Supporting the Academic Dimension of the Transition to University

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Abstract
The transition from further to higher education is both an exciting and challenging time for first year undergraduate engineering students. This work focuses on developing a tool to support the academic dimension of the transition, specifically the identification and closing gaps in student's pre-requisite knowledge, skills and reasoning. A transition survey was developed and deployed to a large cohort of Chinese engineering students on a British Transnational Education Programme (TNE). The first iteration of the survey was first deployed to Queen Mary Engineering School (QMES) students in September 2018. The results from which are presented in this paper. The transition survey was enhanced with support from colleuges from two other universities (Hassell, D, G., Gan, S, Y., Spowage A.C. 2019) and deployed to students in three partner Universities in September 2019. Selected results from this second iteration deployed to QMES students are included in this paper for comparison purposes.The results indicate the approach can support students in identifying and closing gaps and thus support them in the management of the academic dimension of the transition to undergraduate engineering education. However, additional work and access to data from a graduating cohort is needed to completely address the research question. The work identified several areas where students background knowledge skills and reasoning are incomplete to take full advantage of the learning opportunities presented to them. The work defined several areas of improvement for future iterations of the survey.

Keywords: Academic Transition, Transnational Education, Transition Survey

Introduction

The transition from further to higher education is an emotionally and intellectually challenging experience. Harvey et al identified several factors which influence a successful transition. The impact of student retention, satisfaction and performance has led to support of the first-year transition being considered a high-priority research area. The transition in the United States is considered by social and academic integration theories. In British universities more emphasis is given for preparedness for higher education, expectation management, satisfaction and the quality of the experience (Harvey, Drew, & Smith, 2006). The most common way universities support students during their transition is the resource (or "best practice") approach (Fox, 1986) (Barefoot, 2000). Many universities provide counselling, online resources and written guides to help support students make the transition (Mutch, 2005).

The literature suggests that in order to understand the issues students are having during the transition it is important to appreciate their background (Eriksen & Strommer, 1991). Queen Mary University of London (QMUL) has established a "Joint Education Institute" with Northwestern Polytechnical University in Xi'an China. The school, Queen Mary Engineering School (QMES), currently runs two, four year long, undergraduate bachelor's programmes in "Materials Engineering" and "Polymer Science & Engineering" the first two years of which are undifferentiated. Each programme has approximately 120 students per year and at the time of writing the first cohort is in their 4th year of study.

After a review of past work, the approach of (Goodhew, Murphy, McCartan, & Myler, 2011)(McCartan & Goodhew, 2010) (Goodhew, Bullough, McCartan, & Connor, 2013) (McCartan C. D., 2015) were considered to be most adaptable to the objectives of this work. The objectives of this early work are different to that in this work. However, the question bank developed holds the greatest potential to support the objectives of this work.

The aim of this work is to support QMES engineering students during their transition from school to a UK based engineering programme. The research question in this initial study is: could a transition survey support the academic dimension of the transition to a transnational engineering education programme. Put it another way the work aims to help students with the transition by enabling them to identify any gaps in their prerequisite knowledge, skills and reasoning. Once these gaps are identified support should be made available to close the gaps.

This paper presents the findings for the first iteration of the transition survey and contrasts them with the basic results from the second iteration.

Materials and Methods

The primary reference for the transition survey is that of (McCartan & Goodhew, 2010). The authors developed a diagnostic tool, referred to in this work as a "transition survey" which aimed to "assess the knowledge and experience of incoming engineering students". Effectively the authors develop a comprehensive question bank with links to related background reading although the purpose of the study and the mode of deployment (paper based) did not really encourage students to use the links.

This work used the same question bank to determine if a “transition survey”, the term used in this work, could be used to address the research question. The latest version of the questions was generously provided by Prof. Goodhew, the complete dataset contained 80 questions. These questions were reviewed for relevance to the QMES programmes and suitability for deployment within the Chinese context. The web-links in the transition survey needed to support student close any gaps identified. The links were reviewed for suitability to the purpose of this work and accessibility in China.

Questions were classified into a number of ***areas*** relating to discipline*,* and subclassified into the following question ***types***: knowledge, skills and reasoning (McCartan C. D., 2015). The survey was deployed via the schools Moodle based virtual learning environment (VLE).

Prior to deployment of the first iteration of the survey it was beta tested by several graduate students. The survey was opened for two weeks, and students could access the quiz as and when they chose.

The question bank for the second iteration of the survey was heavily modified in conjunction with colleuges from the university of Bath and the University of Nottingham Malaysia Campus (Hassell, D, G., Gan, S, Y., Spowage A.C., 2019). Limited results from the second iteration are contrasted with those from the first iteration where appropriate.

Results & Discussion

In the first iteration of the transition survey data was collected from a total of 225 students’, the basic data is summarised in Table 1. The percentages of students that attempted the survey was high (100%). However, the number of students completing the quiz was significantly lower (87%). Informal discussion with students that did not complete the survey suggested it was too long or that they were actively working on it and simply forgot to submit before it closed. To improve the submission rate the number of questions was reduced in the second iteration (Hassell, D, G., Gan, S, Y., Spowage A.C., 2019). In addition, several reminders were sent to encourage completion and submission before the survey closed. The approach improved the number of students that managed to complete the survey, the result was a higher number of successful submissions in the second iterations, Table 1.

The response rate was better than in the original work (72%) which was delivered synchronously in class using a paper-based approach (McCartan & Goodhew, 2010). This may be associated with the way the survey was administered or the character of the QMES students. Another explanation could be the different focus of the work i.e. this work aimed to help students identify and then close gaps in their STEM background while the original work had a stronger focus on assessing knowledge and experience which may not translate as readily into a direct benefit for students. While the questions were similar, the purpose would be perceived very differently by students. Additional work and comparisons with UK students on those on other

Transnational Education Programmes is recommended to help decouple these observations in future iterations of the survey.

When the scores in the first iteration of the transition survey are mapped against the QMUL grading bands a relatively high percentage of students (38.8%) obtained 1st class marks (70% or more). This is not too surprising as the transition survey focuses on knowledge, skills and reasoning that the students should have mastered as pre-requisites to starting their undergraduate engineering programmes. At the opposite end of the spectrum nearly one quarter of students (22.3%) scores were in the 3rd class or below bands. Assuming that the questions are indeed related to areas important for success within the degree programme, then this observation suggests a real need to support at least a subset of students to close gaps in their pre-requisite knowledge. The average performance of students in the second iteration was higher than in the first, Table 1.

Analysis of the time students invested to complete the survey indicated that on average students spent over 2days accessing the survey in both iterations. The observation indicate that students were following the links and closing gaps as the survey would have taken less than 2hrs to complete. This is the only metric available to assess if students actually followed the links to close any gaps identified. A more direct metric is needed to determine the extent to which students followed the links, and if possible, how much time they spent closing the identified gaps. In both iterations some students clearly did not follow any of the links as the time taken was far too short.

Analysis of correlation between the time taken to complete the transition survey and their average mark in QMES modules was investigated. The results indicate weak or no correlation between time taken with either entry grade, transition survey performance or the 1st academic year average mark.

Statistic	Value	Value
Number that attempted the quiz	225 (100.0%)	227 (100.0%)
Number that finished the quiz	195 (86.7%)	222 (97.8%%)
Average grade	41.7 (63.2%)	32.6 (74%)
Number of questions	66	44
Number of questions answered correctly by 90% or more of students	2 (3.0%)	13 (29.5%)
Number of questions answered incorrectly by 90% or more of students	3 (4.5%)	0
Average time taken (must have finished)	2 days 1hours 23min 7s	2 days 14 hours 30 mins
Correlation – Gender and transition survey score	None	None
Correlation – Entry grade and transition survey score	None	None
Correlation – Between question types	Moderate to Strong	Strong
Correlation – Between question areas	Weak to Strong	Weak to Strong
Correlation – Time taken in the survey and score, first year average or module marks	None	Weak

Table 1: Transition survey basic Statistics

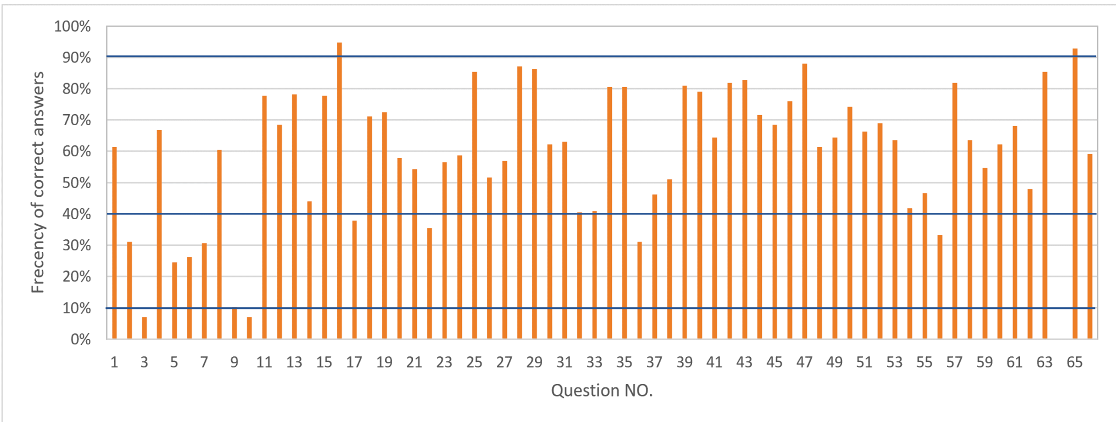

Figure 1: Frequency of correct answers for each question in the transition survey 1st iteration

The frequency of correct answers for each question in the first iteration is shown in Figure 1. The results indicate only two questions were answered correctly by over 90% of students. The results indicate that except for these two questions, the question bank focused on areas that represented gaps to a major proportion of students. In the second iteration some questions were removed, and new questions added. The results indicated that a higher number of questions (13) were answered correctly by more than 90% of students. It is not clear if this is reflective of the differences between cohorts or that the updated question bank was less challenging to students.

McCartan 2015 found (in there 40 question, 600 student survey that used a subset of the questions from iteration 1 of this work) that in 2 questions less than 10% of students and in 16 questions less than 40% of students got the correct response. On a macro level these results would seem comparable. Comparing the questions where less than 40% of students got the correct response, the UK based students found difficulty in areas of Manufacturing, Mechanics and Maths. However, the QMES students found most difficulty in skill type questions (4 of 15 questions got lower than 40% accuracy), math topic (4 of 13 question got lower than 40% accuracy). McCartan noted that it was surprising that even when students had very high mathematics entry grades that did not necessarily translate to a high score in the math focused questions of their quiz. Combining these observations may suggest that the issues QMES students found with the math questions may not be completely associated with language. Additional work and more direct comparison with British and students on other transnational education programmes should be considered in future studies.

Three questions from the first iteration were answered incorrectly by over 90% of students. These questions were evaluated and either the phraseology improved, or they were replaced in the second iteration. As a result no questions were answered incorrectly by more than 90% of students in the second iteration.

The transition survey in this and the questions in the original work targeted three *types* of questions; skill, knowledge and reasoning, Figure 2. In the first iteration the significance coefficient (2-tailed) for the total average score and the average score for each question *type* indicated no significant difference for all question *type*s. Analysis by question types indicated that in only 6 (out of 38) knowledge, 4 (out of 15) skills and 2 (out of 13) reasoning questions did 40% or more of students get the correct answers. The observations indicate that the gaps in students STEM background, and that the student's backgrounds are quite diverse.

In the second iteration student performance in skills type questions was similar (64%) to that in the first iteration but significantly higher in the knowledge (81%) and reasoning (79%) type questions. Figure 2. Due to the differences in the question banks used it is not clear if the results are reflective of differences between cohorts or if the questions asked.

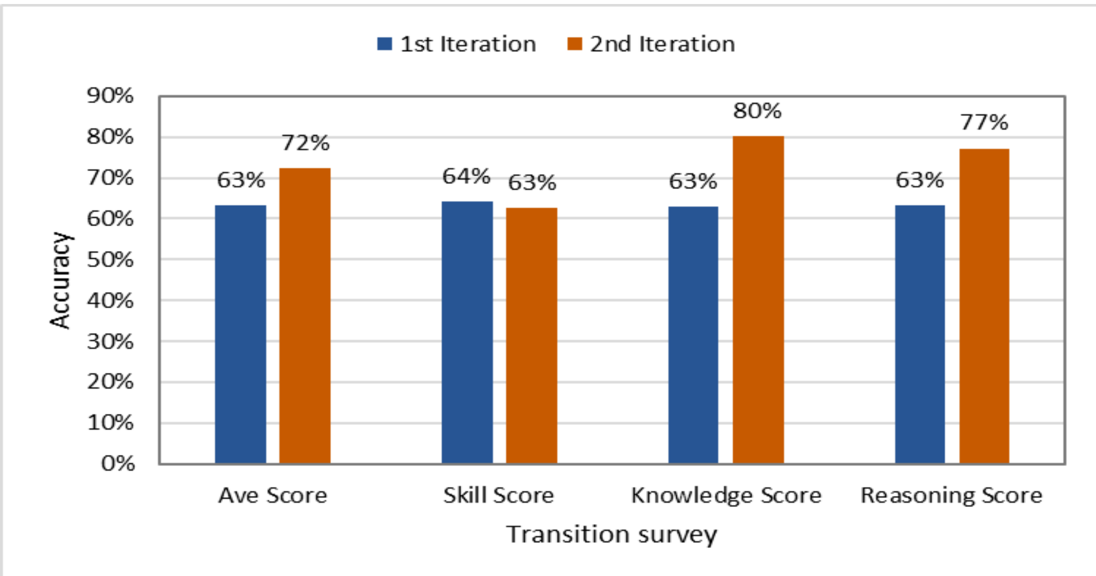

Figure 2: Comparison of all question types from the 1st iteration of the transition survey.

The Pearson correlation coefficient between questions types is shown in Table 2. Skills, Knowledge and Reasoning question types all indicate moderate to strong correlation between *types*. That is it can be expected that students who scored highly in knowledge type questions would also score well in skills and reasoning type questions, Table 2.

Skills-Knowledge	**Skills-Reasoning**	**Knowledge-Reasoning**
1st Iteration		
0.7 Strong correlation	0.5 Moderately correlation	0.6 Strong correlation
2nd Iteration		
0.70 Strong correlation	0.59 Strong correlation	0.65 Strong correlation

Table 2: Pearson relevance among question types

The question *type* QMES students found most challenging were associated with skills in both iterations. It was suspected that issues with skills related question was associated with English language capabilities e.g. the names of hand tools of other specialist vocabulary. The lack of correlation with the English language module scores might be due to the lack of engineering specific terminology within the module which might be an important factor in curriculum review. Either way it is an important area and discussions with the English language team and a suitable glossary of technical terms should be added to the survey for future iterations.

The relatively low performance of QMES students in mathematics related questions (many of the reasoning type questions) in the was something of a surprise as mathematics is given considerable attention in the student's pre-university education. It was suggested by Chinese colleuges that the result may be associated with the students not understanding the questions or how to apply their previous knowledge to the way the questions were phrased. Further, there was no correlation between the student's performance in the transition surveys maths questions and the mathematics modules they study in their first year. This issue needs additional investigation in future iterations in the survey.

Questions in the transition survey were also divided into several *areas* based on discipline lines. The performance of male and female students, and between programmes in each question area are considered in Table 3. The *area* of best performance was MS Office & IT and the worst was General Knowledge. However, there were only a small number of questions in each of these *areas*. ANOVA analysis indicates the average scores were similar in each *area*. The question areas were reorganised in the second iteration so a direct comparison would not be appropriate. However, in each question area the performance of students was generally higher in the second iteration with the exception of the "how they work" and "MS office and IT" areas.

Number of correct answers in each topic	Number of Questions	Performance
Chemistry	3	55.3%
The Workshop	4	62.8%
Nuclear Power	1	64.4%
How They Work	5	63.9%
General Knowledge	2	41.6%%
MS Office & IT	4	72.4%
General Physics	14	59.6%
General Engineering	7	59.9%
Materials Properties	13	57.2%
Maths	13	56.2%

Table 3: Analysis by question area 1st iteration

Table 4 indicates some question *areas* from the first iteration are strongly correlated with other question *areas* such as MS office & IT skills, General Physics, General Engineering, Materials Properties and maths. While other question *areas* have only a week/moderate correlation such as chemistry, the workshop and general knowledge. Similar observations can be made about question areas from the second iteration.

The student's entry grades were based on the Chinese Gaokao examinations. Gaokao or the "The National Higher Education Entrance Examinations" cover six modules. For science stream students this includes elements of Chinese, Math, English, Physics, Chemistry and Biology. The Ministry of Education determines the current years key enrolment benchmark depending on the number of applicants and the capacity of the universities. This will be different in different provinces (Davey, De Lian, & Higgins, 2007). As a result, the Gaokao scores cannot be compared directly between provinces. In this work the score over key

	The Workshop	Nuclear Power	How They Work	General Knowledge	MS Office & IT	General Physics	General Engineering	Materials Properties	Maths
Chemistry	0.34 weak	0.27 weak	0.40 weak	0.30 weak	0.37 weak	0.48 moderate	0.45 moderate	0.50 moderate	0.46 moderate
The Workshop	-	0.28 weak	0.57 moderate	0.34 weak	0.47 moderate	0.54 moderate	0.52 moderate	0.61 strong	0.58 moderate
Nuclear Power	-	-	0.33 weak	0.30 weak	0.47 moderate	0.45 moderate	0.35 weak	0.49 moderate	0.40 weak
How They Work	-	-	-	0.38 weak	0.56 moderate	0.66 strong	0.57 moderate	0.62 strong	0.60 moderate
General Knowledge	-	-	-	-	0.44 moderate	0.49 moderate	0.49 moderate	0.48 moderate	0.47 moderate
MS	-	-	-	-	-	0.70	0.63	0.70	0.63

Office & IT						strong	strong	strong	strong
General Physics	-	-	-	-	-	-	0.61 strong	0.73 strong	0.69 strong
General Engineering	-	-	-	-	-	-	-	0.66 strong	0.63 strong
Materials Properties	-	-	-	-	-	-	-	-	0.71 strong

Table 4. Pearson relevance among different question areas 1st iteration

benchmark rate has been used for comparisons between provinces and termed “Entry Grade” for simplicity.

The student’s entry grades were based on the Chinese Gaokao examinations. Gaokao or the “The National Higher Education Entrance Examinations” cover six modules. For science stream students this includes elements of Chinese, Math, English, Physics, Chemistry and Biology. The Ministry of Education determines the current years key enrolment benchmark depending on the number of applicants and the capacity of the universities. This will be different in different provinces (Davey, De Lian, & Higgins, 2007). As a result, the Gaokao scores cannot be compared directly between provinces. In this work the score over key benchmark rate has been used for comparisons between provinces and termed “Entry Grade” for simplicity.

The relationship between *entry grade* and transition survey performance was investigated using the Pearson correlation coefficient. There was no significant correlation between entry grades and student’s performance in both iterations of the transition survey. The observations indicate that *entry grades* alone cannot be used to predict QMES student performance. It is possible that the additional subjects studied in the entry qualifications diluted any correlation with performance in the transition quiz. Future iterations should look for a correlation between the scores in the relevant science subjects of the entry examinations and the results of the transition survey.

The Gaokao examinations are locally administered and there can be differences between the areas covered, and, emphasis given to certain subjects in different provinces. This can be thought of being analogous to different A-level examination boards in the UK which might have a greater or less focus on specific areas. QMES students are from different provinces. Figure 3 has been ordered highest entry score by province on the left to lowest on the right. Province 1 has the highest *entry grade* (0.6) and province 16 the lowest (0.1). Interestingly the province with the best entry grade didn’t perform very well in the transition survey. That is Pearson correlation between the score in transition survey and *entry grades* shows a negative correlation, Table 5, in both iterations.

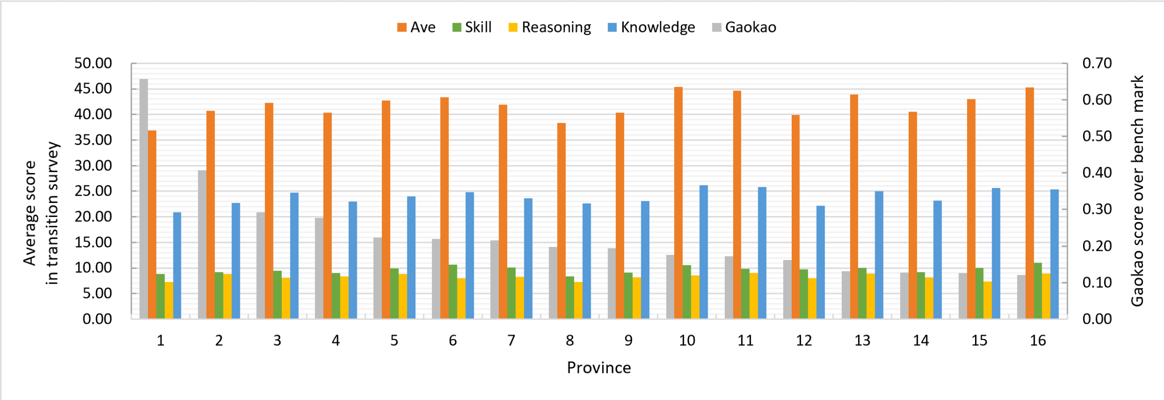

Figure 3: Comparison of the performance of students from different provinces in Entry Grade and in each question type of Transition survey 1st iteration

Similar comparisons have been done for each question *type,* Figure 3. The results indicate that Skill, Knowledge and Reasoning have Moderate, Strong and Weak NEGATIVE correlation respectively with entry grade. The observation is interesting but there is inadequate data for to draw any meaningful conclusions. It is however an area which warrants additional consideration in future surveys.

Pearson correlation coefficient indicates no correlation between the year average performance and the transition survey scores. This is to be expected as the students complete the transition questions before receiving the feedback which in turn helps them close any gaps. In this initial iteration of the transition survey no metric exists to measure the effectiveness of the survey, in future iterations direct measures of assessing the survey's effectiveness in helping students close gasp in their STEM knowledge, skills and reasoning needs to be investigated.

While there was no correlation between average first year marks, there was a correlation between the transition survey scores and specific modules. Similarly, Harvey et al. did not find a link between entry grades (A-level) and overall performance. However, they went on to say that "prior knowledge or expertise in a subject and the grades achieved in the early part of the first year are indicators of success but only in combination with other variables". It will be interesting to review the data available post-graduation to determine if the transition survey, perhaps in combination with the entry grades and other variables, are able to predict either performance or identify potential problem areas.

The average score in QMES modules for students that did not submit the transition survey were all lower than the score of students who did complete it. This observation needs to be investigated future as it could act as a useful metric for the value of the transition survey and as a warning system to flag students that might be at risk of underperforming.

Conclusion

The research question could not be fully answered based on the results of the first two iterations of the transition survey. The gaps identified indicate a need to help students identify and close them. Further, the QMES students were willing to spend time closing those gaps as indicated by the high completion percentages. Together this suggests that the survey has value to QMES students. Additional metrics are required to fully evaluate the research question over the long term.

Although no graduating class was available for comparison at the time of writing this, the initial results suggest a link between first year performance in some modules and the transition survey. Performance in the transition survey is not a direct reflection of the extent to which completing the survey supports closing gaps. That is, the students take the survey before getting the links which helps close the gaps. Other metric need to be developed to determine the effectiveness of the transition survey.

The results from this work indicate that indeed students who sat the transition survey scored higher in the QMES examinations. There are of course other factors which confound a direct correlation, methods of decoupling these need to be developed in future iterations.

The transition survey is a student centred, deficiency model i.e. it helps to identify and fill in the gaps in students' knowledge, skills and reasoning. In the terminology of (Palmera, O'Kaneb, & Owensc, 2009) the transition survey could represent a "key turning point" in helping student with their transition. Completing the transition survey has the potential to support students feeling that they are truly ready for at least the academic dimension of university life and successful completion will build academic confidence right at the start of their higher education journey. Additional work is required to understand the scope of any improvements in these areas.

The concept of "academic and social" integration implies that students must possess the pre-requisite academic capabilities if they are to engage in the ongoing academic conversation (Barefoot, 2000) (Tinto, 1993). It is generally believed that this engagement is essential to support higher performance and provide validation as an integral member of the university. A portion of new students are not equipped with the knowledge, skills and reasoning capacities that some within the academic community consider important for success. The transition survey provides a means to support all students to enhance their pre-requisites capabilities and in doing so smooth their academic journey.

Research suggests that students may accept the principle of autonomous learning (Harvey, Drew, & Smith, 2006). However, they need help in becoming autonomous learners. It is hypothesised that the way the transition survey is delivered, could, itself represent a turning point on this journey. To that end future iterations of the transition survey should also aim to further enable independent and active learning.

The available research suggests that, overall, predicting first-year outcomes is complex and requires a wide range of variables. There is little doubt that academic background is one of the most important predictors of success (Van den Broecka, De Laetb, & Lacantec, 2019). While it may not be possible to predict final grades with any degree of certainty, it is feasible that the transition survey can be used to support identification of potential problem areas in the students near term future. Further, by allowing students to close any gaps enhance their chances of attaining higher grades.

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