WHAT RESEARCH AND EVALUATION METHODS HAVE BEEN USED TO STUDY COGNITIVE AND NON-COGNITIVE FACTORS IN STUDENT TRANSITION BETWEEN HIGH SCHOOL AND FIRST YEAR POST-SECONDARY EDUCATION?

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Abstract – Students undergoing post-secondary transition are impacted by cognitive and non-cognitive factors. This paper will review available literature on the factors, which affect students during the post-secondary transition and perform a comparative analysis to compare and summarize what research and evaluation methods are used in these studies. The research methodologies described in each study are scrutinized, and details in the methodology used are tabulated and compared. Non-cognitive studies generally prefer medium-sized ($N=100$ to 500) samples, assessed with numerically-scored pre-established questionnaires, whereas cognitive studies do not show a specific sample size or assessment preferences. However, cognitive studies are shown to employ a wide range of data analysis techniques, whereas non-cognitive studies heavily prefer statistical analysis only. A proposed framework is extracted to describe the preferred research methodologies for investigations into cognitive and non-cognitive factors.

Keywords: post-secondary transition, first year students, cognitive factors, non-cognitive factors

1. INTRODUCTION

The transitional period between high school and post-secondary studies is a tumultuous time for students, especially those who go through this transition at the young age of 17 or 18. Facilitating a successful adjustment into post-secondary studies requires a complex understanding of the students' psychosocial fortitude and professional capabilities, as well as environments the students moved from, and environments they are expected to move into. Many studies have examined this complex balance of external and internal factors that affect the students' transition.

A review of selected literature on the transition of students into post-secondary education is performed, where the literature focuses on student groups in general

(as opposed to only engineering students) to provide a higher-level view of the factors impacting the students on a holistic level. The review reveals two common themes of studies performed on the topic. The effect of various cognitive and non-cognitive factors on the student transition they both have is investigated.

This paper aims to provide an overview of the different research methodologies used when investigating cognitive and non-cognitive factors on the student transition. First, background literature will provide the key cognitive and non-cognitive factors found. The scholarly inquiry of this paper and the methodology employed in the literature review is outlined next. Results gathered from the selected literatures are highlighted and discussed, and finally concluding remarks are made.

2. BACKGROUND LITERATURE

2.1. Cognitive Factors

Cognitive factors are the skills, abilities, and habits that directly contribute to the student academic performance. From literature, there seems to be a lack of consensus on which specific cognitive factors are key in impacting the student transition. Clercq, Galand, and Frenay [1] believe key cognitive factors are the past performance, socioeconomic status, study choice process, and academic self-efficacy beliefs. Goodlowe-Scott [2] argues that good learning habits, less absenteeism, taking harder courses, and sustained work habits in completing homework are the most significant cognitive factors that lead to student success. Other studies identified factors such as skills students acquired during high school (complex problem-solving in particular) [3], competency [4], and rigorousness of students' educational content in high school [5].

Overall, these studies agree that developing certain cognitive skills will help to facilitate the students' transition into post-secondary education. It is recommended that post-secondary educational institutions proactively form closer relationships with individual

students and with high schools, so they can develop meaningful, person-centric student profiles post-transition [1] while also helping high schools prepare curricula that support the students pre-transition [6].

2.2. Non-Cognitive Factors

Non-cognitive factors consist of the psychosocial factors, which affect this transition period and may not purely relate to the student academic performance. Unlike the studies of cognitive factors, there is more consensus of the key non-cognitive factors that affect students during the transition period. Predominantly, stress [7],[8],[9],[10], emotional intelligence [8],[10], expectations [7],[11],[12], social support [7],[8],[9],[13], and uncertainty [14],[15] are identified as the most important non-cognitive factors that impede students' adjustment. Each factor has a complex relationship with their impact on the students, where the effect is neither purely positive nor purely negative.

To effectively help students during their transition, it would be effective to combine systemic change with early prevention and intervention methods [9]. Academic coaching and counselling allow for a more impactful and personalized intervention and improves student stress management and anxiety, all of which improve student academic performance [16].

3. SCHOLARLY INQUIRY

The factors affecting student transition are clearly revealed by the conclusions of the reviewed studies. Additionally, the varied research methodologies employed in the studies are worth exploring to understand how scholars reached their conclusions, and if there is a difference in the approach when studying cognitive factors versus non-cognitive factors. The underlying research methodologies for all papers analyzed comprise of four major categories: a research subject (demographic and sample size of participant), materials and measures (a measurement scale and questionnaires used, often pre-established to measure different factors), a procedure (how the questions were administered), and data analysis (post-processing performed on the collected data). A comparative analysis on the research methodologies employed in studying cognitive and non-cognitive factors provides a systematic view and understanding of the difference between these studies.

The research and evaluation methods used in the studies are compared and summarized. The summary provides a framework of methodologies used and compares the execution of cognitive studies and non-cognitive studies. This comparison will be useful for researchers interested in studying the factors responsible for the academic performance of first year engineering students to formulate research inquiries and select appropriate methodologies for their studies.

4. METHODOLOGY

A preliminary list of suitable literature was determined using a relevant keyword search, such as “post-secondary transition”, “first year university”, “high school to university transition”. These resulting papers are reviewed for the relevance of their content, and those that provided insight into the research question are kept. Within the relevant papers, referenced literature are also reviewed, until a suitable selection of literature is formed.

From the selected literature, the research methodologies described in each study are scrutinized. Aspects of the methodology considered include the research subject, measures used, procedures, and data analysis techniques. Details of the methodology used by research on the two factors (cognitive vs. non-cognitive) are tabulated and compared. Four categories will be compared between the two types of studies: the research subject used, materials and measures used, the procedure of the study, and the data analysis techniques employed. A generalized framework is extracted to describe the preferred research methodologies observed for investigations on the cognitive and non-cognitive factors.

5. RESULTS

For the purpose of this paper, eight studies on the impact of the non-cognitive factors and six studies on the impact of the cognitive factors on student transition are examined.

5.1. Research Subject

The key factors considered for each research subject include the size of the study sample and the gender distribution of the study sample. Other factors related to the research subjects, such as age or race distributions, are not considered by the original studies.

5.1.1. Non-Cognitive Factors

Figure 1 shows the gender distribution in the study samples outlined in Table 1. From the studies selected, four use a predominantly female sample, while two of the studies use a predominantly male sample. Overall, there does not seem to be a distinct gender preference in selecting the research samples when performing studies on the non-cognitive factors. The size of the study sample ranges from around 400 participants to around 100 participants, all of which are expected and considerably reasonable sizes of research samples for the nature of the study.

Overall, the studies on the non-cognitive factors tend to favor a smaller research sample size (in the lower hundreds of participants), with a large variation in the distribution of gender within the samples.

Fig. 1. Ratio of Male and Female Non-Cognitive Study Participants.

Table 1: Research Sample of Non-Cognitive Studies.

Study ID	Total Sample	Gender Distribution			
		Male	Female	Male (%)	Female (%)
1 [9]	115	21	94	18.26	81.74
2 [10]	372	78	294	20.97	79.03
3 [13]	408	116	292	28.43	71.57
4 [7]	226	68	158	30.09	69.91
5 [17]	280	123	157	43.93	56.07
6 [8]	250	135	115	54.00	46.00
7 [11]	114	73	41	64.04	35.96
8 [12]	363	285	78	78.51	21.49

5.1.2. Cognitive Factors

Table 2 illustrates the gender distribution in the cognitive studies. Study 5 used pre-existing data selected from NELS:88/92 and NELS:88/94 [17]. The final sample size used in the study is not clearly stated (as only a range is given), and the gender distribution is unknown. Study 6 also does not specify the gender distribution.

Unlike the studies on the non-cognitive factors, the studies on the cognitive factors are much less uniform in terms of sample size. The total research sample size ranges from 30 to around 25,000 participants. Gender distribution appears in three of the studies considered, but since it is also not specified for two of the studies, it is hard to conclude whether cognitive studies generally use an even gender distribution in their research samples.

The large difference in sample size is due to the difference in the data collection procedures. The very small sample size indicates studies with intimate focus groups, whereas the very large sample size used pre-existing data.

Table 2: Research Sample of Cognitive Studies.

Study ID	Total Sample	Gender Distribution			
		Male	Female	Male (%)	Female (%)
1 [3]	165	64	101	38.79	61.21
2 [1]	2178	1026	1152	47.11	52.90
3 [6]	35	18	17	51.43	48.57
4 [4]	30	25	5	83.33	16.67
5 [2]	<24599	N/A	N/A	N/A	N/A
6 [5]	1933	N/A	N/A	N/A	N/A

5.2. Materials and Measures

5.2.1. Non-Cognitive Factors

All non-cognitive studies utilize a series of survey questions, either pre-established or developed for the sake of the study to construct a questionnaire for the participants. Every study used a combination of questions specifically tailored to the precise topic of their study, and therefore there is not a lot of overlap of questions used across the studies. However, one set of assessment measure, the Student Adaptation to College Questionnaire (SACQ) [18] stands out as being used more frequently than any other questionnaires, for appearing in four of the selected studies. The SACQ is a 67-item self-report that measures the quality of adaptation to post-secondary life. Other commonly used assessment measures include the Perceived Stress Scale (PSS) [19], and the Multidimensional Scale of Perceived Social Support (MSPSS) [20]. Even when the study uses its own scale to assess certain questions, the developed scale tends to be based on a pre-existing scale. Furthermore, almost all non-cognitive studies favour numerical assessment metrics that can be converted into a score. Rarely does a study ask open-ended questions or allow the participants to give written feedback. Instead, the questions tend to be grouped into sub-sets of 10 to 20 questions, often assessed on a 5-point or a 7-point Likert scale.

5.2.2. Cognitive Factors

There are less distinctive patterns in the preferences of how studies on cognitive factors select their assessment metrics. The largest distinction from non-cognitive studies is that participants' Grade Point Average (GPA) is a strong factor in almost all studies, which is fitting as cognitive studies are more concerned with the participants' academic performance. Unlike non-cognitive studies, there are no recurring themes in the questionnaires used. Instead, the cognitive studies favour developing personalized questionnaires tailored to the study. These developed questionnaires are often based on some pre-existing questionnaires, especially when assessing factors like intelligence, self-efficacy, or complex problem-solving. Furthermore, these cognitive studies more frequently

employ a semi-structured interview format. This type of qualitative data gathered from interviews and focus groups provides richness of information on the meaning behind student behaviours and feelings, compared to quantitative data that provides aggregated averages and approximations.

5.3. Procedure

5.3.1. Non-Cognitive Factors

The general procedure of the studies on the non-cognitive factors is outlined in Figure 2.

A second distribution of the questionnaires could be optional as some studies opt to collect one set of data. The choice of collecting one or two sets of data depends on the nature of the study. If the study is looking for the current state of the students, it would collect one set of data. Otherwise, if the study is looking for the change in the students over time, it would distribute two (or even more) sets of questionnaires.

Fig. 2. General Procedure of Non-Cognitive Studies.

5.3.2. Cognitive Factors

The studies on cognitive factors that use questionnaires follow the same procedure as outlined in the previous section, but often opt to collect only one set of data. The studies, which use formats similar to the semi-structured interview, follow a different procedure. These studies interview participants in smaller focus groups and often incentivize the participants.

5.4. Data Analysis

5.4.1. Non-Cognitive Factors

The questionnaires used in non-cognitive studies provide a numerical score for each of the answers, which makes the data analysis portion of the study relatively straightforward. The non-cognitive studies typically perform a statistical analysis on the scores from each question. The specific technique used in the statistical analysis varies between the studies as it should correspond to the assessed factors.

5.4.2. Cognitive Factors

As the cognitive studies lack the uniformity of data collection seen in the non-cognitive studies, these studies employ a variety of data analysis techniques. The techniques used are as the k-means clustering analysis [1] and the multiple regression model [5]. Furthermore, software, such as the QSR NUD*IST VIVO [4], are used to code the interview transcripts using content analysis methods. In some cases, coding was done manually to determine the emergent themes in the data.

6. DISCUSSION

From the results, it is apparent that procedures employed in the studies of the non-cognitive factors differ significantly from those used in the studies of the cognitive factors, even if the goals of the studies are ultimately similar. The non-cognitive studies seem to have a pre-established and systematic routine of selecting sample and assessment measures, whereas the cognitive studies do not appear to have a consistent preference in either the selection of samples or the assessment metrics. However, the cognitive studies typically incorporate a much more rigorous data analysis process to offset the lack of formal assessment metrics, whereas the non-cognitive studies do not often go beyond simple statistical analysis methods, such as sample mean and sample variance.

An aspect not significantly considered by either types of studies is the success of the transition. The cognitive studies use GPA as a primary measure of a successful student transition, where a high GPA indicates good academic performance, and thus a successful transition into the post-secondary academic environment. Non-cognitive studies vary on what is considered a successful transition, usually depending on what the topic of the study is. There is no uniform protocol on what defines a successful transition and how to measure the said success. It is worth performing a closer examination on the tools and methodologies behind how success is measured, because the transitional success is an important factor to be considered in performing a cognitive or non-cognitive study.

6.1. Framework

Based on the literature reviewed, Figure 3 proposes a generalized framework of the high-level systematic methods of conducting studies of the factors impacting students during post-secondary transition. This framework combines the cognitive and non-cognitive studies and proposes to use separate procedures based on the research sample size. Small sample sizes allow for focus group interviews using open-ended or semi-structured questions. The data collected contains interesting insights, but this format is strictly limited to very small sample sizes. Medium to large samples can utilize questionnaires with pre-established numeric scores as the larger sample allows for better statistical analyses. Should the topic demand it, a repeat study may be warranted. Ultimately, the data analysis technique should be chosen to best fit the data collected rather than the topic of the study. If the study procedure yielded a lot of unorganized quantitative data, it would be worth to apply the k-means clustering to classify the data with labels of what the data represents qualitatively. For studies that produce data already coded with numerical scores, using various statistical analysis methods would be beneficial. However, if the study produces qualitative interview data, it would be fitting to perform content analysis as the other methods would be less viable.

Fig. 3. Framework to Conduct Post-Secondary Transition Studies.

7. CONCLUSION

Our study shows that there is a clear differentiation between the research methodologies employed in the studies on the impact of the cognitive factors compared to those on the impact of the non-cognitive factors. Ultimately, studies on cognitive factors would benefit from a more systematically rigorous procedure in selecting measures for the impact of factors, for example selecting a validated instrument to assess the measures [9]. The studies on non-cognitive factors would benefit by incorporating more statistical rigour in the data analysis component, for example using analysis techniques such as k-means cluster analysis [1]. Future work includes determining a general procedure for cognitive studies like generalizing the procedures used in the non-cognitive studies. Transitional success should be considered in the proposed framework, but a further study is needed on how success is defined and measured. Furthermore, the proposed framework could be adapted into specifically studying the factors that impact the post-secondary transition process of engineering students.

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