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(Attached Form 6)

学位論文の要旨（論文の内容の要旨）
Summary of the Dissertation (Summary of Dissertation Contents)

論　文　題　目
Dissertation title
A Study on the Relationship between Upper Secondary School Track and Post-Secondary Aspiration of Science, Technology, Engineering, and Mathematics (STEM) Majors in Cambodia

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Introduction: Given the required role of human resources in science, technology, engineering, and mathematics (STEM) to help Cambodia advance during the Fourth Industrial Revolution (also called Industry 4.0) in general, and to help the country achieve economic growth in particular, there is great demand for graduates with STEM majors. However, fewer students are pursuing STEM nowadays. Although interest in STEM is developed and nurtured in upper secondary school, in recent academic years, there has been a worrisome declining number of science track students. Therefore, with the conceptual gap in this context, the main objective of this explanatory sequential mixed methods study is to examine, from a multi-dimensional perspective, factors influencing students' choice of the science track and the effects of tracking as well as other variables that explain Cambodian upper secondary school students' post-secondary aspirations of STEM majors. To achieve this main objective, three related *Research Questions* guided the investigation:

- *Research Question 1*: What factors are influencing Cambodian upper secondary school students' choice of science track?
- *Research Question 2*: What are the trends and patterns of the time-varying covariates for students who attended in different tracks at upper secondary school for one academic year?
- *Research Question 3*: What are the effects of the tracking system and other variables on Cambodian upper secondary school students' aspirations in STEM majors?

Methods: To answer the three research questions, this study employed explanatory sequential mixed method with repeated measures cross-sectional designs. A self-rated questionnaire containing 28 questions (25 closed-ended and 3 open-ended ones) were used to collect two waves of quantitative data. To explain significant predictors in greater detail, qualitative semi-structured interviews and focus group interviews were conducted online with 25 students. To answer *Research Question 1*, since the outcome variable was coded dichotomously into the science and social science tracks, *Binary Logistic Regression* was employed to analyze the first wave data from a sample of 752 early 11th grade students. Second, *Research Question 2* was addressed through a descriptive lens and some inferential statistics, including independent sample t-test, pair sample t-test, and repeated ANOVA on the two waves of data (waves 1 and 2). Third, to address *Research Question 3*, which was aimed to measure the effects of the tracking system and other variables on students' aspirations of STEM majors, the study employed *Hierarchical Linear Model (HLM)* with Bernoulli method to analyze the data of 700 participants from the second wave data (end of 11th grade). As the nature of the study implies, the data from the first wave, first and second waves, and second wave were used to answer research question one, question two, and question three, respectively.

Key findings: From the analysis of the data, the study revealed:

- that performance in science and mathematics subjects, attitudes towards science, plan to major in STEM, hours spent self-studying science and mathematics subjects, family encouragement and support, mother's education, and school location significantly predicted upper secondary school students' choice of the science track. Of the 49% of variance explained by the final model, individual factors explained 47% of the variance in Cambodian students' choice of the science track.
- that students perceived science and mathematics outcome expectations, science as a practical subject, and the importance of science in society at a high level. However, they rated science and mathematics self-efficacy, science and mathematics self-concept, interest in science at school, science activities outside school, extracurricular activities in science, future plan in science, support from science and mathematics teachers and interactive science and mathematics lessons at the moderate level. They rated science and mathematics performance as lower than average. Most interestingly, across the span of one academic year, some constructs exhibited increasing trends, yet based on *Cohen's d,* the effect size was at a small level. Moreover, there was a significant negative trajectory for future plan in science and no significant effect for interactive science and mathematics lessons. The patterns also varied across the observations as a function of the covariates of study track, gender, and school location. Notwithstanding, based on the value of *partial eta-squared*, the effect size was also at a small level.
- that there is class difference in the upper secondary school students' aspirations of STEM majors. Simply put, 18% of the variance in Cambodian students' aspirations is between class. Specifically, the random-regression coefficients model indicated that gender, academic achievement, future plan in science, and family encouragement and support had significant influence. Next, the means-as-outcomes model revealed that students' choice of the track was not significantly associated with aspirations of STEM majors; however, the interactive science and mathematics lessons was influential.

Conclusion and implications: After all, the main result of this study could be concluded as follows. The finding from the first study helped explained that the worrisome declining number of students that choose the science track is due not only to individual academic ability and attitudinal variables, but also to cultural influences from family and the condition of upper secondary school. The second study showed that despite the significant influence of different tracks on the time-varying covariates, different tracks had a small effect in improving the constructs that predict aspirations of STEM majors. The effect was negative for students' future plan in science. Consequently, given the small effect, course-taking behaviour between the science and social science tracks in Cambodian upper secondary school did not have any significant association with the students' aspirations of STEM majors in higher education. Instead, their aspirations were influenced by how interactive science and mathematics lessons (in different classes for each respective track) were conducted.

The process leading students to enter STEM fields is complex, as it involves the diverse influences of individual, psychological, contextual, and social factors. Therefore, to address this issue, science and mathematics teachers need to realize that, in addition to enhancing students' academic performance through their teaching practice, one of their ultimate missions is to inspire and deepen students' science self-concept. Also, because the practicality of science subjects matters in one's choice of science track, the most substantial change entails framing the presentation of the material to make science and mathematics lessons (especially starting in early grades) more practical, interactive, and realistic for students. Moreover, learning experiences related to teaching science and mathematics should focus on providing a learning environment with a high level of interaction to propel cognitive activation. Thus, in order for upper secondary school science track to be more effective in promoting students' STEM interest and success, the norms of science and mathematics instruction (for science track) need to be reconsidered. Parents can engage in many school-related tasks to boost their children's science performance and to motivate them to take STEM. Finally, starting in the early grades of secondary education, students should be made aware of how one's choice of track is associated with one's future major and career prospects, so that students have enough information to make a well-informed decision to major in STEM.