



Positive Findings Regarding a New Trend in University Architecture Evaluating Student Impressions of an Innovative Academic Building

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ABSTRACT

Bryant University recently opened a spectacularly visually appealing, new building, the Academic Innovation Center (AIC). It was designed to promote innovative problem solving classroom experiences for business and liberal arts students alike with a spacious and wide open feeling. Bryant is among a group of other universities who are turning to radically different building design. Kamal (et.al.) in a lengthy white paper captures the essence of why universities are turning towards such novel architecture [1]. Students and faculty alike are enjoying the pleasure of working in such an aesthetically pleasing place. The intentions of this paper were to capture the emotions and perceptions of students regarding their impressions of the new building as it just opened, and capture perceptions on whether the new design really did effect a feeling of engagement and collaboration. Upon the opening semester, we surveyed the students that fall with a pre and post survey (September and December) regarding perceptions of engagement, collaboration, and enjoyment. We hoped that the administered survey would illustrate that the new space did indeed foster a feeling of academic success and bolster a new excitement for learning with the students. Varied statistical techniques were used to capture diverse results.

Keywords: University Architecture, Innovative Academic Buildings, Student Perceptions of Academic Architecture

INTRODUCTION

Bryant University recently opened a spectacularly visually appealing, new building, the Academic Innovation Center (AIC). It was designed to promote innovative problem solving classroom experiences for business and liberal arts students alike with a spacious and wide open feeling. Winner of numerous design awards the architectural firm hired for this project was EYP, Inc. They created a building that fosters intellectual collaboration amongst students and faculty alike. Under the direction of lead architect Kip Elliss, the building and classrooms were designed to create a welcoming space for students to congregate, study, and learn and a space that would promote ingenuity and a collaborative environment [1].

Experimenting with new classroom design initially came to the forefront in the 1970s with the concept of Open Classrooms, which did not have a positive impact on the classroom experience as educators had hoped. Michael Horn published a 2 part interview with Larry Kearns, an innovative architect who has spent years exploring the history and future of school designs. Kearns maintained in the 2015 interview that the Open Classroom model was not successful because the 'universal' space that was created for all types of learning within a school was as a space that was not created to fit any one particular activity in any specifically productive way. Also technological advances in learning were not incorporated into the classrooms. The advances we have today were of course not available then. Kearns believes that purposely designed spaces for different modes of learning can be captured into one large space that will greatly enhance the classroom design of the future. Today these new spaces can and will incorporate new and always advancing technology as well [4].

Bryant is among a group of other universities who are turning to radically different building design.

Kamal (et.al.) in a lengthy white paper captures the essence of why universities are turning towards such novel architecture. From a wide range of small liberal arts schools to large private universities, many schools see these new open and spacious buildings as 1) attracting STEM and Non-STEM students alike and 2) offering flexible classrooms for innovative teaching and technology and 3) offering 'soft spaces' for students to study and collaborate [1].

Attracting students interested in science, technology, engineering, and mathematics (STEM) is now viewed by many institutions of higher learning to be key in promoting a vibrant and successful academic community. Kamal explains that while many universities are struggling with increasing the number of students in a STEM program, a small but growing number of institutions have boosted their STEM initiatives in several ways. One ingredient to their success has included designing radically new buildings. In fact EYP has been tracking the impact of these new building designs on university campuses for about 10 years now. They maintain that the new designs can be new buildings or renovated existing ones, but all the designs that are transforming teaching methods have incorporated 5 design elements: soft spaces for informal learning, flexible laboratories, classrooms that can be re-configured with ease, glass walls putting STEM classes on display, and innovative research labs [1].

Bryant's new AIC building is bright and welcoming, and it is modeled with the 5 design elements in mind. The building has classrooms of different sizes and arrangements; all rooms can be configured to fit different teaching modes:

- 5 Flat Classrooms (called pods) - these rooms have easily moveable small tables and chairs of different styles and can be configured in several ways to facilitate teaching styles, and they have several different display screens depending on the room
- 5 Tiered Classrooms - these are amphitheater style also equipped with state of the art technology, and there are chalkboards and digital whiteboards
- 1 Innovative Forum - the main forum is very open and bright with 2 separate projectors, and it is best used in the evening hours due to the amount of natural lighting
- 23 Breakout Rooms - these rooms vary in layouts and capacities, all have display screens and varying types of comfortable furniture, but quite small [2].

The AIC was awarded the national College/University Grand Prize for outstanding design and architecture in College Planning and Management (CP&M) 17th Annual Education Design Showcase [3].

Students and faculty alike are enjoying the pleasure of working in such an aesthetically pleasing place. It is exciting to have such a transformative space on campus. The intentions of this paper are to capture the emotions and perceptions of students regarding their impressions of the new building as it just opened, and capture perceptions on whether the new design really did effect a feeling of engagement and collaboration. Upon the opening, we surveyed the students in that fall semester with a pre and post survey (September and December) regarding perceptions of engagement, collaboration, and enjoyment. While it is always gratifying to be in fresh, new, and clean environment, we hoped that the administered survey would illustrate that the new space did indeed foster a feeling of academic success and bolster a new excitement for learning with the students.

THE SURVEY AND GENERAL COMMENTS

The twice given survey had six questions that followed a Likert scale, two questions asked for open comments, and one question identified the most important features of the building. The last question inquired whether the student would prefer future courses in the AIC or not, given a particular class. The survey data was analyzed with various statistical techniques such as graphs, t-tests, and data mining decision trees to try to capture some overall viewpoints and impressions. The most interesting findings are highlighted in the Results section below.

Generally the two choices for classrooms are an amphitheater room or a pod room. The pods have several monitors around the room, moveable and comfortable furniture, a mixture of white and blackboards, and glass walls which can be used as a writing board. Rather than desks, these rooms have easily moveable (smaller) tables and chairs, which particularly facilitate group work. The sound systems and all the technology in all spaces are state of the art. Students were asked for general comments about what they liked or disliked, and they noted that certain classes performed better in one type of setting than another. For example, smaller groups felt lost in a larger amphitheater room. Also students commented that working in groups was difficult in an amphitheater setting. A few comments were made to the effect that the building needs color! Students missed the sensation that color can add; the building has all white walls and floors with a large amount of glass.

SOME STATISTICAL RESULTS

A pre-survey and post-survey were administered to capture student impressions regarding the new building in the first semester of opening. We had 462 students responding for the September survey and 317 on the December one, 711 total responses. However, all the boxplots and all of the decision tree analysis was done with missing data removed.

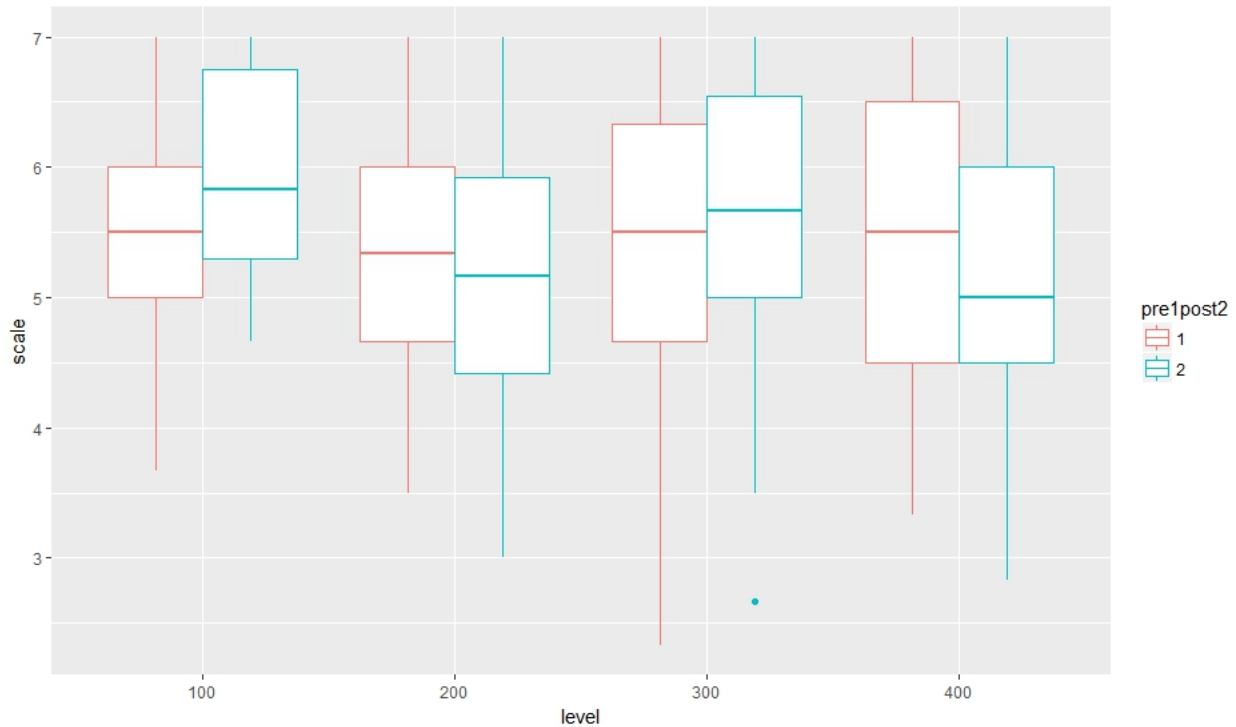
Finding 1:

Since all was anonymous, a pre/post-survey pairwise comparison was not possible. However, we took all six questions that followed the Likert scale from 1 (low rating) to 7 (high rating), averaged the responses for the pre and post-survey, and compared all 6 pre/post surveys. The smallest p-value of all 6 comparisons was $p = .15$ [$t(df = 709) = 1.43$]. Thus, after having a semester in the new building, the overall impressions of the students did not change very much. Impressions from the beginning of entering a new classroom space remained more or less the same with their impressions at the end of the semester.

Finding 2:

We then created a boxplot, Graph 1, of the overall feelings from September and again in December, divided by level of course, and all responses were at least 5 or greater, so the responses indicated that the students liked the AIC building. It appears from Graph 1 that the 200 and 300 level courses did not change their opinion very much regarding how they liked

the AIC overall from September to December. Notice though that the 100 level courses liked the AIC building more by the end of the semester, where the 400 level courses liked it less at the end of the semester. It seems that the freshmen classes were impressed, and the seniors preferred the more traditional classroom. Interesting that the seniors' impressions seem to decrease by the end of the semester, so we took a closer look.



Graph 1: Pre and Post survey regarding overall impression by class level. Variable 'pre1post2' indicates the time the survey being taken where values 1 means the survey taken at the beginning of the fall and values 2 means it is taken at the end of fall.

To see if there was a difference regarding the freshmen and senior courses as the Graph 1 suggests, we ran an ANOVA test. The results listed below in Figure 1 show that there actually is no significant difference between the two levels of classes (100 and 400) and the pre/post survey, as the graphs might suggest.

ANOVA: scale versus level, pre1post2

Factor Information

Factor	Type	Levels	Values
level	Fixed	2	100, 400
pre1post2	Fixed	2	1, 2

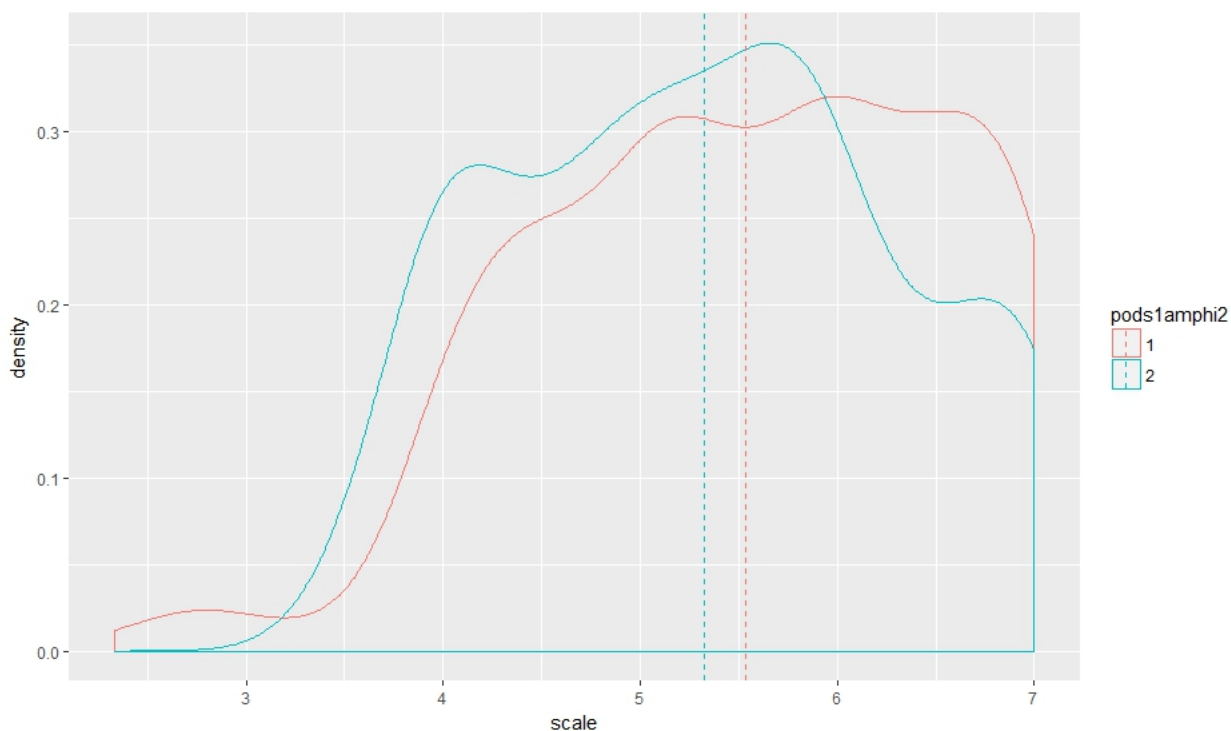
Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
level	1	1.878	1.8776	1.88	0.172
pre1post2	1	0.299	0.2986	0.30	0.585
level*pre1post2	1	1.439	1.4395	1.44	0.231
Error	170	169.506	0.9971		
Total	173	171.874			

Figure 1: ANOVA (2x2) Comparing Level of Course and Pre/Post Test Overall Impressions.

Finding 3:

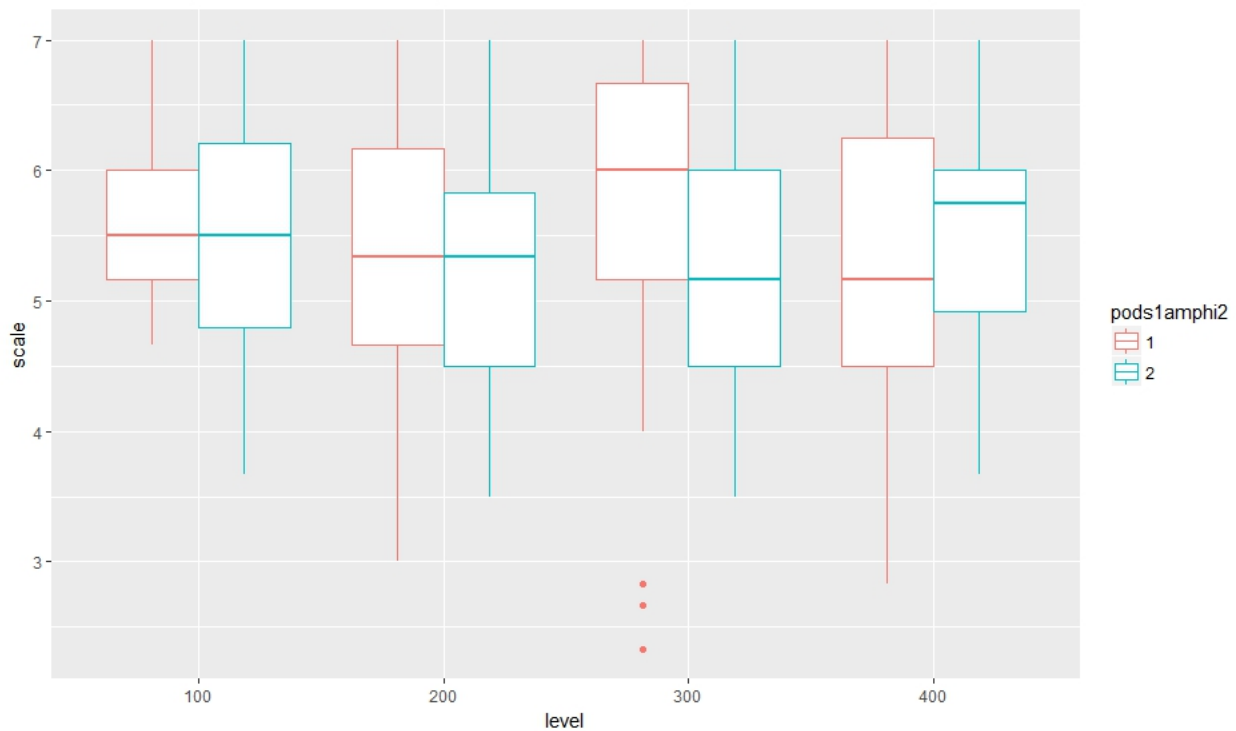
Regarding the question of whether the students prefer one type of room over the other, we looked at a descriptive histogram by grouping of pod or amphitheater. Graph 2 shows that **overall** students rated the flat room higher than the amphitheater.



Graph 2: Overall rating by students of the pod room compared to the amphitheater illustrated by density histogram. Variable '*pods1amphi2*' takes value 1 if the class is in a pod setting and value 2 if the class is in an amphitheater setting.

The vertical lines indicate the means of the two groups. We can see that there is a difference in the two means, so a t-test comparison was performed to check significance. The p-value was 0.049, just under a rating of 0.05, so the difference between the two is not highly significant. This result is shown in Table 1 below.

We then looked at how each course level ranked the two types of rooms. On Graph 3 we see 300 level courses ranking amphitheater much lower than the pod (Means 5.29 and 5.77), and the 400 level classes ranking the amphitheater setting actually a bit higher (Means 5.54 and 5.35). This may be a direct result of the type of class that juniors and seniors had in those classes. The amphitheater rooms would lend themselves to lecture style, while the pods would be better for group, collaborative classes. Freshmen and sophomore classes ranked both classrooms the same.



Graph 3: Overall Impressions of the two types of classroom, divided by level of course. Since it appears that different classes were not consistently naming the amphitheater or the pod as their first choice, we thought perhaps there was some interaction occurring between the level of course and the type of room. When we ran a Two Way ANOVA with the factors level of course and type of room, we did see that the interaction was significant with a p-value of 0.039.

ANOVA: scale versus level, pods1amphi2. There are 4 levels (100, 200, 300, 400)

Source	DF	Adj SS	Adj MS	F-Value	P-Value
level	3	3.278	1.0927	1.11	0.345
pods1amphi2	1	1.834	1.8340	1.86	0.173
level*pods1amphi2	3	8.321	2.7737	2.81	0.039
Error	553	544.923	0.9854		

When we ran ANOVA again with just the levels 300 and 400, in which we saw some difference, we see that the interaction becomes highly significant with p = .006:

ANOVA: scale versus level, pods1amphi2. There are 2 levels (300 and 400)

Factor	Type	Levels	Values
level	Fixed	2	300, 400
pods1amphi2	Fixed	2	1, 2

Source	DF	Adj SS	Adj MS	F-Value	P-Value
level	1	0.495	0.4946	0.47	0.493
pods1amphi2	1	1.489	1.4894	1.42	0.235
level*pods1amphi2	1	7.955	7.9547	7.56	0.006
Error	364	382.887	1.0519		

We then looked at some t-test comparisons regarding the question of whether the students prefer one type of room over the other. They revealed the pods, compared to the amphitheater rooms, were considered more engaging, facilitated communication with other students better, and had higher ratings across the average of the six Likert scale items (scale), as illustrated in

Table 1. Furthermore the Cronbach alpha for this scale was excellent being equal to 0.92. The rule of thumb is that this scale should be above 0.7.

	t	(df)	p	flat mean (SD)	amphitheater mean (SD)
engaging	2.108	(600)	.035	5.80 (1.10)	5.60 (1.13)
communication	4.815	(600)	< .001	5.59 (1.30)	5.08 (1.29)
Scale	1.975	(600)	.049	5.48 (1.01)	5.32 (0.97)

Table 1: T-tests Comparing Pods to Amphitheater Rooms - Variable 'scale' is the average of the all the rankings for interesting, engaging, enjoyable, ability to learn, ability to communicate with students/instructor with 7 being the highest ranking.

Although the amphitheater classroom is new and roomy, designed with very comfortable seating, the students still selected the pods for improved engagement and communication. One possible answer might be that Bryant University generally supports smaller class sizes. Small classes may feel that the amphitheater was too large. Also the pods lend themselves to group work, which is very popular pedagogy in university classrooms. In the pod, re-arrangement of the furniture is easy, and the rooms can be divided quickly into sections with plenty of writing space on the walls in each area.

Finding 4:

Continuing from Finding 3, we looked at the difference from 100 – 400 level classes on three questions regarding whether classes in the AIC were more a) interesting, b) engaging, and c) enjoyable specifically at the end of the semester on the post-survey. Surprisingly, only the question of 'more interesting' showed results with significance, with a p-value of 0.03. The next smallest p-value regarding 'engaging' and 'enjoyable' was p-value = 0.15. Table 2 shows the means for the 4 levels on the question of 'more interesting', and we see that all means are above 5.

n	Level	Mean/scale	St. Dev.
43	100	5.26	1
172	200	5.4	1.1
236	300	5.66	1.07
151	400	5.44	1.19

Table 2. Post-Survey Means: Are classes in the AIC more interesting?

Tukey comparison of means test showed that the difference between the 200 and 300 level means approached significance, but the p-value was only p-value = 0.087. The difference between those two levels was approaching significance, but certainly not highly significant. Only the Omnibus test showed significance. One may think that the comparison of 100 level to 300 level would show significance, but it does not, most likely due to the smaller sample size of the 100 level course. We also note that the mean responses on the question of 'more interesting' from all 4 levels are quite close.

Finding 5:

In the general comment section, several students maintained that they felt they could deliver presentations in a more professional way in the AIC rather than in traditional classroom settings. In one of the questions they were asked to rank the features of the new building from 1 (most important) to 4 (least important) in regard to one's ability to learn in the AIC, and the four choices were physical layout of the room, general ambience, technology, or collection of

different classes. Every level of class ranked the 'physical layout of the rooms' most important to their learning with a mean of 1.84. The next two closest rankings were 'technology' with a mean of 2.22 and 'general ambience' with a mean of 2.4. It appears that the majority of students in each level feels that the physical change of the room had some effect on their learning. This feature was ranked highest by every individual class level with 56% of the freshmen down to a low of 41% of the seniors saying physical layout of the room was most important.

Another interesting overall result was that only 8% of the freshmen classes (100 level courses) ranked technology as first compared to physical layout, general ambience, or collection of different classes as to being most important to their learning, although overall technology was ranked second with a mean of 2.22 as most important to a student's learning. Freshmen may feel that technology is now simply a part of every classroom, whether it be in a new building or not. Freshmen have been immersed in technology their entire educational lives and perhaps now are expecting new and innovative technology as a given.

Finding 6:

To get a different perspective on some of the survey questions, we ran some decision tree analysis using SAS Enterprise Miner on the full data set, and we see slightly different results. The first query that was posed was whether students overall like having classes in the AIC. At the top of the tree, 71.8% of the students said that they liked taking classes in the AIC. In the pre-survey, the data showed that 73.8% of the students preferred to register for classes in the AIC building and on the post-survey this dropped slightly to 68%, giving the overall average of 71.8%.

At the bottom of the tree, following the branch of the post-survey responses and the 100 level classes, 100% of the responses said that they liked having classes in the AIC (n = 32). Thus 100% of the freshmen at the end of the semester said that they prefer the AIC. On the pre-survey branch of the tree, 80.5% of the students who took the level of 100 – 300 level classes in the pods, liked classes in the AIC. On that same branch, if a student was in an amphitheater room, 70.6% of those students liked the AIC. With different algorithms we capture slightly different results from other Findings, but it is good to examine different statistical methods. A different algorithm can highlight different results. Now we are seeing some results that state the amphitheater classrooms are well liked.

Decision trees identified that 63.5% of the students felt overall it was easier to communicate with the instructor in the AIC, and that percentage increased to 71% if the class was a 200 level class in an amphitheater room. Another interesting result, as the boxplots showed that overall the 200 level courses ranked the pod and the amphitheater rooms equally the same. Also if the class was a 100 or 300 level course and the class was in a pod, the percentage increased to 77%. Thus the percentage is still the highest in the pod classroom, regarding whether students felt the communication with the instructor was improved. The pod classrooms are still identified as the better of the two types.

Decision trees were also used to examine the question of whether classes are more interesting in the AIC. Overall, 80% of the respondents noted that classes were more interesting in the AIC, and that percentage increased to 87.5% for the Honor students. 92% of the freshmen courses identified the course as more interesting, if it was taught in a pod. This concurs with previous results (Finding 3 and 4).

Also, regarding the physical layout of the room, using decision trees 43% of all responses said that they would select the physical layout of the classrooms as the most important feature as a reason for learning. However, 53% of the freshmen identified the physical layout as important, if the class was in a pod, which supports the 56% in Finding 5 as mentioned above.

CONCLUDING REMARKS

The statistical analysis of this paper was intended to capture the feelings and impressions of students who were taking classes in a new, innovative building for the first time. Bryant and other universities have made the decision to invest in radically different classroom building design. Bryant's new building has only been open for one academic year, but student impressions are important. Different statistical techniques were used to evaluate the findings in hopes of uncovering some nuances. Having class or working in a new, clean building is always pleasant, but we hoped to discover some interesting points of engagement in the classroom experience.

Overall the students responded that they did like the AIC, as particularly noted in the decision tree analysis. 80% of all the classes felt the classes were more interesting, and that statistics grew to be 87.5% if the branch identified Honor students. Furthermore, 92% of the freshmen felt the classes were more interesting, if the class was held in a pod classroom. In fact several varied results illustrated that the pod was the favored classroom style. Freshmen particularly enjoyed the experience of the new building, which would be a new experience for most of them, just coming out of high school.

Other trees illustrated that 43% of the students felt the physical layout of the classrooms improved learning, and that percentage grew to 53% if the branch was freshmen who had classes in a pod. Results with several different statistical techniques and questions highlighted that the pod style was clearly the favorite classroom type.

Bryant has built its reputation on smaller classroom environments. Perhaps because of smaller classes, the students usually identified the pods to be more to their liking than an amphitheater room. The amphitheater rooms are really designed for larger classes with a lecture style approach. Under Finding 3, the students overall gave the pods a higher ranking, but they also identified those classrooms to be more engaging and facilitate better communication with other students, and the comparisons were statistically significant. Furthermore, because the pods are easily changeable and adaptable to different set up designs, those rooms are particularly comfortable for group work.

FUTURE RESEARCH

This is a first look at impressions regarding an innovative learning environment. Similar studies conducted in a longitudinal manner could help identify true comparisons of this new building to traditional classrooms. It would be interesting to have information on what type of class and teaching style was used in the classes to see if that made a difference on any outcomes of impressions.

In fact, a similar pre/post survey was given to faculty members who taught in the AIC during this same period, but the sample size was very small. Capturing the faculty impressions in future surveys would be particularly helpful, especially if we could identify the teaching style of each professor and each particular class.

The ANOVAs that were done were all Between Subject design. It would be interesting to construct a Within Subject design to examine any differences. It would also be good to identify

professors who taught two sections of the same class, where one class was in the AIC and the other was in some of the older, traditional classrooms in other buildings.

Finally, since many classes at Bryant are pedagogically set up with team-based learning, and since pods seem to be the classroom that most students prefer, a hypothesis to be tested in the future might be to see whether the interactive design of the pods, facilitates introverts' engagement in team-based learning to a greater extent than the traditional classroom. It has been previously noted by Persky et. al (2015) that introverts have lower preference for team-based learning than other students [5]. Might the new pod style classroom have an effect on engagement and communication to a student, who has a personality on the quiet side?

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