Demographic Factors Associated with Student Success in Two Upper-Year Agronomy Courses

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Abstract

Understanding the factors that determine college students' success could enhance the university experience for students and could help direct resources at students who most require them. This study was conducted to determine the factors that influence students' course performance in two upper-year agronomy courses at the University of Saskatchewan. The study was based on data collected from students (n=274) who completed the two courses (PL SC 345 and AGRN 375) between 2013 and 2015. Female students performed better than their male counterparts, exhibiting a 4.3% higher ($P < 0.05$) average final grade compared with male students. Diploma students performed more poorly than undergraduate students from all other majors, a trend that was statistically significant in two years but consistent across all three years of the study. Sophomores had 3.5% to 9.5% lower final grades compared with juniors and seniors, although the differences were statistically significant in only one year. A significant, positive relationship was identified between the number of hours spent in class (attendance) and final course grade, wherein each hour spent in class improved final course grade by nearly 1%. These results provide course instructors with practical information that may aid them in their pursuit of student excellence in future upper-year agronomy courses.

Introduction

Grain and oilseed prices have increased over the past decade, which has resulted in a strong rural economy that has contributed to increased enrollment in agricultural colleges. Without corresponding increases in new faculty, increased enrollment can produce academic units that struggle to provide consistent course offerings with ever fewer teaching resources, which adversely impacts student success rates (Vitale et al., 2010). Nevertheless, student performance in college courses continues to be critical to the success of academic institutions (Seidman, 2005). Instructors and administrators typically are concerned with student success because it is an important metric used for the assessment of learning and instructor effectiveness (Barkley and Forst, 2004). Moreover, there are often high costs associated with poor student performance, especially if it results in decreased student retention (Kuh et al., 2007). Understanding why some students excel while others do not is critical to improve student success in individual courses, as well as student retention rates.

Student performance is notoriously difficult to measure, and even more difficult to predict due to the complexities involved in academic excellence (Vitale et al., 2010). Students vary widely in their previous experience, cognitive abilities, comprehension, personality, socioeconomic backgrounds, and numerous other factors. Several studies have reported that students' prior academic performance, as measured by GPA, is a good predictor of student grades attained at university (Barkley and Forst, 2004; Martin, 1989; McKenzie and Schweitzer, 2001). Prior field experience has been shown to have a positive impact on the final grades of students enrolled in agricultural undergraduate courses (Mousel et al., 2006; Wildman and Torres, 2002). Absenteeism also can influence final grades in university courses (McMillan et al., 2009). Large, required courses often have high rates of absenteeism, and this negatively impacts student performance (Romer, 1993). Absentees may not gain the same level of competence or acquire the same volume of knowledge outlined in the course objectives compared with students who regularly attend classes (McMillan et al., 2009).

Other factors, which are demographic in nature, could impact student success rates. Demographic factors and their influence on student performance should be of increasing concern as the demography of the student population changes in agricultural colleges (Buchanan, 2008; Lyvers Peffer, 2011). An increasing number of students enrolled in agricultural colleges are urban, female, and from a visible minority (Reiling et al., 2003). Generally, females perform better than males throughout their university careers in subjects that require verbal competence (Burke, 1989). Lancaster and Robinson (2011) reported that females tended to score higher than males in an introductory plant science course. However, this may not be true for all courses

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in agriculture as Lim et al. (2014) reported that females in agricultural economics scored nearly three percent lower than men. Likewise, White et al. (2015) observed that gender had no influence on the critical thinking ability of animal science students. Student classification (year of study) may also influence student performance, although recent studies have produced ambiguous results. White et al. (2015) noted that classification had no influence on students' critical thinking ability, while Mousel et al. (2006) cited classification as a major factor determining student success in an introductory forage crops management course.

In order for an academic program or course to remain successful, it must address the interests and needs of its students (Lyvers Peffer, 2011). At the University of Saskatchewan (U of S), PLSC 345 (Pesticides and Crop Protection) and AGRN 375 (Current Issues in Agronomy) are offered to students as part of the curriculum for undergraduate or diploma (vocational) students majoring in agronomy. These courses also serve as open or controlled-elective courses for students in other majors. Moreover, the U of S offers a two-year diploma program that is separate from the undergraduate program, yet undergraduate and diploma students can take the same courses simultaneously. Collectively, these factors lead to a diverse classroom setting and it is important to understand how this diversity influences the demographics of the classroom and also, whether demographic factors affect student performance. Therefore, the objectives of this study were to determine if demographic factors influenced student performance in these courses and to assess whether an association exists between class attendance and student performance in one of the courses (AGRN 375).

Methods

This study relied on data collected from students enrolled in two upper-year plant science (PLSC 345) and agronomy (AGRN 375) courses in the College of Agriculture and Bioresources at the University of Saskatchewan. Plant Science 345 is a pesticides course that consists of three 50-minute lectures each week, with no laboratory session. Agronomy 375 is a course designed to explore current and topical issues vexing crop production, and consists of two, 80-minute lectures each week, with no laboratory sessions. Both courses run the entire semester, which includes 14 weeks of lectures.

Data presented in this manuscript were collected for both classes at the end of the second (winter) semester from 2013 to 2015, to assess the factors associated with student success in upper-year agronomy courses. Within each course and year, only students who remained enrolled in the course for the entire semester were considered for the study. Gender, classification (year of study), major, and overall course performance were determined from course enrollment records. Majors were classified into four discrete categories: two-year diploma students (DIPL), undergraduate students majoring in Agronomy (AGRN), in Bioresource economics (BPBE), or in other (OTHER) majors (Crop science, Soil science, or Environmental science). Student classification was based on current year of study and included sophomores, juniors, and seniors. Course performance was based on final course grades (n=274) that were determined from examinations, written and verbal composition, and participation; the weight of each criterion varied with each course, but the instructor was common to both courses in all three years. In one of the courses (AGRN 375), the number of absences was recorded for each lecture to evaluate the relationship between absenteeism and student performance.

All analyses were carried out with SAS (version 9.2; SAS, Cary, NC). Descriptive statistics for demographic variables were calculated using PROC FREQ. Analysis of variance (ANOVA) was conducted on the data using the general linear model procedure (PROC GLM) appropriate for a completely randomized design. Gender, major, classification and their interactions were included as fixed effects in the model. Data were pooled across courses but analyzed within years. Variables included in the model were declared significant at $P \leq 0.05$, with means separated using a Fisher's protected least significant difference. Pearson correlation values (PROC CORR) were used to assess the strength of the relationship between final grade and gender, major, and classification. To determine the relationship between absenteeism and final grade, the number of absences was converted to the number of hours that each student attended class, and these values were then regressed against students' final grades using linear regression (PROC REG).

Results and Discussion

The demographic information for the classes within each year is shown in Table 1. A total of 274 students were included in the study. The largest class size was in 2014, when 95 students completed the two courses, whereas the smallest class size was in 2013 and was comprised of only 88 students. Statistical analyses indicated there were no significant interactions between any of the response variables and therefore, results

Table 1. Number of observations for gender, major, and classification in two upper year agronomy courses from 2013-2015.

	Total		2013		2014		2015	
	n	%	n	%	n	%	n	%
Gender	274		88		95		91	
Male	164	60	55	63	59	62	50	55
Female	110	40	33	37	36	38	41	45
Major[z]	274		88		95		91	
BPBE	22	8	3	3	9	9	10	11
AGRN	145	53	45	51	49	52	51	56
DIPL	64	23	16	18	24	25	24	26
OTHER	43	16	24	27	13	14	6	7
Classification	274		88		95		91	
Sophomore	86	31	30	35	32	34	24	26
Junior	123	45	33	38	40	42	50	55
Senior	65	24	25	28	23	24	17	19

[z]Abbreviations: BPBE, Bioresource Policy, Business, and Economics; AGRN, Agronomy; DIPL, Diploma; OTHER, Other (includes Crop Science, Soil Science, Environmental Science)

were reported based on the main effects of gender, major, and classification.

Participants in the study were 40% female (n = 110), with 2015 being the year with the greatest number of female students completing the courses (Table 1). Gender had a significant impact (P < 0.05) on student performance in all years of the study (Table 2). Females consistently performed better than their male counterparts, regardless of major or classification. On average, the final grades achieved by female students were 4.3% higher than for male students (Table 3). Pearson correlation analysis revealed a positive association between final grade and gender in all years of the study (Table 4). Taken together, this implies that all else being equal, student grades in upper-year agronomy courses are correlated with gender.

It is possible that these gender-based differences stem from females performing better than males throughout their university careers in subjects that require verbal competence (Burke, 1989), as is required in both courses reported here. It is also plausible that females exerted more effort or had more motivation than males to obtain higher final grades because of a perceived lack of prior field experience, which can impact student performance (White et al, 2015). Females may perceive this in concert with the need to become more highly motivated in such courses, or they may be more willing to develop better academic skills when necessary (Aitken, 1982). Males, on the other hand, may perceive that they already know or have experience with the subject matter, and this may lead to complacency or perhaps, it may undermine their motivation. Students with more experience tend to perceive a small number of gains in applied courses (Evans et al., 2009). Further research is required to determine the underlying causes of these gender-based differences. Data regarding the impact of gender on student performance in agricultural courses is conflicting, but the results of this study are concordant with others who have noted significant differences between genders in regard to student performance (Burke, 1989; Lancaster and Robinson, 2011; McMillan et al., 2009). In contrast, other studies reported no significant effect of gender on course performance (Lyvers Peffer, 2011; Mousel et al., 2006; Torres and Cano, 1995; White et al., 2015).

Academic major had a significant effect on classroom performance in two of three years (Table 2), although the trends were consistent across all three years (Table 3). Nearly one quarter (23%, n=64) of the students included in the study were diploma students (Table 1), and they performed more poorly than students from all other majors. The average final grade for diploma students in 2013 was 14.7% and 6.9% lower than for BPBE and AGRN students, respectively (Table 3). Likewise, diploma students exhibited 11.5% and 9.3% lower final grades in 2014 than BPBE and AGRN students, respectively. In both 2013 and 2014, Pearson correlation analysis revealed a significant association between major and final grade (Table 4). There were no significant differences in final grades between the other majors included in this study.

These results suggest that academic major can influence student performance. Moreover, this study revealed that agricultural diploma students are consistently outperformed in upper-year agronomy courses by students from all other majors (Table 3). There are two possible explanations for these differences. First, diploma students are often in their second (sophomore) year when they enroll in upper-year undergraduate agronomy courses, and they may lack the collegial and field experiences necessary to achieve the higher grades characteristic of juniors and seniors. Prerequisites and prior experiences have a profound impact on student performance across a variety of courses (Mousel et al., 2006; Vitale et al., 2010; White et al., 2015). Second, diploma students often take fewer courses, most of which are applied in content and thus, they may lack the some of the basic competency skills attained in liberal arts courses that are required to excel in upper-year

Table 2. Significance (P) of the effect of various factors on final grades in two upper year agronomy courses from 2013-2015 (n=274).

Source	df	2013	2014	2015
			P value	
Gender (G)	1	**0.020**	**0.047**	**0.025**
Major (M)	3	**0.048**	**0.038**	0.178
Classification (C)	2	**0.044**	0.801	0.603
G X M	2	0.293	0.761	0.233
G X C	2	0.536	0.207	0.139
M X C	4	0.833	0.611	0.339
G X M X C	6	0.054	0.579	0.458

Table 3. Mean final grade as affect by sex, major, and classification in two upper year agronomy courses from 2013-2015, where n=274.

Factor	Level	2013	2014	2015
Sex[x]	Male	71.6 b	71.2 b	70.0 b
	Female	76.4 a	74.6 a	74.6 a
	LSD	3.5	3.1	3.2
Major[x]	BPBE[y]	83.0 a	76.2 a	78.4
	AGRN	75.2 a	74.0 a	72.3
	DIPL	68.3 b	64.7 b	68.6
	OTHER	74.4 a	78.7 a	73.3
	LSD	4.7	5.9	NS[z]
Classification[x]	Sophomore	67.5 b	66.5	69.8
	Junior	75.2 a	75.4	72.1
	Senior	78.3 a	76.0	75.0
	LSD	4.2	NS[z]	NS[z]

[x]Means followed by the same uppercase letters are not significantly different within years based on LSD *P* < 0.05

[y]Abbreviations: BPBE, Bioresource Policy, Business, and Economics; AGRN, Agronomy;

DIPL, Diploma; OTHER, Other (includes Crop Science, Soil Science, Environmental Science)

[z]NS; not significantly different

Table 4. Pearson correlation coefficients of student characteristics with final grade in two upper year agronomy courses from 2013-2015.

	2013		2014		2015	
Factor	ρ	*P*-value	ρ	*P*-value	ρ	*P*-value
Gender	0.256	**0.016**	0.130	**0.048**	0.225	**0.032**
Major[z]	0.259	**0.021**	0.180	**0.034**	0.051	0.634
Classification	0.465	**<0.001**	0.366	**0.001**	0.161	0.126

[z]Abbreviations: BPBE, Bioresource Policy, Business, and Economics; AGRN, Agronomy;

DIPL, Diploma; OTHER, Other (includes Crop Science, Soil Science, Environmental Science)

undergraduate courses. As a result, diploma students may possess lower cognitive skills compared with their undergraduate counterparts, including reduced communication skills, problem-solving, and critical thinking abilities (Brooks and Shepherd, 1990; Johnson, 1988). This may lead to lower GPAs if both types of student are enrolled in the same course and the course is taught at the undergraduate level; GPA is known to be a good predictor of student success in college courses (Nolan and Ahmadi, 2007; Vitale et al., 2010).

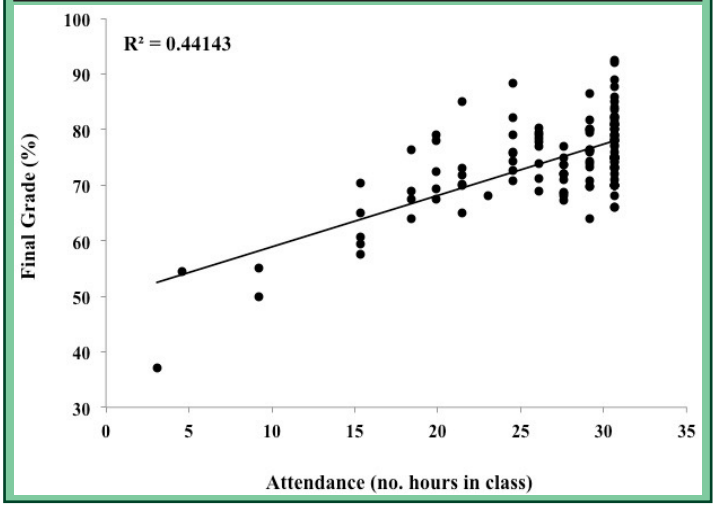
Nevertheless, the results of this study indicate that diploma students still performed at an acceptable level in undergraduate agronomy classes, despite significantly lower final grades. This suggests that combined diploma and undergraduate courses represent a feasible approach to maintaining both types of programs without the additional teaching staff that would be required if separate programs were offered. Moreover, combined courses could allow undergraduate students to attend courses aimed at diploma students, which are often applied in nature. Such courses would not likely be offered to undergraduate students for credit, but may be of significant interest to them nevertheless.

An interesting finding of this study was that the differences between BPBE students and students majoring in AGRN or OTHER were not statistically significant (Table 2). However, BPBE students did perform better than students from the other majors across both courses in all years (Table 3). Martin (1989) also found that agricultural economics students (BPBE) performed better than students from other majors in an agricultural economics class. Because BPBE students typically take agronomy courses as open or unrestricted electives, these students probably possess a genuine, unfettered interest in the course material and are intrinsically motivated, which likely contributes higher final grades in these courses (Ryan and Deci, 2000). Further research employing appropriate survey questionnaires is needed to test this idea.

Student classification by year of study influenced final grades, but was statistically significant in only one of the three years (Table 2). Sophomores had significantly lower final grades than juniors (7.7%) and seniors (10.8%) in 2013 (Table 3). Although not statistically significant (Table 2), there was a consistent trend in the data whereby sophomores always achieved lower grades than did juniors and seniors (Table 3). This may be due to the appreciable number (23%) of diploma students in the classes, most of who were sophomores. Given the aforementioned results, we can expect that these diploma students likely performed at a lower academic level than the undergraduate students and may have downwardly biased the final grades of sophomores. Nevertheless, the results of this study agree with Mousel et al. (2006), who reported that classification was a major determinant of student success in an introductory forage crops management course. Likewise, Rossano and Burk (2013) documented that sophomores were at a 7% disadvantage compared with upperclassmen in a 300-level equine management course. The current study also found a 7% disadvantage for sophomores in 2013, while disadvantages of 9.5% and 3.5% were noted in 2014 and 2015, respectively (Table 3). Pearson correlation analysis revealed a significant association between classification and final grade in 2013 and 2014 (Table 4). These results contrast with White et al. (2015), who suggested that student classification does not influence students' critical thinking abilities and may not influence student performance.

Linear regression indicated that the amount of time spent in class (AGRN 375) positively affected student performance as determined by final course grade (Figure 1). For every hour spent in class, a student's final grade was predicted to increase by 0.93%, almost a full percentage point. This suggests that class attendance is important to student success in this course, which agrees with the findings of Marburger (2001), Eash et al. (2006), McMillan et al. (2009), Lancaster and Robinson (2011) and others. It is important to note, however, that the regression only explained a moderate amount of the variance (R2 = 0.44), which was surprising and may indicate that attendance is less important than anticipated. In this course, and indeed many college courses, course notes are routinely posted online and available to students on-demand. By posting course material online, instructors may inadvertently discourage students from regularly attending classes, and it is possible that students can glean enough information from the posted material to succeed in a course. Support for this assertion comes from both the moderate R2 value in the regression equation as well as from the y-intercept in the regression equation (Figure 1), which showed that spending 0 hours in class resulted in a predicted final grade of approximately 50%. Strategies to manage this are difficult but include providing course material in class only, or providing partial online notes so that students must attend class to acquire all of the course material.

Figure 1. Relationship between final grade and class attendance (number of hours in class) in an upper year agronomy course from 2013-2015. Linear regression equation: y = 49.6x + 0.93.



Summary

This study documented several factors that collectively impact student performance in upper-year agronomy courses, including student gender, major, and to a lesser extent, student classification and class attendance. Females performed better than males, while diploma students had significantly lower final grades than undergraduate students from other majors. Sophomores had lower final grades than juniors and seniors in all three years of the study, although the differences were statistically significant in 2013 only. Final course grade improved markedly (one percentage point) with each hour a student spent in class, which indicates that students who attend class more regularly are more likely to succeed than those students who do not. Unfortunately, the factors most associated with adequate student achievement in this study are factors that neither the student nor the instructor can control (i.e. gender, major, classification). Nevertheless, these results provide course instructors with practical information that may aid them in their pursuit of student excellence in future upper-year agronomy courses. For example, students in a demographic that is expected to struggle in these courses could be monitored closely with regard to student effort and attendance, with adequate time apportioned out of class to address specific needs (Vitale et al., 2010).

Mousel et al. (2006) attributed differences in course performance between majors to differences in agricultural background, with students that lacked an agricultural background being disadvantaged. Although information regarding agricultural background was not collected in the current study, this is not anticipated to be the major factor underlying current grade differences given that diploma students, who often have substantial prior field experience, had the poorest course performance. Instead, it is more likely that the learning styles and cognitive abilities of students contributed to the differences in grade distributions observed in the current study. Future studies are required to assess the impact of prior field experiences and learning styles on student performance in these courses to determine the causes of the differences reported in this study.

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