AC 2012-3188: THE DIGITAL CARNIVAL: OBSERVATIONS ON THE ROLE OF GAMING IN STUDENT LIFE AND COMPUTER SCIENCE

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The Digital Carnival: Leveraging Gaming for Recruiting and Retention in Computer Science

1 Introduction

As computer technology becomes an ever more integral part of modern society, software development has become one of the fastest growing segments in the United States economy. The Bureau of Labor Statistics estimates growth rates upwards of 30% in software development in the next ten years [1]; a recent report from the Georgetown University Center on Education and the Workforce predicts that a whopping 51% of STEM occupations will be computer-related occupations by 2018 [2], [3]. At the same time, there has been a general downward trend in computer science enrollments since 2000 [4], and retention in CS1 courses nationwide has stubbornly hovered between 35% and 50% nationally [4]. Clearly, a focused effort to understand student motivations in considering computer science as a profession, and leveraging these motivations to attract and retain computer science students is needed if U.S. universities hope to be successful in meeting the nation’s future workforce needs.

Video games represent a huge shared experience for many students who have otherwise diverse educational interests and aspirations. Video games are also a common entry point for students interested in Computer Science (CS): several student population studies have shown that, on average, male CS students cite an interest in developing and understanding video games as one the primary reasons they enter the discipline [5], [6].

Realizing that gaming could play an important part of retention and recruitment efforts for both our college and the Computer Science program, we began working with our ACM student chapter to develop a series of gaming-oriented events we call "Digital Carnivals". Over the past five years, these events have been supported by the Computer Science program, the Student Union Network, the office of Student Life, and three retention and recruitment grants awarded by Northern Arizona University (NAU). These events have become an important recruitment tool for our computer science program, attracting the attention of computer-savvy students from across campus. The fact that these events are planned and executed by the ACM club (i.e., students themselves) has made the carnivals a strong retention mechanism as well: as students participate in the events they get to know other students in our program, creating formative and mutually-supportive friendships that create a support structure that helps students succeed in our program.

In this paper we will describe the funding, design, and evolution of the Digital Carnival concept, and reflect on the surveys and participation data collected over the five years since launching the...
Digital Carnival initiative. The results show that gaming represents a unique crosscut of the student population and that these students are not well served by other extracurricular activities. This suggests that gaming can be an important part of student socialization, which can be critical in student retention efforts [7]. More generally, we argue that “discipline-centric social activities” like the Digital Carnival series can be used not only in computer science, but also in other engineering disciplines to create a more robust learning community and aid recruitment and retention.

2 Motivation and Background

In 2006, the Computer Science faculty at NAU embarked on a comprehensive retention initiative centered around building a strong “learning community” for computer science undergraduates. This was motivated by years of stubbornly high attrition in the lower division despite a lengthy series of curricular revisions, as well as increasing evidence that social connections are a critical element in retaining undergraduates [7]. As a central vehicle for this initiative, we began by “rebooting” our local ACM chapter, which had languished for years, with minimal student participation. We provided a room dedicated to ACM club activities, and provided departmental funds for a variety of ACM events. The ACM club then consistently advertised in introductory computer science courses, with regular recruiting visits by seed members. Participation in ACM grew from a low of perhaps 3% of CS majors to around 45% in the first year. Our feeling is that a vibrant computing-centered student organization provides a conduit for students to become more active in both departmental and professional activities, while also providing the strong social network that is so critical for retention.

We began our redesign of the ACM club by surveying CS students, asking why they had chosen to forego active membership in the ACM club. Results showed that students overwhelmingly felt that the ACM club brought no value for them: simply going to meetings for the sake of meetings was seen as pointless. This makes perfect sense: in a world of competing priorities, students are naturally going to choose those that bring clear benefit for time invested. We used these insights to restructure the ACM club around three value-added activities:

1. **Learning new technologies.** We instituted a “Demo and Movie” theme for meetings, in which a more advanced student would offer a 15-minute “flash introduction” to a new technology (e.g. Android programming, security basics, etc.), followed by a short demo of that technology. After some discussion, pizza would arrive and a (technology-themed) movie would be shown. This activity provides a socially-supported mechanism for keeping up with new developments in the field.

2. **Learning about the profession.** Less frequently, meetings would center around an invited speaker, usually a practicing software engineer, who would be persuaded to come and speak to ACM members of the nature of his or her work, training required, and retrospective analysis of the value of key coursework taken during undergraduate studies. Again, snacks and discussion followed.

3. **Connecting to others on campus.** We encouraged the ACM club to consider engaging in outreach activities that might draw in other students from across our campus; one early suggestion was that the ACM should host “LAN parties.” A LAN (Local Area Network) party is an event where people bring their personal computers to a central location, where they form a small, dedicated local network for the purpose of playing multi-player games.
The first two of these concepts were enthusiastically embraced by the ACM membership, and have become a cornerstone of ACM activities to this day. The LAN parties were modestly successful, but did not effectively meet our goal of broadly increasing social connectivity among CS majors and increasing the visibility of computer science across campus. In practice, attendance at LAN parties was modest and highly selective. Only those who (a) had a gaming PC and (b) were willing to transport their setup across campus became involved. This left us with a small population of the most dedicated gamers where (a) most were male, with (b) an almost exclusive focus on “first-person shooter” games, and (c) a strong focus on highly-competitive “last man standing” tournaments. The consequence of this dynamic was that, while everyone on campus was invited in theory, in practice, a small hard-core group of males participated; the appeal and “entry threshold” was simply too restrictive. Not only did the LAN party concept fail to involve more computer science students in a relaxed techno-social activity, it actually increased the insularity of the few participants.

These observations led us to start again, and re-envision the concept of the LAN party. We began with the name: rather than calling it a “LAN party”, or even a “computer gaming competition”, we re-cast it as a “Digital Carnival”, aiming to portray it as a light-hearted, festive celebration of all things fun and computational. We envisioned an event where a broad variety of students could come and play a variety of games, perhaps including third-person shooters but also explicitly including more casual party games. We also envisioned it as a venue for exhibiting digital and computing inspired artifacts, like animation, movies, or even cosplay. The new concept was explicitly centered around three central goals for these events:

1. **Raise the positive visibility** of Computer Science on campus. Computer science students offer suffer from the image being nerdy, boring, or anti-social. By hosting and running a fun, campus-wide event, they would gain positive exposure and strengthen self-esteem with respect to their on-campus image.

2. **Attract new CS students.** Experience has shown that there are many potentially great CS majors lurking, for one reason or another, in disciplines like physics and mathematics; other simply know nothing about what computer science is really about. Bringing them to an event where they can interact socially with computer science students and faculty might help them find their way into the software profession.

3. **Retain existing CS students.** By providing a fun, “general audience” event that is as much a spectator sport as a place to play, we hoped to engage students (from CS and elsewhere) that were not necessarily gamers at all, but just wanted a fun “arcade atmosphere” to meet and interact with friends.

The Digital Carnival concept has proven itself to be excellent, meeting all of the goals above; it has become one of the most popular activities hosted by the ACM club, easily creating the commitment and enthusiasm among the ACM membership needed to organize these events. The club organizes, on average, about two Digital Carnivals per semester, generating an attendance ranging between 50 and 80 students.
3 Design, Funding, and Evolution of the Digital Carnival Concept

Despite its current success, the Digital Carnival concept has had a number of growing pains, evolving over time from the first offering, as we incrementally encountered problems and worked toward a formula for success. In the following sections, we highlight the successive milestones (“versions”) of the Digital Carnival over time, focusing on challenges and solutions developed, with an eye towards distilling out planning tips and best practices for those interested in implementing a similar event.

3.1 Digital Carnival 1.0 – An Exercise in Over-Engineering

As we planned our first Digital Carnival in fall of 2006, we were fortunate to have an extremely motivated group of students in the ACM. We began the semester with weekly ACM meetings dedicated to developing the concept, with the aim of offering the first Digital Carnival event by semester’s end. Three problems quickly emerged as key issues: how to manage hardware, how to structure the event, and how to make the event financially viable.

The first problem centered around acquiring the hardware – gaming computers/consoles, controllers, LAN switches, and TV monitors – that we would need for the event. It was clear from the start that the ACM club (or any organization) could never realistically expect to provide all the hardware needed; the sheer number of games to support and the need to continually purchase updated gaming consoles over the years would make this approach financially prohibitive. As this early stage of the initiative, we had minimal hardware to offer: the department was able to provide some LAN switches and cabling to connect gaming systems together. The first carnival, therefore, was designed as a “Bring Your Own Computer/Console” (BYOC) affair. We encouraged students to bring consoles, computers, and TVs to one of the large engineering building lecture halls on a Friday evening. This was not only awkward, but raised an important concern that becomes relevant anytime participants are encouraged to bring large amounts of personal gear: how to keep track of all the personal gear. Participants donating personal gear must be assured that none of this gear is stolen, and that they leave with the same units they came with.

In response, the ACM club designed an inventory tracking system, which worked by tagging hardware with initialed numbered stickers as participants entered the meeting hall. When students left the play area later, an ACM student stationed at the door checked that they left with items marked with the same stickers, matching each item with a number and description maintained in an Excel spreadsheet. In a subsequent carnival, this system was improved by adding a magnetic strip reader to swipe student cards, clearly linking individuals to hardware. Even with this improvement, however, keeping track of what comes in and comes out always...
took a lot of time and was a huge bottleneck. Early Digital Carnivals were characterized by long lines of people holding TVs, Xboxes, and Wiis while waiting to be checked in.

The second problem we identified was how to structure the overall nature of the carnival. Given our commitment to characterizing it as carnival rather than a competition we began by just conceptualizing it as an “arcade” of running games, perhaps with friendly competitions sporadically forming at various games. We found, however, that this made it too casual, discouraging participation by serious gamers, who would otherwise have a legitimate role to play as teachers and role models. It also didn’t work for casual gamers who, after some period of practice, would like to put their new skills to the test. Thus, we settled on a structure based on casual “carnival play” during the early evening, leading up to a “main event” tournament centered on just one of the games near the end of the evening. This way there was something for everyone.

Our first carnivals had cash prizes for the competitive games so, to be fair, we needed to work out brackets, rules, and time limits so that the audience could clearly see who was winning at any given moment…and so we could award a winner immediately at the end of the carnival. Being computer scientists, our ACM members saw this as a software problem and responded by writing a sophisticated program to manage competition brackets and scoring, as well as an elaborate on-line preregistration system. Nonetheless, human judges remained important to monitor the events, verify the scores, and input the data.

The third problem we identified centered around finding a viable financial model for the Digital Carnival or, better yet, finding a way to turn the Digital Carnival into a fund-raising mechanism for the ACM club. In our initial offerings, we charged a $5 entry fee for participants, and ACM members set up a table to sell snacks during the event. This turned out to be a failure: even the $5 entry fee was seen as a barrier to participation by many and, in the end, the funds collected through entry fees and snack sales were barely enough to cover the prizes. The University would later inform the ACM club that they couldn’t sell snacks at their events, as it violated the exclusive contract with campus food vendors; this put the final nail in the coffin of the ACM club’s money-making dreams.

Ultimately, the first few Digital Carnivals involved a steep learning curve and learning some hard realities. Some of the lessons we learned included:

- Keeping an inventory of student gaming gear takes too much time and effort. A better model is to simply minimize the gear students bring to the point where it can be easily tracked.
• Having students carry TVs across campus is probably a liability. Small TVs are fine, but not suitable for gaming. Large TVs are simply too awkward and dangerous to transport.
• Using software to keep track of game scoring was just too heavy weight. Where competitions are desired, scoring should be simplified as a simple win-lose bracket system than can be maintained on the whiteboard.
• The concept of carnivals as a fund-raiser is not realistic, at least at our university. Rather, one should see them as recruiting and retention events, and support them accordingly.
• Dealing with money for prizes and trying to raise this money through entry fees simply isn’t worth it. Students will play just as hard and enthusiastically – and maybe have more fun – just for the prestige of winning the brackets. Small gag gifts for winning make this even more relaxed; one year the winner received an outdated programming languages text from the 60s.

After a series of over-designed carnivals with an exhausting amount of invested effort, we would best summarize what we learned with the classical design principle: keep it simple, stupid.

3.2 Digital Carnival 2.0 – Keeping It Simple
After hosting several Digital Carnivals using the 1.0 model, we quickly realized that, for us to keep hosting these, we had to make them lighter weight. One way we could eliminate the inventory problem was to provide the core equipment on-site. In exploring funding sources for such purchases, we discovered that NAU had a grant program for improving student recruitment and retention, which made awards of a few thousand dollars to clubs and organizations seeking to explore innovative ideas. In 2007, faculty assisted the ACM club in writing a grant proposal to purchase four large LCD TVs, upgraded networking gear, cameras for streaming the events live, and other equipment that would be used to support and enhance the Digital Carnival series. In retrospect, acquiring the TVs was probably the most important asset for the long-term viability of the series; from then on, organizers and select participants merely had to bring their games and consoles - items which could easily fit in a student’s backpack.

Pursuing the grant also motivated us to think more serious about the goals of the Digital Carnival initiative, and about evaluating the success of the program. As part of the grant application process, we were asked to explicitly lists the goals, impacts, measurable outcomes, provide an assessment plan, and outline the plan for long-term viability of the initiative. This mandate led to the series of surveys of Digital Carnival participants that ultimately provided the basis for the
analysis presented in Section 4. Surveys were initially distributed by hand at the events; this was later augmented with online surveys for those participants providing their email addresses.

Based on the positive results of our first grant, we were ultimately successful in securing two additional grants in 2008 that were used to purchase further TVs and hardware for the Digital Carnival events. As noted earlier, we have purposefully avoided entering the never-ending cycle of purchasing gaming consoles and games. Students seem quite willing to bring their own equipment once the need to bring the TV was removed; minimizing the personal equipment also obviated the overhead of checking and tracking personal property.

Another major change in the maturing Digital Carnival series was the increasingly relaxed notion of competitions. Rather than formal, bracketed tournaments with substantial prizes, the competitions have evolved into somewhat ad hoc affairs with relaxed rules. We found that this model encourages substantially broader participation, much in the same way a conga line is more likely to draw in bystanders than a formal dance competition. The emphasis now is solidly on participation and social activities. This resulted in a much more vibrant, interactive character to the meeting, which in turn has resulted in much broader attendance. The most recent Digital Carnivals have emphasized casual and party games almost exclusively over competitive first-person shooters.

Under the new, lightweight model we have adopted for recent Digital Carnival events, the technical challenges and logistic overhead of organizing the tournament have been tremendously reduced. As it stands, the work of putting on a Digital Carnival is delegated to a committee within the ACM club that assigns members the following tasks:

1. Advertising (via email, Facebook, flyers, posters, etc.)
2. Managing surveys
3. Organizing the equipment and games that will played
4. Organizing food for the event
5. Organizing music, video and animation for the event (sometimes a DJ)

Note that there are almost no difficult logistic or time-consuming technical challenges in the above list. In addition, the infrastructure associated with these tasks (e.g. the flyer and poster templates, the survey templates, the catering request forms, etc.) can be re-used again and again. It is this efficient, lightweight nature, more than anything that has allowed the Digital Carnival to sustain and flourish beyond the exciting first years. Simply the involvement of both old and newer members, along with a little generational mentorship, is all that it has taken to pass the task of running the Digital Carnival on to new members year after year.

3.3 Funding Sources
When we launched the Digital Carnival concept, a major focus in our discussions was on minimizing the costs. After all, who would be interested in paying for students to play video games? As it turns out, there are many potential sources; one of the most important lessons we learned in developing the Digital Carnival series is that there is money out there to support this kind of retention and recruitment effort.
As mentioned earlier, the most important funding source we took advantage of was a university retention and recruitment grant program, which we used to purchase the large televisions and hardware that form the core equipment for the program. Diligent exploration of other campus programs and entities also yielded further funds. For instance, we have been successful in partnering with NAU Entertainment, the program supported by student fees that is responsible for providing interesting on-campus activities for students; here, the ACM club applied for and received support for advertising, free access to space in the student unions, and free drinks and snacks for the larger events.

To cover the mundane costs associated with running individual Digital Carnival events, we’ve also explored a “sponsorship” model, in which a particular event is “brought to you by” a particular campus entity. For instance, University Life, the administrative entity responsible for campus activities overall, has sponsored a special Welcome Week Digital Carnival; individual departments, including Computer Science, Electrical Engineering, and Physics have supported specific events. The Office of NAU Student Life, the umbrella group for all NAU student organizations, has also been receptive to small proposals for supporting individual events.

Finally, we have also had good success with local bookstores and businesses providing prizes for our carnivals in exchange for a well-placed banner or mention of the business during the event. When the local Microsoft evangelist came to speak to our ACM club, the students hit him up for “swag” to use as prizes as well!

The important lesson to draw from these observations is that, if you explicitly work to structure and characterize your event as a generally attractive student activity, and particularly as one designed to support recruitment and retention, there may be substantial financial support available on your campus. We summarize our best practices for funding such events as follows:

- Structure your event to serve as a general access activity to include a broad range of participants. This broadens the constituent base while at the same time raising the profile of your discipline and students on campus.
- Avoid substantial prizes. Cash prizes in particular raise the cost of the event, ultimately requiring an entry fee. This, in turn, ruins the casual, low-commitment participatory model that is key to the broad success of the event.
- Keep costs low: aside from purchasing core hardware, costs should be limited to advertising expenses and not much more.
- Focus sponsorship on individual Digital Carnival events. To add snacks, prizes, and other extras to individual events, seek out sponsors for specific events around campus.

In sum, funding should be no obstacle to developing a Digital Carnival series, provided the events are efficiently designed and strategically marketed around campus.

4 Evaluation
As mention earlier, surveys were developed early on and deployed at almost every Digital Carnival to help improve future events, as well as to gather demographic information and data to assess how well the Digital Carnival serves as a recruitment and retention tool.
In the five years that the Digital Carnival series has been in existence, we have gathered survey results from upwards of 500 survey participants. The survey questions we have used have changed and evolved somewhat over time, so our goal here is not to present a rigorous statistical analysis, but rather briefly highlight some of the most interesting statistical observations.

From surveys where we collected gender information, we found that participants were overwhelmingly male (84%, see Figure 5). While all the events show some gender disparity, it was most pronounced at events that we held at the engineering building and advertised more locally. Obviously, this is due to a certain self-selection that happens in this scenario; more diversity both in gender and academic major was apparent in events held at the Student Union. This clearly suggests that central, high-visible locales like the student union are desirable to support the “campus visibility” and “non-CS networking” goals of the initiative.

An analysis of the academic level of Digital Carnival participants reveals another interesting trend: there are more freshmen and seniors involved than sophomores and juniors (Figure 6). One actually would expect mostly freshman to be involved, under the assumption that they are seeking out clubs and activities to get involved in; this should then taper off, as students move to the upper division and cull and more carefully select their activities as their academic load.
increases. In fact, we believe that this is to be generally true; the large degree of senior representation is likely due to many of the ACM organizers being seniors, as well as the conflation of 4th year (true seniors) with 5th and 6th year students within this category.

Figures 7 and 8 may illustrate the most telling justification for the Digital Carnival series: students are overwhelmingly located on-campus and are not very involved in other student activities. This indicates that video gaming appeals to many students not well-served by other activities and therefore lack strong social networks. It is precisely such students who are “at risk” from a retention perspective, and so we view the Digital Carnival series as a unique and important part of the student support mechanisms available on campus. In many cases, students come to the Digital Carnival and then get interested in the ACM student club, thereby tapping into a strong social safety net that supports friendships and camaraderie.

5 Conclusion
Despite the skyrocketing market for talented computer scientists, enrollments and success rates in computer science education have remained stagnant or have declined in the last decade. After a decade of attempting to remedy this stubborn problem through curricular reorganization and improvements, our department has focused on providing a more supportive learning community and strengthened social networks for computer science majors. This initiative was driven by a simple but profound observation: as personal computing has become ever cheaper, computer science students spend ever less time in the lab, interacting with and learning from their peers, and more time at home at their own computer, working in isolation. There is no way that clever curricular reorganization or adding free tutoring can replace the mutually-supportive effect of studying, programming, and playing together with peers.

In many ways, our ACM club, with its dedicated room (gained, ironically, by removing a cobwebbed computer lab) has become an effective replacement for the vibrant scene in the computer labs of bygone days, with students meeting, discussing, and working on their assignments in a joint space. In this paper, we have focused our discussion on the Digital Carnival series, a gaming-centered event that has become one of several cornerstones of the ACM club’s activities. Although organized gaming events are not uncommon in computer science departments, the Digital Carnival series was specifically designed to encourage student contact and the building of social networks spanning a maximally broad population. Whereas typical “LAN parties” have very exclusive dynamics, further isolating a small group of specialized participants, the Digital Carnival concept is broadly inclusive. Not only does it reach out to computer science students only casually or peripherally interested in gaming, strategic advertising exposure can extend this outreach across the entire campus, allowing the computer
science students hosting the events to become visible in a positive way on campus, and potentially attracting new converts to the discipline.

Our goal in this paper has been to describe both the philosophy and motivation behind the Digital Carnival concept, as well as highlighting some of the misconceptions and pitfalls that hampered our early offerings of Digital Carnival events. By distilling these insights into a set of best practices, we hope to encourage others to try similar “discipline-focused social networking” events to create more robust and mutually-supportive learning communities in computer science and engineering departments nationwide.

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Bibliography