

## STUDENT PERCEPTIONS OF PROJECT ESSAY GRADE (PEG) SOFTWARE

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### ABSTRACT

*The development of increasingly sophisticated software to grade student written work (Project Essay Grade, or PEG) has created a controversy within higher education. Proponents of this technology point to virtually instant grading and feedback as well as studies that demonstrate no significant differences in grades given by the computer and faculty. However opponents contend that this software fundamentally alters the nature of the faculty-student relationship and can have long term consequences for education. This study looked at how college students perceived the value of this technology and issues they had with it. The study surveyed 684 students at four colleges and revealed that perceptions generally fell into four components; faculty relationship issues, grade issues, technology acceptance, and ethical/fairness considerations. Grades were the most significant perceptual concern for students. ANOVA analysis further revealed that significant variables in overall perception of PEG software included the type of institution the student attended and their experiences in classes that utilized PEG software. Overall, students had a strong preference for faculty grading written work, although for several demographic groups there was considerable interest in PEGs.*

**Keywords:** Project Essay Grade (PEG) software, technology acceptance, principal component analysis, student perceptions

### INTRODUCTION

The use of computer software (called PEG for Project Essay Grade) to grade student work has become an increasingly challenging issue in higher education [7,24]. One side of the argument contends that allowing computers to assume a greater role in grading student written work provides many benefits to both the student and the instructor. Students benefit from increased response time for both grades and feedback. In many cases, an essay can be ‘graded’ and feedback provided within minutes [26]. This also allows students the opportunity to revise work in order to achieve better grades by consistently having drafts of written work graded [14,18,26]. Proponents of PEGs also contend that the grades presented by the software are statistically equivalent to those provided by actual instructors and also remove any issue of instructor bias in the grading process, thereby giving the student a more accurate assessment of his writing [10,23,25]. Supporters also point out that the use of PEGs can free faculty from hours of grading and allow them to focus more on other areas that can enhance the student experience, as well as providing additional time for other areas that faculty wish to pursue [16,17].

Opponents of the use of PEG software contend that this technology may fundamentally alter the nature of the student-teacher relationship [16,23]. One of the main ways in which faculty connect with students and learn about them is through the evaluation process, especially in regard to written work [1,3]. This may be increasingly true in regard to online courses, where contact and interaction between teachers and students is often substantially less than in a campus-based class environment [6]. This may also decrease the mentoring aspect of the student-teacher relationship. Additionally, some also contend that, while a computer may give an equivalent ‘grade’ for written work, the substantive and personal nature of faculty feedback cannot be given by a computer.

The purpose of this study was to discover perceptions that college students have regarding the use of PEGs and evaluate the influence of these perceptions on their acceptance of this technology. As PEGs continue to develop, and there have been substantial advancements in this area in recent years, universities may consider turning to them to enhance academic programs [7,15]. They can be hugely cost effective, especially in the emerging area of MOOCs (Massive Open Online Courses) and can provide students with additional resources for success. What remains to be seen is the degree to which students are willing to accept this technology, and what perceptual areas are most significant to students in regard to PEGs. Understanding which factors are important to students can benefit designers of this software, as well as helping universities and faculty with assessing whether or not to utilize this technology.

## LITERATURE REVIEW

Faculty grading of student written work has been well researched [1,28,31]. Issues in faculty grading have often included concerns over bias and fairness, turnaround time, the nature of feedback, and the amount of time and effort faculty expend on grading [8,29,31]. Recently, much research has been done on the emerging technology of computer software that can be used to grade student written work, providing both feedback and grades often in a fraction of the time that faculty takes. Called Project Essay Grade (PEG) software, several universities have adopted this technology, and it is expected to continue to grow [7,18,30]. Several studies have indicated that on issues important to students, including grades, feedback, and response time, PEGs have performed at least as well as faculty and, on the issue of response time, substantially better [10,23,25]. Several studies also contend that the use of PEGs can reduce instructor bias in assessment of written work and that students' impressions of the fairness and efficacy of instructors using this technology has actually increased [5,9,22].

Additional studies on PEGs have focused on designing algorithms that can mimic faculty responses and deliver a grading and feedback experience to a student that simulates human responses in almost seamless fashion [19,13,20,27]. The technology of PEGs has continued to develop and will invariably improve, and universities have begun to look at its impact [7,23]. A number of studies indicate that it can be a benefit to students, a time saver for faculty, and a cost saving device for universities [7,14,16,23]. However, there seems to be little research on how students perceive the value of this technology and the degree to which they are willing to accept having a non-human assess and, ultimately, grade written work. The focus of this study is to look at student perceptions about this issue.

## METHODOLOGY

### *Data Collection*

A 30 question survey was developed to measure the degree to which students were willing to accept PEG software in place of faculty grading (Appendix A). The survey consisted of 23 Likert-scaled statements/questions and 7 demographic questions. The survey was distributed at four universities; these included one medium sized private not for profit, one medium sized public university, one campus based for-profit school, and one online for-profit university. After gaining institutional approval at the subject universities, several faculty members that agreed to participate in the study passed out a paper form of the survey, along with an instructional page outlining its purpose and explaining informed consent. This was done in their classrooms, and surveys were then placed in sealed envelopes and returned to the researchers.

Data collection took place over a seven week period. All surveys were then mailed to the authors for analysis. All data from the surveys was transferred into a spreadsheet and then uploaded into SPSS for analysis. To minimize the possibility of data entry error, the process of transferring the data was done twice by different members of the research team.

### *Data Analysis*

Six hundred and eighty seven surveys were returned. After the data was transferred into a spreadsheet and uploaded into SPSS, it was checked for errors and outliers. Frequency distributions and descriptive statistics were run, and the data was analyzed, resulting in 3 surveys being eliminated from the data set. One had only 2 responses, and two others had illegible responses, making it impossible to determine their accuracy. That left 684 useable surveys. Forty-two had some missing data (usually one or two blank responses); however, they were retained for the study. The results from the survey are listed in Table 1.

**Table 1:** Survey results

<b>Type of Institution</b>	<b>Number of participants</b>	<b>Percentage of Sample</b>
private not for-profit university	241	35.2%
public not for-profit university	175	25.6%
campus based for-profit university	103	15.1%

online for-profit university	165	24.1%
Totals	684	100%

<b>Gender</b>		<b>Percentage of Sample</b>	
Male	431	63.0%	
Female	253	37.0%	
<b>Age</b>			
Age Range	18 - 54	Mean Age	20.2
<b>Academic Major</b>		<b>Percentage of Sample</b>	
Business	231	33.8%	
Education	112	16.4%	
Computer Science	89	13.0%	
Communications	65	9.5%	
Social Sciences	43	6.3%	
Engineering	71	10.4%	
Other	73	10.7%	
<b>Academic Standing</b>		<b>Percentage of Sample</b>	
Freshman	312	45.6%	
Sophomore	115	16.8%	
Junior	124	18.1%	
Senior	98	14.3%	
Graduate	35	5.1%	
<b>Have you ever taken a class that utilized computer generated grading and feedback of written material?</b>		<b>Percentage of Sample</b>	
Yes	119	17.4%	
No	345	50.4%	
Not Sure	220	32.2%	
<b>Which of the following types of courses have you taken</b>		<b>Percentage of Sample</b>	
Online only	42	6.1%	
Campus-based only	370	54.1%	
Both online and campus-based	272	39.8%	
<b>Which of the following types of courses have you mostly taken?</b>		<b>Percentage of Sample</b>	
Mostly online	85	12.4%	
Mostly campus-based	387	56.6%	
Fairly even mix of online and campus-based	212	31.0%	

Statement	Less than 24 hours	Within 1 week	1 to 2 Weeks	More than 2 weeks
How long do you think it <b>should</b> take a faculty member to grade a short (less than 10 page) essay?	60	451	110	45
How long do you think it <b>should</b> take a faculty member to grade a major (10 or more page) essay?	18	233	326	104
Statement	All instructor graded	Majority instructor	Majority computer	All computer

		<b>graded</b>	<b>graded</b>	<b>graded</b>
What would be your preference for having your own written assignments graded?	333	195	104	28

Statement	SD (1)	D (2)	A (3)	SA (4)	Mean
Timely grading and feedback of written work is important to me	21	35	332	292	3.32
Instructor's personal perceptions of a student influences how they grade their written work	69	155	267	191	2.18
Usually Instructor feedback is adequate on written work I have submitted	46	215	315	105	2.72
Instructor feedback on written work improves my future writing	109	267	248	59	2.77
I value the personal nature of instructor feedback on my written work	84	111	360	125	2.77
I am most concerned with the final grade on written work	26	120	181	355	3.27
Grading for written work is highly subjective	102	118	402	59	2.61
Computer generated grades and feedback on written work would be of equal value to an instructor's	165	375	101	41	2.03
I appreciate both positive and constructive feedback on written work	59	141	315	165	2.86
I would be accepting of a computer providing a final grade on written work	170	380	97	36	2.00
A computer program is capable of effectively evaluating and grading written work	230	290	101	61	1.99
Having faculty grade written assignment strengthens the relationship between faculty and students	42	280	310	49	2.54
Computer generated feedback is valuable in improving writing	128	215	220	117	2.48
Computer generated grades are fair	80	140	275	185	2.83
I would prefer to have my written work graded by a computer	281	265	100	35	1.84
Computer generated grades and feedback are appropriate for online courses	76	151	267	188	2.83
I would be comfortable with any written work being entirely evaluated by a computer	185	310	110	79	2.12
I would be concerned about signing up for a class in which all writing assignments were graded by a computer program	58	110	340	175	2.93
A written assignment graded by a computer would have less bias	56	240	275	109	2.63

The 20 items from the survey were subjected to principal component analysis (PCA) using SPSS Version 20. Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of several coefficients of .3 and above. The Kaiser-Meyer-Okin value was .77, exceeding the recommended value of .6 and Bartlett's Test of Sphericity reached significance, supporting the factorability of the correlation matrix [2,11,12].

Principal component analysis revealed the presence of four components with eigenvalues exceeding 1, explaining 45.8%, 18.6%, 7.3%, and 5.1% of the variance respectively. A scree test and parallel analysis were also performed and validated that four components contributed to the structure [4]. The components were faculty relationship issues (statements 3,4,5,7, and 14), grade issues (statements 6,8, and 11), technology acceptance issues (statements 10, 12,13,15,18, and 21), and ethical/fairness considerations (statements 9,16,19, and 22). Statements 17 and 20 were used as measures of overall acceptance of PEG software by students. The selection of these grouping factors was based on both discussions with students in a small focus group (11 students) and the literature on the nature of grading [1,3,5,8,29,31]. Further testing on this instrument was done to establish reliability. With short subscales (generally fewer than 10 items) reliability can be established using the inter-item correlation for the items. The

recommended optimal range for inter-item correlations is .2 to .4 [21]. Each of the four subscales was within those parameters. Demographic variables were cross tabbed with individual statements on the survey as well as grouped perception issues developed from PCA. Those that demonstrated possible relationships were subjected to further analysis.

### FINDINGS

Independent-sample t-tests were conducted to compare the four perception variables from the PCA with each of the demographic variables. Several, including gender, academic major, and age (grouped) showed no significant difference. The variable ‘Which of the following types of courses have you taken’ did reach statistical significance for students who had only taken online classes. However, the correspondingly low effect size (eta squared = .02) indicated that the magnitude of the relationship was small [21]. Two variables, ‘type of institution attended’ and ‘familiarity with PEG utilization in classes’ both reached significance ( $p < .05$ ) and had moderate or high effect sizes. These were then subjected to ANOVA testing. A one-way between-groups analysis of variance was conducted to explore the impact of ‘type of institution attended’ and levels of positive perception of PEG software relating to each of the four grouped factors (faculty relationship, grades, technology acceptance, and ethics/fairness) as measured using the survey instrument. There were statistically significant differences in perception scores for students who attended both campus-based and online for-profit universities. The effect sizes for this variable are listed in Table 2.

**Table 2:** Effect Size for ‘Type of institution attended’ and Perception factors

Perception Factor	Eta Squared	Analysis of Relationship
Faculty issues	.05	Moderate
Grades	.35	High
Technology acceptance	.28	High
Ethics/Fairness considerations	.08	Moderate

The emergence of ‘type of institution attended’ was an interesting finding. Several statements on the survey were indicative of the difference between these variables. A crosstab between type of institution attended and the question ‘I would be comfortable with any written work being entirely evaluated by a computer’ illustrates this dynamic (Table 3):

**Table 3:** Crosstab of ‘type of institution attended’ and ‘I would be comfortable with any written work being entirely evaluated by a computer’

Type of institution attended	Strongly disagree	Disagree	Agree	Strongly agree
Private not-for-profit university	44	165	19	13
Public not-for-profit university	61	90	14	10
Campus based for-profit university	28	20	36	19
Online for-profit university	52	35	41	37

Students attending the not-for-profit universities in this study either disagreed or strongly disagreed with the idea of being comfortable with the use of PEG software in 86.5% of the cases, while those attending for-profit universities either disagreed or strongly disagreed in only 50.4% of the cases. This indicated that those attending for-profit schools had a much likelier probability of accepting PEGs. Interestingly, while only 17.4% of the total sample was certain they had been exposed to PEGs, that percentage was even smaller for those that were exclusive to the for-profit schools (12.3%), which may increase the perceived value of PEGs for students that attend these types of institutions.

A one-way between-groups analysis of variance was conducted then to evaluate the impact of ‘familiarity with PEG utilization in classes’ and the four perception variables. The ANOVA tests on ‘familiarity with PEG utilization in

classes' reached statistical significance ( $p < .05$ ) for both grades and technology acceptance, and each had a high effect size (eta squared for grades = .58 and for technology acceptance = .62).

Another interesting finding was the relationship between academic standing and perceptual issues regarding PEGs. ANOVA testing compared the means for academic standing and the four perceptual factors. Statistical significance was reached for three of the four factors (grades, technology acceptance, and ethical/fairness issues) for undergraduate students. Corresponding effect sizes revealed that only grades (eta squared = .61) was a largely meaningful factor for this population. However, graduate students' perceptions were much more focused on 'faculty relationship issues'. While both grades and faculty relationship issues reached significance in ANOVA testing, only the effect size for 'faculty relationship issues' was high (eta squared = .62).

Types of courses taken also had an influence on the perceptions of PEGs. A one-way between-groups analysis of variance was conducted to explore the influence of 'types of courses taken' on each of the four perceptual factors measured by the survey instrument. There was a statistically significant difference at  $p < .05$  level in perception scores for students that were either 'online only' or 'campus-based only'. The effect size for 'online only' was moderate (eta squared = .09) and for 'campus-based only' was small (eta squared = .03).

In order to study the strength of the relationship between the four factors of perception and the willingness of students to accept PEG software, Spearman's Rho correlation coefficients were established between each of the grouped perception factors and overall acceptance of PEGs. Table 4 illustrates the relationship between these variables:

**Table 4:** Spearman's Rho Correlation Coefficients for Grouped Perception Factors and Overall Acceptance of PEGs

Factor	Spearman's Rho	Significance (2 Tailed)
Faculty relationship issues	.244	.045
Grade issues	.788	.000
Technology acceptance issues	.367	.013
Ethics/Fairness issues	.339	.004

All of the variables reached statistical significance and the correlation between grade issues and student acceptance of PEGs was strong [21]. Each of the other factors had a moderate correlation to acceptance of PEGs; however, the dominant perceptual issue for students in this area is grades. Apparently, if students are convinced that a positive grade outcome can be achieved, they are very accepting of this technology.

## DISCUSSION

The study revealed some interesting insights into the perceptions that college students have regarding the use of PEG software. The grouping of perception related issues regarding the use of PEGs proved highly interesting. The principal component analysis demonstrated the four major perceptual issues that college students consider when considering the use of PEGs in class. The emergence of grades as the primary consideration was not surprising, however, the low emphasis on faculty relationship issues (especially among undergraduates and online students) was an area that was somewhat striking. The mentoring relationship between faculty and students has long been perceived to be one of the bedrock elements of a college education, which, while almost impossible to measure, has traditionally been a source of value to both students and faculty. This study suggests that, for this population, the emphasis may be inaccurate. While it is likely that the distance of online education may contribute to that decline, it was surprising that this finding was relatively consistent for both online and campus based students.

The emergence of 'type of institution attended' was particularly striking. Students that attended for-profit institutions were more positive towards the PEG software on each perceptual dimension than students that attended not-for-profit schools. This difference was most pronounced for students that attended an online for-profit university. This group had very low scores on 'faculty relationship' issues. This may not be surprising, since the virtual environment makes establishing relationships with faculty challenging. The 'type of institution' attended has

interesting ramifications for the developers of PEG software since this study indicates that certain types of institutions (especially for-profit schools) may be more ready to have students accept PEGs than others. This insight could assist PEG developers in creating marketing strategies for this product.

Among the most important findings of this study is the relationship of grades to acceptance of PEG software. While the importance of grades to students has a long documented history [3,8], the degree to which students seemed unconcerned who or what graded their work as striking. This was especially pronounced in students who had high expectations of quick turnaround times on essay grading. Table 5 illustrates this using a crosstab analysis of students who expected 24 hour turnaround time on short (less than 10 page) essay.

**Table 5:** Crosstab of students who responded ‘less than 24 hours’ to question 1 (How long do you think it should take a faculty member to grade a short (less than 10 page) essay?) on the survey with question 17 ‘I would prefer to have my written work graded by a computer’ on the survey

	Strongly Disagree	Disagree	Agree	Strongly Agree
Less than 24 hours	4	16	18	22
All other options	277	249	82	13

Students who expected essays to be graded within 24 hours either agreed or strongly agreed with the statement ‘I would prefer to have my written work graded by a computer’ in 66.7% of the cases compared to the rest of the population which agreed or strongly agreed in only 15.3% of the cases. This indicates that for students that consider time a critical factor in grading, that PEGs may actually be considered an improvement over faculty grading.

Taken in its entirety, this study reveals a portrait of college students’ perceptions regarding PEG software in classes. There is a disparity between undergraduate and graduate students, with undergraduates strongly considering grades to be the most important factor, and they seem unconcerned whether the grade comes from a professor or a computer. Graduate students, however, seem firmly convinced that the written work they submit forms a strong basis for their relationship with faculty, which they place high value on. This can be illustrated using a crosstab of student rank (combined undergraduate) and the question ‘Having faculty grade written assignments strengthens the relationship between faculty and students’ (Table 6).

**Table 6:** Crosstab of ‘Student Rank’ and ‘Having faculty grade written assignments strengthens the relationship between faculty and students’ statement from survey

Student Demographic	Strongly Disagree	Disagree	Agree	Strongly Agree
Undergraduate	42	278	295	41
Graduate	0	2	15	18

In this crosstab, 94.3% of the graduate students either agreed or strongly agreed with this statement, indicating a very strong perception of the value of the relationship that develops between faculty and students, in regard to assessing their written work. It is not especially surprising that graduate students would place a high value on the assessment that faculty give them on written work, since such a large portion of graduate study is usually based on student research and writing. On the other hand, undergraduates only agreed or strongly agreed with this statement in 51.8% of the cases, indicating that undergraduate students are somewhat ambivalent regarding the degree to which having faculty assess their written work strengthens their relationships.

### CONCLUSIONS

While it seems that most students have an initial preference for faculty-graded work (80.0% preferred either all or majority faculty grading for written work), there were some demographic variables that had an influence on this perception. Increasing study of these factors and the influence they have on how students perceive the use of PEGs in the classroom, both online and on campus will increase the ability of producers of this software to meet the needs

of their target audience. It seems clear that technological advances will continue to occur in this field and that increasing numbers of schools will be interested in using this technology once it has been critically evaluated and student perceptions and concerns about this software are addressed. Therefore, increased understanding of perceptions of PEG software will continue to be an important issue for colleges and universities.

#### **AREAS FOR FUTURE RESEARCH**

While this study examined perceptual issues that college students considered when thinking about PEGs, another important component would be studying faculty perceptions on this issue, as well. There may be conflicting perceptions on the value of PEG software between students and faculty and a study on faculty perspectives might shed light on the differences between these two groups. It seems clear that, for this population, especially undergraduates, grades were the primary concern when perceiving the use of PEGs in classes. These students did not seem overly concerned with the mentoring and relationship aspects of their interaction with faculty, in regard to written work. A qualitative study investigating the deeper meaning of this variable might prove instructive. Another interesting area for further research was the degree to which the 'type of institution attended' influenced perception of PEGs. Further inquiry into this difference would be another interesting area of study.

Also, the instrument used to measure perceptions was an original creation of the authors. While the instrument proved valid and reliable and a relatively large population was subjected to the instrument, further use of this survey and its indexed subscales would provide additional reliability and validity data. Also, variation one the survey itself might prove valuable as well. A more expansive survey would allow for more statements to be included in each grouping. Since small subscales are often vulnerable to reliability concerns [21], additions to the survey could create an even more valid and reliable instrument.

#### **LIMITATIONS OF THE STUDY**

While the study has large or moderate amounts of data from all four 'types of institutions', it must be noted that all universities have unique and varying cultures. Even within a university, there can often be differences in perceptions and expectations between campus students and online students. The study also had a high percentage of males in the sample (63.0%) which might have some influence on the results, although gender did not reach statistical significance as a variable. This study illustrates the possible dimensions that different groups within a student population might consider when perceiving the concept of PEG software, but any definitive conclusion on this issue will need further research and rigorous examination.

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## Appendix A: Survey Instrument

Survey on Student Perception on the use of Computer Programs (PEG) that grade student written work. Please mark the circle for each question that best approximates your response to the statement. Thank you for your participation in this study.

### Survey Questions

1. How long do you think it **should** take a faculty member to grade a short (less than 10 page) essay?

Less than 24 hours      Within a Week      Within 2 Weeks      More than 2 Weeks

2. How long do you think it **should** take a faculty member to grade a major (10 or more page) essay?

Less than 24 hours          Within a Week          Within 2 Weeks          More than 2 Weeks

For the following statements, check the box that most closely approximates your opinion

1 = strongly disagree          2 = disagree          3 = agree          4 = strongly agree

- 3. Timely grading and feedback of written work is important to me
- 4. Instructor's personal perceptions of a student influences how they grade their written work
- 5. Usually Instructor feedback is adequate on written work I have submitted
- 6. Instructor feedback on written work improves my future writing
- 7. I value the personal nature of instructor feedback on my written work
- 8. I am most concerned with the final grade on written work
- 9. Grading for written work is highly subjective
- 10. Computer generated grades and feedback on written work would be of equal value to an instructor's
- 11. I appreciate both positive and constructive feedback on written work
- 12. I would be accepting of a computer providing a final grade on written work
- 13. A computer program is capable of effectively evaluating and grading written work
- 14. Having faculty grade written assignments strengthens the relationship between faculty and students
- 15. Computer generated feedback is valuable in improving writing
- 16. Computer generated grades are fair
- 17. I would prefer to have my written work graded by a computer
- 18. Computer generated grades and feedback are appropriate for online courses
- 19. Computer generated grades and feedback are appropriate for campus-based courses
- 20. I would be comfortable with any written work being entirely evaluated by a computer
- 21. I would be concerned about signing up for a class in which all writing assignments were graded by a computer program
- 22. A written assignment graded by a computer would have less bias
- 23. What would be your preference for having your own written assignments graded?

**Demographics:**

- 24. Gender    Male    Female
- 25. Age    \_\_\_\_\_
- 26. Academic major (Please circle the term that best describes your major course of study)

Business          Education          Computer Science          Communication

Social Science   Engineering          Other

27. Academic Standing

Freshman          Sophomore          Junior                  Senior                  Graduate

28. Have you ever taken a class that utilized computer generated grading of written assignments?

Yes    No

29. Which of the following types of courses have you ever taken

Online only          Campus-based only          Both online and campus-based

30. Which of the following types of courses have you mostly taken:

Mostly online          Mostly campus-based          Fairly even mix of online and campus based