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Improving Learning Outcomes in Dentistry College Students: The Impact of Learning Strategies

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Research Article

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ABSTRACT

Even after graduating from dental college, one need to continue learning in one's occupational and civic life, and the importance of acquiring new learning skills is increasing. However, the learning environment where necessary knowledge and skills are acquired is very different from a typical school setting. Therefore, it is necessary to acquire learning strategies before graduation that can help dental graduates cope with real-life situations. Historically, education has centered on providing academic guidance for knowledge and skills that need to be learned; however, there is inadequate guidance about learning strategies or learning ability that can be used as new skills and that need to be assimilated into daily life.

To date, various factors related to learning have been examined in terms of educational psychology. In this study, we focused on learning strategies that are cognitive strategies to improve the efficiency of learning in a dental school. A factor analysis on learning strategies consisted of 12 scales, which were analyzed using the maximum likelihood method. On the subscales of the obtained results, the correlation between the students with learning outcomes in the top 25% and those in the bottom 25% was analyzed. The results can begin to define the required abilities and characteristics of dental school students, and this understanding can be used to support the success of students aiming to be admitted to dental schools.

INTRODUCTION

In modern society, new problems and challenges arise due to changes in society and life such as declining birth rates and aging, informatization, and globalization. To respond to these unpredictable changes, it is necessary to continue learning new skills and abilities in occupational and civic life, even after graduation. The importance of acquiring learning skills has increased in recent years; however, the learning environment where the necessary knowledge and skills are acquired is very different from a school setting, where textbooks and teachers are provided. In real-life situations, we must already have learning skills to deal with challenges encountered outside the school environment. Education has mainly provided academic guidance as "learned power" to introduce knowledge and skills [1]. Although various attempts have been made to impart "learning ability," there is not yet any clear link to long-term and continuous guidance [2].

We have previously reported that strong motivation and academic achievement were associated with learning and learning strategies, which have been studied in educational psychology regarding the learning skills necessary for dental school education

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[3]. In the present study, we focused on learning strategies, which is a measure of the individual learning ability of dental school students. A questionnaire on learning strategies was administered to dental students, and the relationship between the questionnaire results and learning outcomes was assessed.

SUBJECTS AND METHODS

During the orientation period for the academic year starting from 2018, we explained to the participants—verbally and in writing-about the survey and that it would use the school's data. Written consent was obtained from participants. This study adopted the principles of the Helsinki Declaration and received approval from Fukuoka Dental College's Ethics Committee.

Subjects

A questionnaire was administered to dental students at the time of academic orientation in April 2017. The questionnaire was given to 612 subjects, and responses were collected from 592 (96.7%). Respondents comprised 85 first-years (96.6%), 102 second-year (96.2%), 97 third-year (99.0%), 113 fourth-year (96.6%), 85 fifth-year (95.5%), and 110 sixth-year students (96.5%).

Analysis Related to Learning Strategies

The questionnaire consisted of 12 items to assess learning strategies using the psychological scale by Ueki [4]. The questions were randomly arranged using random number **(Table 1)**. The items to assess learning strategies were answered by one of the following seven answer choices: Never, Very rarely, somewhat no, Neither, Somewhat yes, Often and always.

Data Used in the Study

For the second-year to sixth-year students, the previous year's grade point average (GPA) was used as the most recent academic record. For the first-year students, the scores on the general academic ability test administered at the beginning of the first year of dental school were used. After these academic data were linked to the survey results using student registration numbers, the registration numbers were deleted to de-identify the results.

RESULTS

Scale Analysis

Use of learning strategies: For the answer choices, respondents were asked to choose the response that matched the frequency of an action or activity ranging from never to always. Higher numerical value was assigned to more positive responses.

Analysis on learning strategy scales: Twelve learning strategy items were analysed by factor analysis using the maximum likelihood method. The changes of eigenvalues were 4.56, 1.60, 0.94, 0.77, 0.72, 0.63, 0.52, and so forth, for which the two-factor structure was considered appropriate. Two factors were hypothesized, and a factor analysis was performed using the method of maximum likelihood or promax rotation. The final factor pattern matrix and correlations between factors **(Tables 1 and 2)**. In addition, the ratio explaining the total variance of the two factors for the 12 items before the rotation was 51.32%.

Table 1. Results of the factor analysis on learning strategy scales (Factor pattern matrix after promax rotation).

	Question items	1	2
36	When something cannot be memorized while studying, memorize it by thinking it in a way that makes it easier to memorize.	0.712	0.008
33	Before memorizing study contents, modify it in a form that easily remains in the head.	0.706	-0.042
35	While reading, read as you confirm to what extent you understand.	0.704	0.045
26	When solving problems that you do not have an answer to, think where you are stumbling.	0.684	0.019
29	While reading something, try to link it with what you already know.	0.676	0.011
18	If you encounter a difficult word while studying, replace it with a word you know and try to understand.	0.674	-0.053
19	Ask yourself questions to confirm what you have studied.	0.664	0.059
5	While reading, occasionally stop reading to confirm the concept as you advance reading.	0.495	0.014
3	During or after a class, ask if you understood what a teacher has taught.	0.492	0.117
23	While studying, if you encounter something you do not understand, simply memorize it as it is※	0.029	0.821
15	While reading a textbook or a reference book, you are uncertain whether your understanding of the contents is correct or not.※	0.154	0.498
30	When memorizing study contents, memorize them by repeating the word in the head if you do not understand its meaning※	-0.382	0.388
※indicates a reversal item that exhibits an opposite tendency of the meaning of the scale.			

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Table 2. Factor analysis results of learning strategy scales (Factor correlation).

Factor	1	2
1	—	0.067
2		—
**p<0.01, *p<0.05		

The first factor consisted of nine items on the tendency to deliberate about study methods. For example, "when studying, if something cannot be memorized, you reorganize so you can remember it" or "Before memorizing study contents, you change it to a form that is easy to remember." This factor represented "ingenuity of methods."

The second factor consisted of three items, all of which indicated the opposite meaning of the scale. For example, "when you encounter something you do not understand, you just memorize it as it is" or, "when memorizing study contents, you repeat the words to memorize them, even if you do not know the meaning of the words." These items, which required not only simple memorization but memorization with understanding, showed high loading; therefore, this factor represented "focus on understanding."

Relationship between Subscales

The average value of the items corresponding to the two subscales of the learning strategy scales were calculated, and "ingenuity of methods" [mean 43.3, standard deviation (SD) SD=7.78] and "focus on understanding" [mean 10.8, SD=2.89] subscale scores were obtained. To examine internal consistency, coefficient α of each subscale was calculated be 0.07. The correlation between subscales of learning concepts is shown in **Table 3**. There was no significant correlation between "ingenuity of methods" and "focus on understanding."

Table 3. Subscale correlation of learning strategies.

	Factor 1	Factor 2
Factor 1	—	0.053
Factor 2		—
**p <0.01, *p<0.05		

Differences between Students in the Top 25% and Those in the Bottom 25%

To examine the difference between students in the top 25% and those in the bottom 25%, student's t-test was performed for each subscale score of the learning strategy. The results are shown in **Table 4**. For both "ingenuity of methods" and "focus on understanding," students in the top 25% had significantly higher scores than those in the bottom 25%.

Correlation between Students in the Top 25% and Those in the Bottom 25%

Correlation coefficients of each subscale of the learning strategies of students in the top 25% and those in the bottom 25% are shown separately in **Tables 5 and 6**. There was a significant positive correlation between "ingenuity of methods" and "focus on understanding" in students in the top 25%, while a significant negative correlation was seen between "ingenuity of methods" and "focus on understanding" in students in the bottom 25%.

Table 4. The mean, standard deviation, t-test results of students in the top 25% and those in the bottom 25%.

	Top 25%		Bottom 25%	
	Average	Standard deviation	Average	Standard deviation
Factor 1	46.3	7.91	39.8	8.27
Factor 2	11.36	3.12	10.5	2.93
**p<0.01, *p<0.05				

Table 5. Correlation of the learning strategy subscale with students in the top 25%.

	Factor 1	Factor 2
Factor 1	—	0.204**
Factor 2		—
**p<0.01, *p<0.05		

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Table 6. Correlation of the learning strategy subscale with students in the bottom 25%.

	Factor 1	Factor 2
Factor 1	—	−0.206*
Factor 2		—
**p<0.01, *p<0.05		

DISCUSSION

Learning strategy is defined as a "cognitive activity to improve learning efficiency" [5]. In Japan's educational system, learning strategies are not systemically taught, and each individual student must master these strategies by trial and error. An earlier study showed that there were individual differences in the degree of active use of learning strategies [6]. In the present study, a questionnaire on learning strategies measured the individual learning abilities of dental school students and investigated the relationship between the questionnaire results and academic outcomes of the students.

Currently, an academic performance management policy by GPA is thought to be necessary in higher education [7]. The GPA system is used by most universities, exactly 638 universities (approx. 85%) [8] as of 2015. GPA data are used for comparative assessments with other institutions and are used by universities to measure learning outcomes. For first-year students, GPAs are not yet available. Alternatively, the general academic ability test taken at the beginning of the first year was used to measure the academic ability when they entered school. The general academic ability test consists of three subjects: English, Mathematics, and Science, and five fields: English, Mathematics, and Science, with Science divided into the three fields of Physics, Chemistry, and Biology.

In the field of educational psychology, various factors related to learning have been studied. In an earlier study, we examined various views of learning and learning strategies required for dental school education. We reported that high-level intention is divided into four scales, which comprise the view of learning as "intention to understand the meaning" and "emphasis on thinking process" and the view of learning strategies as "monitoring strategies" and "refinement strategies." In particular, high-level intention in two scales contributes the most to learning: "emphasis on thinking process" and the learning strategy of "monitoring strategy." Considering the intervention in terms of learning and learning strategies, Shinogaya indicated that accumulation of learning experience is necessary to transform the view of learning, which is a student's belief in learning; however, it is difficult to improve learning outcomes solely through the intervention. As Shinogaya explained, learning strategies are practical actions, and it is easier to influence action than change the view of learning [9]. Therefore, the focus needs to be on learning strategies, which can be easily taught. In the factor analysis, two subscales were extracted: "ingenuity of methods," which is the tendency to deliberately consider study methods, and "focus on understanding," which is to seek memorization with understanding of the presented concepts. The average scores of these two factors are significantly higher in students in the top 25% than in those in the bottom 25%. The correlation between the two factors shows a significant positive correlation in students in the top 25%, but conversely shows a significant negative correlation in students in the bottom 25%. Learning strategies are mainly classified into two types. One type is deep processing aimed at "understanding," wherein the learner is aware of the relationship between the contents of learning and the link to existing knowledge. The other type of learning strategy is shallow processing aimed at "memorization" by simple repetition of the content [10]. It has been shown that the frequency of using deep processing strategies is positively correlated with academic outcomes, and the frequency of using shallow processing strategies is negatively correlated with academic outcomes [11-13]. Additionally, students in the top 25% had significantly more positive answers for both "ingenuity of methods" and "focus on understanding" compared with those in the bottom 25%. Regarding the correlation between the subscales, students in the top 25% showed a positive correlation, whereas those in the bottom 25% showed a negative correlation. This suggests that learning and using deep processing learning strategies is necessary for good learning outcomes. In dental schools, students receive education on the entire body, including the oral cavity. Moreover, the ability to interpret, assess, and retain information as well as integrate content learned from individual subjects and clinical reasoning gradually becomes more important from the lower to higher grades levels. To comprehend such a wide variety of content from new fields of science, effective learning strategies rather than simple memorization are essential.

Even though there have been intervention studies aiming to establish learning strategies including deep processing, they have not been very successful [14]. If a learner who has been using shallow processing learning strategies is taught deep processing strategies, this is rarely maintained by the student. In most cases, the learner immediately reverts to the original shallow processing strategies [15]. One study found that even shallow processing strategies can be somewhat effective in achieving learning outcomes [16]. When teaching learning strategies, Paris et al. described the importance of understanding when and why the strategies are useful [17]. Hardin et al. suggested that the perception of short-term and long-term usefulness of strategies can impact learning [18]. Murayama et al. pointed out that emphasizing the long-term usefulness of a learning strategy during an intervention would most likely be unsuccessful without the student perceiving the short-term usefulness of the learning strategy [10,19].

Altogether, it is important to motivate dental students to use learning strategies to improve learning outcomes, especially for students with poor grades; teaching learning strategies to struggling students is a relatively easy intervention, and can be ac-

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complished by making the student aware of learning strategies and encouraging the student to modify his or her behaviour and motivation related to learning methods. One approach is to introduce mini-tests, which provide awareness of the usefulness of learning strategies after a successful experience. This may encourage students to develop strategies for themselves. In addition, providing interventions using learning strategies will provide support for school enrolment.

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CONFLICTS OF INTEREST

For presentation of this study, there are no conflicts of interest to be disclosed.

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