affective valence | .08 | .26** | .16* | .03 | -.08 |
| | F2: Learning orientation | .11 | -.09 | .05 | -.06 | -.18** |
| | F3: Need to avoid | .00 | .23** | .19** | .07 | .05 |
| | F4: Perceived probability of occurrence | .03 | .06 | .02 | .03 | -.15* |
| #FE-06: Nail got bent with nailing | F1: Negative affective valence | .22** | .18** | .00 | .03 | .01 |
| | F2: Learning orientation | -.02 | -.04 | .12 | -.06 | -.18** |
| | F3: Need to avoid | .07 | .12 | .05 | .05 | -.02 |
| | F4: Perceived probability of occurrence | .00 | .11 | .04 | .09 | .00 |
| #FE-07: Wood got split with nailing | F1: Negative affective valence | .04 | .07 | -.03 | .03 | -.08 |
| | F2: Learning orientation | .11 | .00 | .09 | -.06 | -.11 |
| | F3: Need to avoid | -.03 | .09 | .04 | .05 | -.01 |
| | F4: Perceived probability of occurrence | -.03 | -.01 | .03 | .04 | -.07 |
| #FE-08: Traces of hammer on the wood with nailing | F1: Negative affective valence | .27** | .34** | .31** | .05 | -.04 |
| | F2: Learning orientation | .04 | -.18 | -.04 | -.16 | -.13 |
| | F3: Need to avoid | .10 | .24* | .25* | .03 | -.09 |
| | F4: Perceived probability of occurrence | .08 | .04 | .17 | .10 | .04 |
| #FE-09: Incorrect component at the time of assembly | F1: Negative affective valence | .26 | .10 | .15 | -.07 | -.24 |
| | F2: Learning orientation | .00 | -.37** | -.17 | -.03 | .00 |
| | F3: Need to avoid | .05 | .06 | .40** | -.20 | -.23 |
| | F4: Perceived probability of occurrence | -.01 | .06 | .18 | -.08 | -.05 |
| #FE-10: Shape of the product got distorted at assembly | F1: Negative affective valence | .08 | .04 | .10 | -.06 | -.05 |
| | F2: Learning orientation | .02 | .03 | .06 | .03 | -.09 |
| | F3: Need to avoid | .00 | .03 | .08 | .09 | .01 |
| | F4: Perceived probability of occurrence | -.01 | -.04 | .01 | -.08 | -.09 |

C.A. : Causal Attribution, (shaded) : Both significant and $|R|>0.2$, $^{**}p<0.01$, $^{*}p<0.05$

Next, we focus on “effort attribution” that is expected to be accompanied with positive emotions with respect to failures. If we look at Table 6, unlike our prior anticipation, significant correlation was not found between “effort attribution” and “F2: Learning orientation” for any of the items. Moreover, in two items (#FE-06, #FE-08), we found significant correlation between “effort attribution” and “F1: Negative affective valence”. These results showed that effort attribution is not accompanied with positive emotions with respect to failures, and depending on the item, it is accompanied with negative emotions. In effort attribution, the results didn’t match the existing theory.

In addition, in “task attribution”, significant correlation with “F1: Negative affective valence” was found regarding #FE-08. Moreover, in #FE-08 and #FE-09, significant correlation between “task attribution” and “F3: Need to avoid” was found. Even in task attribution, we found that there were items that were accompanied with negative emotions with respect to failures

On the other hand, in luck attribution and teacher attribution, we did not find any correlation that was worthy including in the discussion.

## IV. Discussion

As a result of verification, as we had anticipated, in most of the failure experiences, we found significant correlation between ability attribution and negative beliefs about failure, which matched with the existing theory. However, unlike our anticipation, there was no failure experience that showed significant correlation in effort attribution and positive beliefs about failure. Not only that, in effort attribution and beliefs about failure, there were items that showed significant correlation. It came to light that in the failure experiences of production learning, there are cases that do not fall under the existing causal attribution theory.

Next, we would look at extending support in failure situations. If we consider the verification results of this study, it is possible that learning support offered on the basis of existing theory known so far cannot be applied to the case of production learning programs. For example, methods that manipulate the existing attribution to effort attribution for increasing motivation to learn (e.g., Araki, 2000; Takeshima, 2004) [24,25] is highly risky. At least, in #FE-06 and #FE-08 shown in Table 6, there would be negative effect if luck attribution and teacher attribution is moved to effort attribution. Such manipulation of attributes that is easily done in the actual production learning situations should be questioned. While keeping in mind decline in the motivation of students of ability attribution, various support methods should be considered without getting restricted by the method of manipulation of attribution.

## V. Conclusion

In this study, we attempted to examine the correlation between beliefs about failure and causal attribution in production learning by conducting questionnaire survey. Through the verification, the below results were derived.

(1) Junior high school students tend to take failures in a comparatively positive manner.

(2) In failure experiments in wood processing, luck attribution and teacher attribution were significantly low compared to other attributions, as with other subject.

(3) In 5 items out of 10 items of failure experience of wood processing, significant correlation was found between “ability attribution” and “negative beliefs about failure”. However, no significant correlation was found in any of the items between “effort attribution” and “positive beliefs about failure”.

As a result of (3), causal attribution theory in production learning show peculiar reaction unlike other subjects. Therefore, it is possible that learning support offered on the basis of existing theory known so far cannot be applied to the case of production learning programs. We need to reconsider the methods under existing attribution theory.

Nonetheless, this study discussed only quantitative verification on the basis of data of questionnaires. We would like to add qualitative verification such as interview methods and projection methods and analyze the reactions obtained in the study in more details in the future.

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