A PROGRAM-BASED COMPARATIVE STUDY OF ENJOYMENT OF MATHEMATICS LESSONS AND CAREER ASPIRATIONS OF UPPER SECONDARY STUDENTS UNDER MATH-SCIENCE AND MATH-ENGLISH PROGRAMS ACCORDING TO THEIR CAREER FIELDS IN ASSUMPTION COLLEGE, BANGRAK, THAILAND

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Abstract: This study was conducted on Math-Science and Math-English program students at Assumption College, Bangrak, Thailand, to examine their enjoyment of mathematics lessons, career aspirations and career fields sought, as well as their enjoyment of mathematics lessons according to their career fields. A population sample of 142 upper secondary students enrolled in the English program during the academic year 2018-2019 at the target school, participated in this study. For data collection purposes, two research instruments were used: The Questionnaire on Enjoyment of Mathematics Lessons (QEML) (adaptation of TOSRA, originally developed by Fraser, 1981) and the Career Aspiration Scale-Revised (CAS-R) (Gregor & O'Brien, 2015). Upon data collection, both the QEML (used to determine the participants' enjoyment of mathematics lessons) and the CAS-R (used to determine the participants' career aspiration and sought-after career fields) were found to be reliable instruments. In order to test the hypotheses of this study, the collected data were statistically analyzed, performing independent samples *t*-test and a 6 (career field) × 2 (academic program) factorial analysis of variance. It was found that there was a significant difference in the enjoyment of mathematics lessons held by the participants, according to their academic program. However, no significant difference was found in the career aspirations between Math-Science and Math-English program students. The study also revealed that the interaction between the career field and the academic program had no statistically significant effect on the enjoyment of mathematics lessons of the participating students. Based on the research findings, recommendations for teachers, school administrators, students and future researchers are provided.

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Introduction

Mathematics is a fundamental subject for teenagers, and it has a close connection with technology and innovation, and is regarded as the "critical filter" that effectively rules out students for prestigious careers (Sells, 1973). The National Council of Teacher of Mathematics (NCTM, 2000) has reported that aptitude for mathematics is one of the basic skills for industry workplace. Students' enjoyment of, interest in, and motivation for their career are the first steps to start selecting the educational program in secondary level, as per their choice and interest toward their career and field of study (Domenico & Jones, 2007). This first step is the most important factor for students, as it leads them toward the path and the career they are aspiring for (Hansen, 1976).

Career aspiration of secondary school students guide them to enroll in a Science or Art-Science program, enabling them to choose the right subjects, which can boost their ability toward their career aspirations (Linderman, 2010). As many students consider mathematics and science irrelevant (National Research Council, 1996), these students usually choose the art stream to achieve their goals, and those who aspire a career in the field of engineering and medical science tend to select a science stream in secondary level. Menzin and Golman (1987) reported that students with a solid background in mathematics have the opportunity to contribute in society in diverse fields. With this in mind, many countries, including Thailand, regularly assess the mathematics, science and reading achievement of secondary school students at age 15 using the Program for International Student Assessment (PISA), with the support of the Organization for Economic Co-Operation and Development (OECD) and the International Association for Evaluation of Educational Achievement (IEA). Moreover, a high level of enjoyment of mathematics lessons leads to pursue careers which demand logical, investigational, critical and analytical skills (Yoong, 2015). Students who aspire to pursue careers in medicine, engineering, computer science, business and commerce must achieve high grades during their high school, particularly in mathematics (Harju & Eppler, 1997). Students who desire to have the career related to the science field usually have high level of enjoyment of mathematical lessons (NCTM, 2000).

Assumption College, Bangrak, Thailand, provides students with the opportunity to learn the Thai curriculum in English (i.e., the English Program, EP). Students enrolled in the EP learn all the subjects in English, with the exception of Thai and social sciences. In the case of upper secondary level, a

large number of students under EP (comprised of two academic programs: Math-Science and Math-English) get selected into prestigious institutes after finishing school. Upper secondary students must work hard to fulfill the demand of their school and their parents as well. To do so, they must maintain a good academic record, particularly in mathematics.

Through his interaction with upper secondary students, the researchers have found that most of the students under Math-English program have lower mathematics grades than the students under the Math-Science program. Most of them want to study university careers such as economics, engineering, and business administration, for which they should have a solid knowledge base in mathematics, with higher order thinking skills. However, the researchers have observed that students from Math-English academic program, in general, exhibit varied levels of interest in the mathematics subject, as well as varied levels of cognitive skills, which may affect their grades, enjoyment of mathematics lessons and career aspirations in a mathematics-related field. In order to get a deeper insight into this situation, the researchers conducted a quantitative study to compare the enjoyment of mathematics lessons and career aspirations of upper secondary students under Math-Science and Math-English programs of Assumption College, Bangrak, Thailand, according to their career fields.

Research Objectives

The following research objectives were addressed in this study.

1. To determine the levels of enjoyment of mathematics lessons held by upper secondary students studying under Math-Science and Math-English programs of Assumption College, Bangrak, Thailand.
2. To determine the levels of career aspirations of the upper secondary students studying under Math-Science and Math-English programs of Assumption College, Bangrak, Thailand.
3. To determine the career fields sought by upper secondary students studying under Math-Science and Math-English programs of Assumption College, Bangrak, Thailand.
4. To identify if there is a significant difference in the enjoyment of mathematics lessons held by upper secondary students studying under Math-Science and Math-English programs of Assumption College, Bangrak, Thailand.
5. To identify if there is a significant difference in the career aspirations of the upper secondary students studying under Math-Science and Math-English programs of Assumption College, Bangrak, Thailand.

6. To identify if there is a significant difference in the enjoyment of mathematics lessons held by upper secondary students studying under Math-Science and Math-English programs of Assumption College, Bangrak, Thailand, according to their career fields.

Theoretical Framework

This section introduces the two major literacy methods on which this study is based: social cognitive career theory (SCCT) and career choices and development theory (CCDT).

Social Cognitive Career Theory (SCCT)

This theory, originally developed by Lent (2002) and based on the social cognitive theory of Bandura (1986), explains the following factors which affect an individual's career choice development: self-efficacy belief, outcome expectation, goal choices, and career aspiration.

Self-Efficacy Belief

This concept refers to the efficacy of an individual to act toward the responsibilities, perform the required actions and show the results with an appropriate behavior, in order to achieve the aspiring career field (Betz & Hackett, 1981; Taylor & Betz, 1983). Thus, this cognitive parameter might affect an individual's career aspiration and behavior. Success in their actions enables students to pursue the academic field in which they are interested the most, while failure might lead them toward the study of other field, acquiring so a negative self-efficacy belief toward the pursued path (Rattan, Good & Dwec, 2012). There are individuals who have high self-efficacy belief, can be stable and consistent against difficult problem or situation as their behavior shows high efficacy and competency to achieve better results (Bandura, 1977).

Outcome Expectation

It refers to beliefs about the consequences or result of performing particular behaviors (e.g., "what will happen if I do this?"). The outcome expectation is an anticipation of a particular outcome, toward which a person must acquire the required skills and find the suitable environmental support for achieving it. Such anticipation comes from observing others, as well as from a variety of sources.

Goal Choices

They can be defined as individual's intentions and focus toward engagement in a particular activity (e.g., pursuing a field as a career) or achieving an outstanding result in a particular area (e.g., to receive an A in a particular subject related to career field of aspiration). Goal choices might be affected by

failure or by the influence of environmental factors, such as social need, family pressure or educational drawback. In the case of the latter, students compromise their aspired career and make the choice which is available for them (Hackett, 2017).

Career Aspiration

It is an important social cognitive variable, defined as the degree of commitment held by an individual to a particular career. Such commitment guides an individual to perform more activities in the relevant area of aspiration. These activities make an individual to move and follow their career aspiration and plan all the activities in an organized manner, which help the individual to reach at aspiring career (Bird, 1988). Students perform better and with more confidence in particular domains related to their career aspirations (Lent, 2002).

Career Choices and Development Theory (CCDT)

This theory, proposed by Brown (2002), provides the answer to questions such as "what is the best career for an individual?", "why is it important for an individual?" and "what are the important factors which one should consider in making career-related decisions?". This theory describes the relationship of family and career choices of an individual. There are many primary factors related to career choices and achievement (Holland, 1985), such as gender, race, talent, culture, biological effects and social economy. In the relation to learning experiences, these factors contribute to the development of a habit of working toward a career, obtaining critical skills to overcome the problems.

CCDT was developed based on Krumboltz's (1979) theory, which is a career development theory based on social learning theory and behaviorism. CCDT identifies two types of differences in terms of level of capability toward career choices: individual-level differences (e.g., differences in personality or in the ability to perform particular tasks), and group differences (e.g., sex differences or differences in school level).

Conceptual Framework

The purpose of study was to compare the enjoyment of mathematics lessons and career aspirations of upper secondary students under Math-Science and Math-English programs, according to their career field, at Assumption College, Bangrak, Thailand. The conceptual framework proposed to address this purpose is depicted in Figure 1.

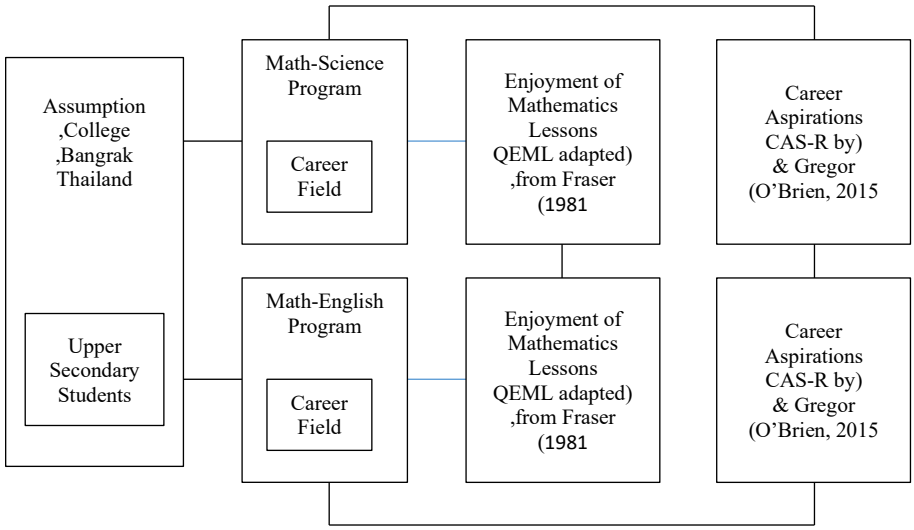

Figure 1. ***Conceptual framework for the present study.***

Literature Review

A study on the relationship between mathematics achievement and career aspirations of secondary school students from 23 different schools in Kandara sub-country, Kenya, was conducted by Nyacomba in 2017. This study found that there was a significant association between the students' career aspirations and their mathematics academic achievement. Also, a significant difference was found in students' career aspiration, according to their gender and school. It was also found that most of the students who aspired careers related to mathematics had a low mathematics achievement.

Another study was conducted by Linderman (2010), in order to determine the career aspiration of Grade 7 students in a suburban middle school located at a Northeastern United States city. It was observed that students' aspired careers were those requiring either a considerable or extensive preparation. It was also found that the students holding the top 5 highest GPAs in the sample aspired to careers in these two categories as well, which indicated a significant direct relationship between students' career aspirations and their academic achievement.

A study conducted by Anwar, Iqbal and Harrison in 2012 was aimed to determine Grade 10 students' attitude toward science in Pakistan. In the result, no significant difference was found between the rural and urban students in the sub-scales of enjoyment of science lessons, leisure interest in science, and

attitude toward scientific inquiry. Regarding career aspiration toward science, boys were found to have a slightly more positive attitude than girls.
A study by Welch (2010), conducted in a Midwestern metropolitan area of USA in the Unites States, examined high school students' attitude toward science after participating in a robotics competition. The results indicate that the students who participated in the robotics completion had a more positive attitude toward the science and science-related areas in four of seven categories examined: social implications of science, normality of scientists, attitude toward scientific inquiry, and adaptations of scientific attitudes.

Method/ Procedure

Population

In the English Program of Assumption College, Bangrak, Thailand, there were 98 students enrolled in the Math-Science program and 44 students in the Math-English program during the academic year 2018-2019 in upper secondary. Therefore, the target population of this study had a size of 142 students in the English Program of Assumption College, Bangrak, Thailand: 98 students enrolled in the Math-Science program, and 44 students enrolled in the Math-English program.

Sample

The sample of this research was the population sample comprised of all the 142 students enrolled in upper secondary at Assumption College, Bangrak, Thailand. Then, all the 98 students of Math-Science program and all the 44 students of Math-English program at Assumption College, Bangrak, Thailand, were considered for data collection in this study. From the 98 students of Math-Science program, 35 were in Grade 10, 42 in Grade 11, and 21 in Grade 12. From the 44 students of Math-English program, 15 were in Grade 10, 13 in Grade 11, and 16 in Grade 12.

Research Instruments

In order to address the objectives of this study, two research instruments were used: Questionnaire on Enjoyment of Mathematics Lessons (QEML) (adaptation of TOSRA originally developed by Fraser, 1981) and CAS-R (Gregor & O'Brien, 2015).

Questionnaire on Enjoyment of Mathematics Lessons (QEML)

In order to determine the enjoyment levels of mathematics lessons, only 10 items were used from the Test of Science Related Attitudes (TOSRA, Fraser, 1981), as these items were related to enjoyment of a subject matter (Section E from TOSRA: enjoyment of science lessons) with minor modifications to the item statements. In the modification, the original word "science" in TOSRA

was replaced with "mathematics", in order to determine levels of enjoyment of mathematics lessons held by upper secondary students. There were five items (1, 3, 5, 7 and 9) which were positively worded for this study and responses were rated using a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), while the other five items (2, 4, 6, 8 and 10) were negatively worded and the responses were rated from 1 (*strongly agree*) to 5 (*strongly disagree*). The responses of these items given by the upper secondary students of Math-Science and Math-English programs helped the researchers to determine the level of enjoyment of the mathematics lessons.

Career Aspiration Scale-Revised (CAS-R)

In order to determine the career aspirations of the students, this study adopted the CAS-R, developed by Gregor and O'Brien (2015). This instrument was used to measure three sub-scales of career aspirations: leadership aspirations, achievement aspirations, and educational aspirations. It has a total of 33 items to measure the career aspirations, but the researchers used only 12 items to measure the career aspiration of upper secondary students studying under Math-Science and Math-English programs, as these items belong to educational career aspirations' sub-scale of CAS-R. The responses to these 12 items helped the researchers to determine the levels of career aspirations of the participant in this study. Items 1-11 were rated using a 5-point Likert-type scale ranging from 1 (*not at all true of me*) to 5 (*very true to me*), while Item 12 was an open-ended response item based on which the researchers were able to identify the career fields sought by the students.

The collected quantitative data was analyzed by using descriptive statistics (means and standard deviations) and statistical hypothesis testing (independent samples *t*-tests and two-way analysis of variance), in order to address this research's objectives.

Findings and Conclusions

This section summarizes the findings obtained from the data collection and analysis.

Research Objective 1

- Upper secondary students of Math-Science program at Assumption College, Bangrak, Thailand, had a high level of enjoyment of mathematics lessons, $M = 3.77$, $SD = .69$.
- Upper secondary students of Math-English program at Assumption College, Bangrak, Thailand, had a neither high nor low level of enjoyment of mathematics lessons, $M = 3.40$, $SD = .75$.

Research Objective 2

- Upper secondary students of Math-Science program at Assumption College, Bangrak, Thailand, had a neither high nor low level of career aspiration, $M = 3.35$, $SD = .55$.
- Upper secondary students of Math-English program at Assumption College, Bangrak, Thailand, had a neither high nor low level of career aspiration, $M = 3.19$, $SD = .43$.

Research Objective 3

- The highest preferred career field for Math-Science program students at Assumption College, Bangrak, Thailand, was engineering (48.38%), followed by business administration (26.87%), economics (8.60%), medical sciences (7.53%), others (7.53%) and law (1.08%). The career field category labeled as "others" includes music, sport, digital art, and communication art, which were grouped together, due to the low count of students selecting these career fields.
- The highest preferred career field for Math-English program students at Assumption College, Bangrak, Thailand, was business administration (31.82%), followed by others (31.82%), economics (22.73%), and law (13.63%).

Research Objective 4

- The results from an independent samples *t*-test revealed that there was a significant difference in the enjoyment of mathematics lessons held by upper secondary students of Math-Science and Math-English program of Assumption College, Bangrak, Thailand, $t(135) = 2.85$, $p = .005$. This result indicates that the enjoyment of mathematics lessons held by Math-Science program students was significantly higher than the enjoyment of mathematics lessons held by Math-English program students.

Research Objective 5

- The results from an independent samples *t*-test revealed that there was no significant difference in the career aspirations of Math-Science and Math-English program students of Assumption College, Bangrak, Thailand, $t(135) = 1.78$, $p = .08$.

Research Objective 6

- A 6×2 two-way ANOVA test with career field (i.e., engineering, medical sciences, economics, business administration, law and others) and

academic program (i.e., Math-Science and Math-English) as between-subject factors revealed that there was no significant interaction between these factors and the enjoyment of mathematics lesson held by the participants, F (3, 127) = 1.69, p = .17. This means that means that the effect of the career field on the enjoyment of mathematics lesson (difference between the six categories of career field) does not significantly differ between upper secondary students of Math-Science and Math-English program. So, statistically speaking, there is evidence that the average career field effect on the enjoyment of mathematics lesson is the same for each academic program.

- It was also found that there was no significant main effect on the enjoyment of mathematics lesson held by the participants based on their career field, F (5,127) = 1.47, p = .20. Thus, the mean enjoyment of mathematics lesson (totally ignoring the academic programs) is the same in the overall population for each career field, and all differences we see between mean enjoyment of mathematics lesson for each career field are due to chance. In conclusion, this can be interpreted as the mean enjoyment of mathematics lesson is statistically the same for each of the six career fields identified in this study.
- Finally, it was found that there was no significant main effect on the enjoyment of mathematics lesson held by the participants based on their academic program, F (1,127) = .20, p = .65. Thus, the mean enjoyment of mathematics lesson (totally ignoring the career field) is the same in the overall population for each academic program, and all differences we see between mean enjoyment of mathematics lesson for each academic program are due to chance. In conclusion, this can be interpreted as the mean enjoyment of mathematics lesson is statistically the same for each of the two academic programs considered in this study.

Discussion

The findings of these study and conclusions are discussed in terms of the following themes: enjoyment of an academic subjects, motivation for learning mathematics, and career aspirations.

Enjoyment of Academic Subjects

Based on the differences in the level of enjoyment of mathematics lessons held by Math-Science and Math-English program students at the target school, it was clear that Math-Science program students highly enjoyed mathematics lessons, while Math-English program students had a neither high nor low level of enjoyment of mathematics lessons. Thus, on average, students of Math-

Science program a had higher level of motivation and mathematics proficiency than those in the Math-English program. This finding is in disagreement with the study conducted by Anwar et al. (2012), which showed that there was no significant difference found in the enjoyment of science lessons held by students from rural and urban areas.

Based on the result of this study, it can be assumed that, on average, Math-Science program students had a high level of involvement and participation during mathematics lessons, as well as a high proficiency in mathematics subject, compared to Math-English program students. This can be said based on the definition of enjoyment made by Fraser (1981), in which enjoyment of an academic subject is defined in terms of involvement, participation and proficiency. Therefore, the finding of this study regarding students' enjoyment of mathematics lessons can be linked to the one reported by Welch (2010), who compared the American high school students' participation and attitude towards science and found that high participation results in a positive attitude toward the subject. Moreover, enjoyment of a subject can lead to a better understanding, motivation for learning and proficiency in the subject (Nyacomba, 2017).

Based on the researchers' experience, the difference in enjoyment of mathematics lessons held by Math-Science and Math-English program students are associated to several individual and environmental factors, such as learning style and family pressure for high performance (Uusimaki & Nason, 2004). This might explain why no significant difference in the career aspirations of Math-Science and Math-English program was found, regardless the differences between these two academic programs.

Motivation for Learning Mathematics

Based on the findings of the study, there was a significant difference in the enjoyment of mathematics lessons held by Math-Science and Math-English program students, with students in the Math-Science program exhibiting a higher enjoyment than those students in the Math-English program. Since enjoyment is related to intrinsic motivation to acquire new mathematics skills (Bent & Hackett, 1983), it can be said that Math-Science program students have then a higher intrinsic motivation to acquire new mathematics skills than those in Math-English program. This conclusion agrees with the one reported by Nyacomba (2017), who found that secondary school students' enjoyment of a subject can improve their understanding, motivation, and proficiency in such subject (Nyacomba, 2017).

Mathematics enjoyment has been reported to be related to quality learning, self-concept of mathematics, and motivation for learning mathematics (Watt, 2004). Therefore, it can be said that Math-Science program students' not just have a higher motivation for learning mathematics compared to Math-English program students, but also that they have a more positive self-concept about their experience learning mathematics than Math-English program students.

Career Aspirations

The research findings revealed that there was no significant difference in the career aspiration of Math-Science and Math-English program students of Assumption College, Bangrak, Thailand. Both Math-Science and Math-English program students had neither high nor low level of mathematics-related career aspiration, despite the fact that both programs have mathematics as a core subject. In terms of the social cognitive career theory (SCCT), career aspiration is an important step for an individual effective behavior towards a desired career field and the acquisition of the required skills to achieve a goal choice. Also, according to the SCCT, career aspirations are strongly connected to interest, capabilities, knowledge, outcome expectation and intentions of an individual (Lent, 2002). Then, by exhibiting a moderate career aspiration, Math-Science and Math-English program students might be considered to have, on average, moderate interest, capabilities, knowledge, outcome expectation and intentions toward mathematics-related careers. This might be explored in a future study. Also, this finding is related to the one reported by Linderman (2010), who found that high career aspirations require high focus toward the study of career-related subjects, as well as an extensive preparation.

In this study, it was found that there was no significant difference in career aspirations of Math-Science and Math-English program students, who seem to differ in academic achievement, based on the researchers' observations. This finding is in line with the one reported by Crump (2011), who found that Grade 8 black and Hispanic adolescent boys from 53 countries generally have comparable aspirations toward future career in math and science as their white male peers, despite a notably large difference in achievement.

Since career aspiration can be seen as the interest toward a particular career choice, career aspiration demands the understanding of fundamental subject related to the sought-after career. The present study agrees with Nyacomba (2017), who found that Kenyan students with high career aspiration had low achievement level in subject related to their aspired career fields. This shows that students are lacking in understanding of their fundamental steps which required fulfilling their dream to achieve aspiring career fields; however, variables such as outcome expectation and goal choices might have certain

influence on the students' career aspirations, according to the SCCT (Lent, 2002). This also might be a reason why a large number of students under Math-Science and Math-English program were found to aspire to the career field of business administration, regardless their academic program and preparation toward it. On this matter, the researchers have observed that many of the participants were considering becoming businessmen and support their family business, regardless their academic program. As mentioned in the SCCT, goal choices might be affected by the influence of environmental factors, such as family pressure (Lent, 2002). Also, this finding is in agreement with agree with the one reported by Anwar et al. (2012), who found that selecting a career for upper secondary students depended heavily on family background and social implications.

Recommendations

Based on the findings, conclusions and discussion, there are some recommendations made for teachers, school administrators, students and future researchers.

Recommendations for Teachers

Based on the findings of the study, teachers have to understand the difference of students' enjoyment of mathematics lesson and career aspirations held by both groups of the students, which will allow them to understand better students' motivations and interest toward mathematics lessons. Teachers need to distinguish the teaching techniques to increase the level of enjoyment of mathematics lesson and career aspirations of Math-Science and Math-English program students at Assumption College, Bangrak, Thailand.

Recommendations for Administrators

Based on the findings of the study, administrators must understand the difference of students' mathematics enjoyment level and their aspiring career fields and must provide the career counseling to improve the goal choice and outcome expectations for both Math-Science and Math-English program students at Assumption College, Bangrak, Thailand.

Recommendations for Students

Based on the findings of the study, students from both academic programs must be focused toward the mathematics subject and be involved during the class discussions to improve their mathematics skills, and then increase their level of enjoyment of mathematics lesson as well as their self-efficacy belief regarding mathematics.

Recommendations for Future Researchers

Based on the findings of the study, future researchers may include all the upper secondary students, including Thai program along with other factors (e.g., family background, social environment, gender, interest, self-concept, knowledge, outcome expectation and intentions toward mathematics-related careers) associated to the career aspirations, in order to gain a deeper insight into the career fields aspired by the students.

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