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Demographics of undergraduates studying games in the United States: a comparison of computer science students and the general population

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Population**

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Demographics of undergraduates studying games in the United States: A comparison of Computer Science students and the General Population

Our study gathered data to serve as a benchmark of demographics of undergraduate students in game degree programs. Due to the high number of programs that are cross-disciplinary with computer science programs or that are housed in computer science departments, the data is presented in comparison with both data from computing students (where available) as well as the US population. Participants included students studying games at four nationally recognized post-secondary institutions. The results of the study indicate that there is no significant difference between the ratio of men to women studying in computing programs or in game degree programs, with women being severely underrepresented in both. Women, blacks, Hispanics/Latinos, and heterosexuals are underrepresented compared to the U.S. population. Those with moderate and conservative political views and with religious affiliations are underrepresented in the game student population. Participants agree that workforce diversity is important and that their programs are adequately diverse, but only one-half of the participants indicated that diversity has been discussed in any of their courses.

Keywords: games, demographics, undergraduate students, curriculum

Subject classification codes: K.3.2 (Computer and Information System Education), K.8.0 (General)

Introduction

Game degree programs at post-secondary institutions in the United States recent hit an all-time high, and many of these programs have sprung from Departments of Computer Science, primarily due to the software development aspects of both (Entertainment Software Association, 2012). Among computing students, student demographics have been carefully monitored, with the Computing Research Association's Taulbee Survey serving as a benchmark for diversity among both undergraduate and graduate students studying computing (Computing Research Association, 2012). To date, there has been some speculation as to the types of students who pursue degrees in games, though no empirical evidence that could be generalized (Bayliss and Bierre, 2008).

There has also been a history of monitoring demographics in both the game industry and computing industry due to the importance of diversity. The International Game Developers Association (IGDA) has previously recognized the lack of diversity within the game industry. In November 2011, the IGDA implemented its second survey on diversity in the industry to establish a benchmark on issues of diversity (IGDA, 2011). The survey explicitly states that "... we all make an effort to acknowledge, understand, accept, value and celebrate differences among our members with respect to age, class, ethnicity, gender, physical ability, race, sexual orientation and spiritual practice" (IGDA, 2011, page 1). This follows their 2005 study of industry demographics, where they found that the typical game development professional is "white, male, heterosexual, not disabled, [...]" and agrees that workforce diversity is important to the future success of the game industry" (IGDA, 2005, pp. 9-10). Likewise, the U.S. Equal Employment Opportunity Commission and the 2012 Science and Engineering (S&E) Indicators continue to monitor workforce diversity in these areas and multiple studies on the representation of groups and subgroups have been conducted (S&E Indicators, 2012; United States Equal Employment Opportunity Commission, 2009).

Similar to the Taulbee study, and in an effort to gain insight into the next generation of game developers, our study gathered data to serve as a benchmark of demographics of undergraduate students in game degree programs. The over-arching research questions posed for this study include:

- What are the characteristics of undergraduate students currently studying games?
- How do the characteristics of undergraduate students studying games compare to the characteristics of students studying computer science and the general U.S. population?

This study creates a benchmark of the demographics of undergraduate students in game degree programs. The data collected will be important for those in the game industry concerned about diversity in the workforce, for academics and other researchers seeking to improve recruiting and retention efforts, and for others, including those who may be considering a career in the game industry.

Background

This section provides a discussion of the growth of games in academia, and demographics, including diversity, in the game industry.

Growth of Game Studies in Academia

Even though video games have been part of popular culture since the 1970s, it has only been more recently that they have become a more largely recognized academic pursuit. In the last few years, universities have begun to offer degrees in game design and development, curriculum framework have been created, and rankings of these degree programs exist.

The first game design degree curriculum document was created by the IGDA (IGDA) in 2003 with an update in 2008 (IGDA Curriculum, 2003; IGDA Curriculum, 2008). While it is unclear how much this document has influenced the process of the creation of game degree curriculums around the world (McGill, 2012), it is the case that a published curriculum document is available for those interested to look at. The IGDA also provides a place for institutions to place sample course syllabi on their website for other institutions to use for reference, including degree requirements documents (IGDA Wiki Category: Courses, 2012).

Since 2009, the Princeton Review, long recognized for its rankings of postsecondary institutions in the U.S., undertook a systematic study of game degree programs. At that time, the Review noted that there were 500 institutions offering such programs and the 2010 report recognized 50 schools. The top 8 schools were ranked (1-8) and the remaining 42 were recognized alphabetically (Princeton Review, 2010). In the 2011 report, the list was expanded and separated into the top 10 graduate and top 10 undergraduate degree programs. Five honorable mentions were also given for each type of program (Enhanced Online News, 2011). In the 2012 ranking, the top 10 undergraduate and graduate programs were once again recognized, with 22 honorable mentions at the undergraduate level and 8 at the graduate level (Princeton Review, 2012).

It should be noted that many of the 500 schools mentioned above do not offer full game degree programs. A study conducted in 2009 found only 20 institutions offering full game degree programs (McGill 2012), and it is implausible that over 400

degree programs would have been produced in a single year. The difference can be explained by the number of programs that offer isolated courses as an extension of other computing degrees. The Princeton Review considers all institutions that offer gaming coursework (Princeton Review, 2010), and the other studies consider only institutions that offer full game degree (McGill, 2012). Regardless of the method by which gaming programs are tallied, it is clear from the inclusion of gaming programs in the Princeton Review that interest in such programs at the university level is growing.

Diversity in the Computer Science and Game Fields

A lack of diversity is an on-going problem in the science and engineering (S&E) workforce. The 2012 S&E Indicators report states that women remain underrepresented, constituting only 38% of the S&E field in 2008, and most minorities make up a smaller share of the S&E workforce than their numbers in the population. Hispanics, blacks, and American Indians/Alaska Natives are 9% of the S&E workforce but 26% of the U.S. population aged 20-70. By contrast Asians work in S&E occupations at higher rates than their representation in the U.S. population, constituting 17% of the S&E workforce but only 5% of the working age population. The same report states that the situation is more pronounced for some groups in the computer science and mathematics field. Women make up 25% of computer and information scientists, and from 1993 to 2008 women's share of computer and mathematical scientists dropped from 31% to 26%. Asians are strongly concentrated in the computer and mathematical sciences, constituting 24.7% of the workforce.

Diversity in the game industry is an even larger issue than in the computer science field. In 2005 the IGDA conducted a study of industry demographics, and since our study was based on the 2005 IGDA survey, a more careful examination of their results is worthwhile. The IGDA received 6,437 responses, filtered to include developers in a certain subset of game studios, resulting in a reduction of the sample size to 4,006 respondents. Due to low response rates elsewhere, only responses from those living in the USA, Canada, the UK, and Australia were considered, which further reduced the sample size to 3,128. As the report notes, this may produce a North American bias. Of the responses 66% were from the U.S., 18% from Canada, 12% from the UK, and 4% from Australia (IGDA, 2005, p. 7).

There was little ethnic diversity in the respondents, with 83.3% identifying as white, 7.5% as Asian, 2.5% as Hispanic/Latino, 2.0% as black, and 4.7% as other

(IGDA, 2005, p.10). The gender balance among respondents was overwhelmingly male, with only 11.5% of respondents identifying as female. Particularly lacking were female programmers, as only 5% of respondents with that job title were female.

Level of education was surveyed, and 80% reported that they have a university-level education (IGDA, 2005, p. 20). The survey asked about sexual orientation, and 92% of respondents identified as heterosexual, with 2.7% identifying as lesbian/gay, 2.7% as bisexual, and 2.6% refusing to answer. Only 0.96% of respondents identified as transgender. Bisexuals, lesbians, and gays both think that the game industry currently lacks diversity and believe that diversity is important (IGDA, 2005, p. 15). When asked about disabilities, 87% reported that they did not have any. Of the remaining 13%, the most commonly reported disabilities were mental and cognitive. Cognitive disabilities were reported by 30%, mental disabilities by 31%, sight 9%, hearing 6%, mobility 4%, other 11%, and 9% declined to specify.

Women who responded to the survey strongly believed that diversity was important for the future of the industry and that diversity impacts the games that are produced (IGDA, 2005, p. 13-14). Respondents with disabilities generally agree that the industry is not currently diverse and that diversity is important (IGDA, 2005, p. 18-20). Interestingly, the study found that “non-whites seem to believe strongly that the industry is diverse and teams are diverse more often than whites” (IGDA, 2005, p. 11). The report concludes “... it is reasonable to believe that diversity does have an impact on the game industry and the products we create – either via broader markets and/or a means to attract future talent” (IGDA, 2005, p. 22).

Previous Studies of Student Demographics

Holders of degrees in computer sciences and mathematics and engineering often work in the field in which they earned their degrees (S&E Indicators, 2012, p. 16), so an understanding the demographics of students studying computing and games is crucial for predicting future demographics in each field. There are regular studies of students in computing, but there have been many fewer studies of game student demographics perhaps because the field is newer.

The Taulbee Survey, first conducted in 1974, is the oldest study that includes computing student demographics is the Taulbee Survey. This annual survey is sent to administrators of computing programs (including computer science, computer engineering, and more recently information science) in Ph.D.-granting institutions in the

United States and Canada. Data from the 2010-11 Taulbee survey indicates that 87.3% of bachelor's degrees in computing were awarded to males, and 65.8% were awarded to whites (Computing Research Association, 2012). Overall the recent trend has been a decline in the proportion of females receiving bachelor's degrees, down from 18% in 2000 (Baumann, 2011). Among ethnic minorities 15.3% of bachelor's degrees were awarded to Asians, 4.6% to African-Americans, 6.5% to Hispanics and 0.5% to American Indians or Alaskan natives (Zweben 2012).

Since Ph.D.-granting institutions generate less than 20% of the undergraduate degrees in computer science (Baumann et al, 2011), recent research has focused on capturing information about undergraduates at other types of institutions in the U.S. The TauRUs survey included U.S. institutions offering undergraduate and Masters degrees in computing. Data from 2009-2010 finds similar results for females enrolled in undergraduate computing degree programs, but found a higher percentage of minority students with 31.1% of undergraduate production (Goldweber, 2011). An article that considers multiple sources for data on computing enrollments found that African-Americans are 10-11% and Hispanics are 5-8% of the population for associate's degrees, highlighting the importance of encouraging minorities in those programs to pursue 4-year degrees (Taylor & Ladner, 2011). The same article found that 12% of undergraduate information technology (including computer science, information science and systems, and computer engineering) students had a disability. This percentage is close to the percentage of all students who have a disability attending college (Taylor & Ladner 2011).

The data on game student demographics is much sparser. Bayliss and Bieere (2008) performed a study at their institution comparing their game students to their IT and CS students. They found that 10% of the students studying games at their university were females and 90% male. They were particularly interested in understanding why students chose their major. They concluded that it is important to game students to express their creativity and found that 25% of them want to be game designers rather than software developers. Interestingly 31% had no prior programming experience before coming into the program, and 35% chose their major because they liked to program, with 2% choosing it because they liked problem solving, and 27% because they liked to express their creativity.

Summary

As games have become more pervasive in the post-secondary computing classroom, this has naturally extended to full-blown curriculum providing games as an area of major study. All indications from this research indicate that games are becoming a standard part of the regular computing curriculum, with multiple tools provided for exploratory learning.

A primary point of concern over the last two to three decades in the area of computing is the lack of diversity among both industry employees and those studying computing at post-secondary institutions. Though at least one major study has been completed on the subject of diversity among game industry employees, only local references and hints have been made concerning diversity among undergraduate students. A comprehensive look at undergraduate students studying game demographics is necessary before any critical discussion and reflective introspection can be conducted. Since education is so prevalent among employees in that sector, understanding the demographics of students studying related fields provides a glimpse into the future directions of diversity in the game industry.

Methodology

The Game Industry Employee Pipeline Survey was developed for this study. Many of these questions were taken directly from the 2005 IGDA survey “Game Developer Demographics: An Exploration of Workforce Diversity” and the 2011 IGDA Industry Survey with permission. The survey consisted of nine demographic questions, one question about favorite high school subjects, four questions about religious preferences, sexual preferences, and political views, and two questions about disabilities (See Appendix). In addition, the survey elicited information about student perceptions of diversity in the game industry. This particular study compares the student demographics against both undergraduate students studying computer science students as well as the US population.

The initial population for this cross-sectional study included undergraduate students in game degree programs in the United States (U.S.), United Kingdom (UK), and Canada. The institutions initially contacted included public, not-for-profit private, and for-profit private institutions that offered undergraduate degrees in games and included institutions of various sizes and locations with the specific intention of having data from students at a variety of institutions.

Faculty at post-secondary institutions in the U.S., UK, and Canada were contacted to participate in the study and act as conduits for disseminating the study to their students. Due to this step, faculty were required to first apply for and receive Institutional Review Board/ethics committee approval at their institutions.

As a result, faculty at four institutions in the U.S., one institution in the UK, and one institution in Canada completed this step. Upon their IRB approval, the surveys were distributed to students within those institutions between March 1, 2012 and September 20, 2012. For each institution in the U.S. and the UK, two emails were sent to participants on behalf of the faculty researcher, the first announcing the survey and inviting participation. The second email was a survey reminder and was sent one week after the first.

The data collection followed techniques that were previously approved by the researcher's committees on research of human subjects. To gather the data, an electronic form of the survey instrument was created using the Qualtrics online survey tool using SSL for an added measure of security. Only participants who agreed to the letter of consent that appeared on the first page of the survey were able to complete the survey. As an incentive, participants in the UK and U.S. were offered a chance to enter a prize drawing for a Samsung Galaxy Tablet upon completion of the survey. To enter the drawing, participants followed a link to a second survey in order to keep the demographic data for the survey separate from the drawing survey which required participants to enter the contact information. Upon completion of the survey by U.S. and UK participants, the drawing was held and the prize was awarded. The data from the drawing survey was destroyed immediately thereafter.

Once the data was collected, it was analyzed using descriptive statistics with the SPSS software tool. Descriptive statistics, specifically frequency counts and percentages, were used to answer the questions pertaining to the demographics of students in game degree programs. Chi-square tests were performed on the game student demographic data against the computer science student demographic data as well as the U.S. population data using the online GraphPad tool (GraphPad Software, 2012).

Results

Institutional demographics are given to provide insight into the type of institutions involved in this study. This is followed by student demographics, including general

demographic data (age, sex, ethnicity), areas of study within games and career interests, high school activities and self-assessment of abilities, religious and political leanings, sexual orientation, medically diagnosed disabilities, and perceptions on diversity.

Institutional Demographics

Faculty at thirteen institutions were invited to be secondary research participants, including seven in the U.S., three in the UK, and three in Canada. These institutions included private not-for-profit institutions (4), private for-profit institutions (1), and public institutions (8). As a secondary researcher, faculty were required to submit the research packet for IRB or corresponding ethics committee approval. Due to this additional burden on faculty, many of whom were very busy, the number of final participating institutions included four institutions in the US, one in the UK and one in Canada.

The primary data analysis in this study, therefore, focused solely on the data provided by students at U.S. institutions. Due to the limited number of participants provided by the Canadian institution, no analysis is provided. Three of the participating U.S. institutions are private (Bradley University, DePaul University, and Rochester Institute of Technology), and one is public (Southern Polytechnic State University). The UK institution is public (University of Portsmouth). The three private U.S. institutions are all listed in either the top 10 undergraduate game programs of the current Princeton Review or listed as honourable mention schools (Princeton Review, 2012). Each of the U.S. institutions has offered game degrees for many years, rather than having recently created gaming programs. All of the institutions chosen have full game degree programs rather than gaming courses that augment other computing degrees.

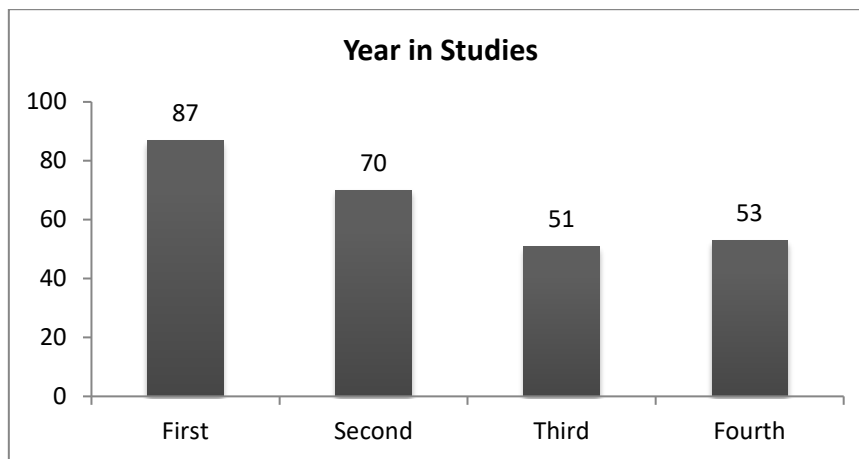
Student Demographics

The Request for Participation was emailed to 988 students in the target population in the United States. Of the 263 responses, one response was removed from the data set due to only one question being answered and one was removed because the respondents was pursuing their graduate degree. This yielded 261 responses, which was a 26.4% response rate of the population. All 261 remaining responses were used in this analysis and response numbers are provided when the number of responses deviates from this in any given question. All 261 confirmed they were undergraduate students and over the age of 18.

General Demographics

General demographics were gathered and include participant age, gender, ethnicity, sexual orientation, and political and religious leanings/affiliations. 250 respondents (95.8%) were in the age range of 18-24, nine (3.4%) were in the age ranges of 25-30, one each (0.4%) were in the age ranges of 31-40 and 41-50. Nearly all were full-time students (97.7%) and the remaining were part-time students. Participants in their first year of studies made up 33.3% of the respondents (n=87), second year 26.8% of respondents (n=70), third year 19.5% of respondents (n=51), and fourth year 20.3% (n=53) (Figure 1).

Figure 1. Year in Studies.



87.4% of respondents were male and 12.6% were female (Figure 2). 95.8% of respondents were native English speakers. 259 respondents responded to the ethnicity question and 71.6% of participants identified as white, 10.2% as Asian, 6.5% as black, and 2.7% as Hispanic/Latino (Table 1).

Figure 2. Female and male respondents.

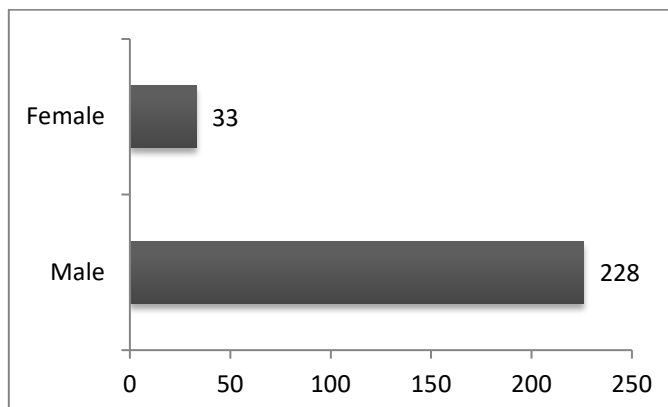


Table 1. Ethnicity.

<i>Categories</i>	<i>Count</i>	<i>%</i>
White	187	71.6
Black	17	6.5
Hispanic/Latino	7	2.7
Chinese	8	3.1
Filipino	4	1.5
Japanese	3	1.1
South Asian (East Indian, Sri Lankan, etc.)	3	1.1
Southeast Asian (Vietnamese, Cambodian, etc.)	3	1.1
West Asian (Iranian, Afghan, etc.)	2	0.8
Other	8	3.1
Decline to Answer	12	4.6

Areas of Study within Games and Career Interests

Participants responded to questions in the survey identifying each participant's area of study within games. Percentages were calculated based on total number of respondents (261). Participants could choose multiple areas of study and could choose between Design, Software Development, Art, Sound, Production, Undecided or Other.

Ten participants marked "Other" as their area of study. Upon further investigation, 5 of the 10 stated in an open response that they were interested in programming or mobile development. These responses were transformed to the category "Game Software Development." Of the remaining five, participants noted the areas of Networking, Writing, User Interface, Narrative, and Game Technical Art.

The top three areas of study were Game Design (41.0%), Game Software Development (31.8%), and Game Production (16.2%). Table 2 presents these results. For interest in careers in games, only one career interest could be selected. Several participants (12.3%) stated that they were undecided, while three participants (1.1%) indicated that they do not intend to pursue a career in the game industry (Table 3).

Table 2. Areas of study.

<i>Areas of Study</i>	<i>Count</i>	<i>%</i>
Game Design	227	41.0
Game Software Development	176	31.8
Game Production	90	16.2
Game Art	39	7.0
Game Sound	15	2.7
Other	5	0.9
Undecided	2	0.4

Table 3. Career interests.

<i>Career Interests</i>	<i>Count</i>	<i>%</i>
Software Development (Programming, Software Analysis, Software Engineering, etc.)	116	44.4
Level Designer	33	12.6
Undecided	32	12.3
Producer	18	6.9
Artist	17	6.5
Administrative	7	2.7
Testing	5	1.9
Quality Assurance	3	1.1
Audio	3	1.1
I do not intend to pursue a career in the game industry.	3	1.1
Business Management	3	1.1
Consultant	1	0.4
Marketing/PR	1	0.4
Other (see below):	19	7.3
Game/General Design/Lead Design	10	3.8
Narrative/Story	6	2.3
Indie development	2	0.8
System Designer	1	0.4

High School Subject Interests

High school activities and interests in various hobbies/activities were measured in the survey. Participants were asked their favorite subject in high school and 256 provided valid responses (Table 4). The area with the most responses was Technology courses (computer science, multimedia) at 30.1%. Two additional major areas of interests were Mathematics (18%) and Art (17.6%).

Table 4. High School Subject Interests.

<i>Subject</i>	<i>Count</i>	<i>%</i>
Art (Drawing, sculpting, graphic design, etc.)	45	17.6
Engineering	4	1.6
English	17	6.6
Foreign Language	7	2.7
Mathematics	46	18.0
Music (Orchestra, Band, Choir, etc.)	14	5.5
Physics	15	5.9
Science (Chemistry, Biology)	10	3.9
Social Studies (Civics, History, Geography, etc.)	21	8.2
Technology Courses (Computer Science, Multimedia)	77	30.1

Religious and Political Leanings

255 participants responded to the religious preferences question, with 31 declining to specify (Table 5). The majority (41.6%) of participants did not have a religious preference. 13.0% identified themselves as Roman Catholic, while 39.6% identified themselves as Christian (Other Christian, Church of Christ, Methodist, Episcopalian, Presbyterian, Baptist, Eastern Orthodox, or Lutheran). 1.5% identified themselves as Muslim, while 2.3% identified themselves as Jewish.

Table 5. Religious preference (n=255).

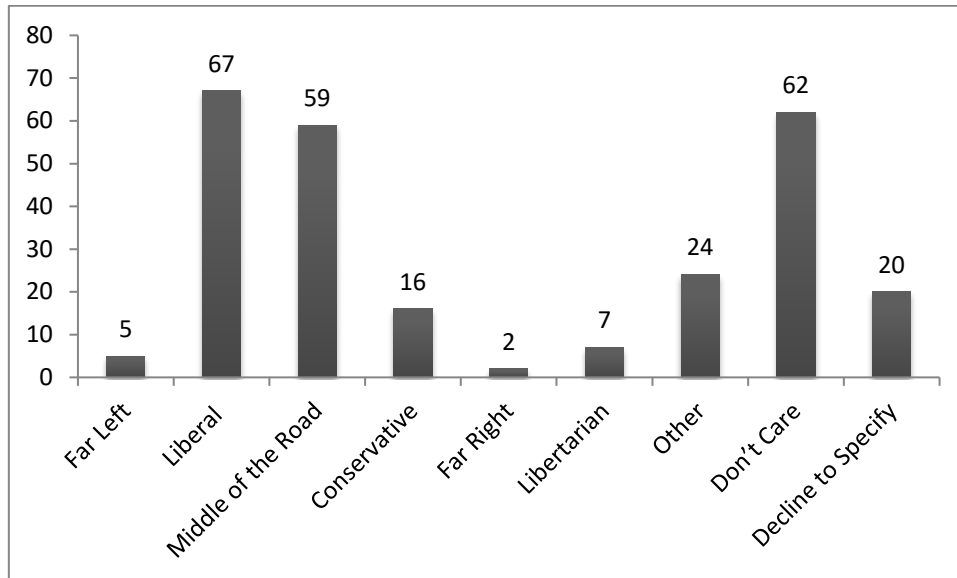
<i>Preference</i>	<i>Count</i>	<i>%</i>
None	106	41.6
Roman Catholic	34	13.0
Other Christian	25	9.6
Decline to Specify	31	11.9
Church of Christ	7	2.7
Muslim	4	1.5
Presbyterian	4	1.5
Other Religion	12	4.6
Eastern Orthodox	1	0.4
Jewish	6	2.3
Baptist	10	3.8
Buddhist	2	0.8
Episcopalian	3	1.1
Hindu	1	0.4
Methodist	5	1.9
Lutheran	4	1.5

Questions about political preferences were also given, with results shown in Figure 3. Participants mostly identified themselves as either liberal (27.4%) or did not care about political preferences (26.4%). Another large percentage (24.1%) identified with middle of the road ideologies. Only 4.5% identified with conservative ideologies. Seven participants stated other, with four (4.5%) self-identifying as Libertarian. The remaining three stated that their view depends on the issue.

In this category, we provided an option for “Other” where respondents could enter their own response. These open-ended responses included “Democrat”, “Depends on issue” (3), “depends on political views”, “differs greatly by individual issue”, “disagree with the entire system”, “I do not ally myself with political affiliations or ideologies because, since I am not seeking a future in the arena of politics, I want to keep an open mind”, “I do not associate myself with either side in any way”, “my own”, “None. Whatever I perceive as correct”, “Our political system is a circus of idiocy run by sadistic clowns”, “people that support gun rights”, “pragmatically idealistic classical

liberal”, “rent is too damn high”, “what’s right for all”, and “Whoever is not saying crazy things.”

Figure 3. Political preferences.



Lesbian, Gay, Bisexual, and Transgender (LGBT)

255 participants responded to the LGBT questions, with 15 (5.9%) declining to specify (Table 6). Of those that did, 87.1% identified themselves as heterosexual. 5.5% identified themselves as bisexual with only four participants (1.6%) self-identifying as lesbian/gay. Though not shown in the table, two participants (0.8%, n=254) self-identified as transgendered.

Table 6. Sexual orientation (n=255).

<i>View</i>	<i>Count</i>	<i>%</i>
Heterosexual	222	87.1
Bisexual	14	5.5
Decline to Specify	15	5.9
Lesbian/Gay	4	1.6

Disabilities

Participants were asked to identify one or more medically diagnosed disabilities. This was a required field and 261 respondents selected at least one answer. The majority, 74.3%, of participants stated that they did not have a disability. Of the remaining

responses, mental illness ranked highest (8.4%), with 7.3% of participants stating that they have a cognitive disorder (Table 7). Of those who selected “Other”, participants specified color blindness, dyslexia, physical limitations in regards to muscle/joint stress (hemophilia), and diverticulitis.

Table 7. Disabilities (n=261).

<i>Disability</i>	<i>Count</i>	<i>%</i>
No	194	74.3
Mental illness (e.g. anxiety, obsessive compulsive disorder, post-traumatic stress disorder, bipolar, depressions, schizophrenia, etc.)	22	8.4
Cognitive disorder (e.g. dyslexia, ADD/HD, specific learning disability, autism, Asperger’s, etc.)	19	7.3
Blind or partially sighted	8	3.1
Decline to Answer	8	3.1
Deaf/Hard of Hearing	3	1.1
Other	4	1.5
Mobility impaired (e.g. paraplegia, quadriplegia, cerebral palsy, ALS, etc.)	1	0.4
Yes, Decline to Specify	5	1.9

A second question was posed to those respondents who indicated that they had a cognitive disability to identify the one or more cognitive orders that they have. Of these, 15 stated that they had Attention Deficit/Hyperactivity Disorder (AD/HD) and three stated that they had a learning disability. One respondent noted that they had “Other” and entered “OCD” as the text, interpreted as Obsessive Compulsive Disorder. This, however, according to the survey falls into the Mental Illness category above and is not counted here.

Table 8. Cognitive Disabilities (n=261).

<i>Disability</i>	<i>Count</i>	<i>%</i>
ADD/HD	15	5.7
Learning disability	3	1.1
Asperger's	3	1.1
Autism	0	0.0
Dyslexia	1	0.4

Diversity Perspectives

The survey included several questions on issues related to diversity both in the game industry and the institution in which the participants were studying. Participants were asked to rate diversity related questions on a Likert scale, where 1=Strongly Disagree, 2= Disagree, 3= Agree, and 4=Strongly Agree.

Table 9. Diversity perspectives.

<i>Diversity Statement</i>	<i>N</i>	<i>M</i>	<i>SD</i>
Workforce diversity is important to the future success of the game industry.	255	3.07	0.78
The game industry workforce is diverse.	255	3.04	0.78
A diverse workforce has a direct impact (broad appeal, quality, etc.) on the games produced.	254	3.03	0.82
My program at my university is diverse.	255	2.95	0.75
My program would benefit from more diverse students.	254	2.90	0.78
Project teams in my game degree program are diverse.	254	2.83	0.69
In one or more of my courses, we have discussed diversity.	255	2.58	0.90

Analysis

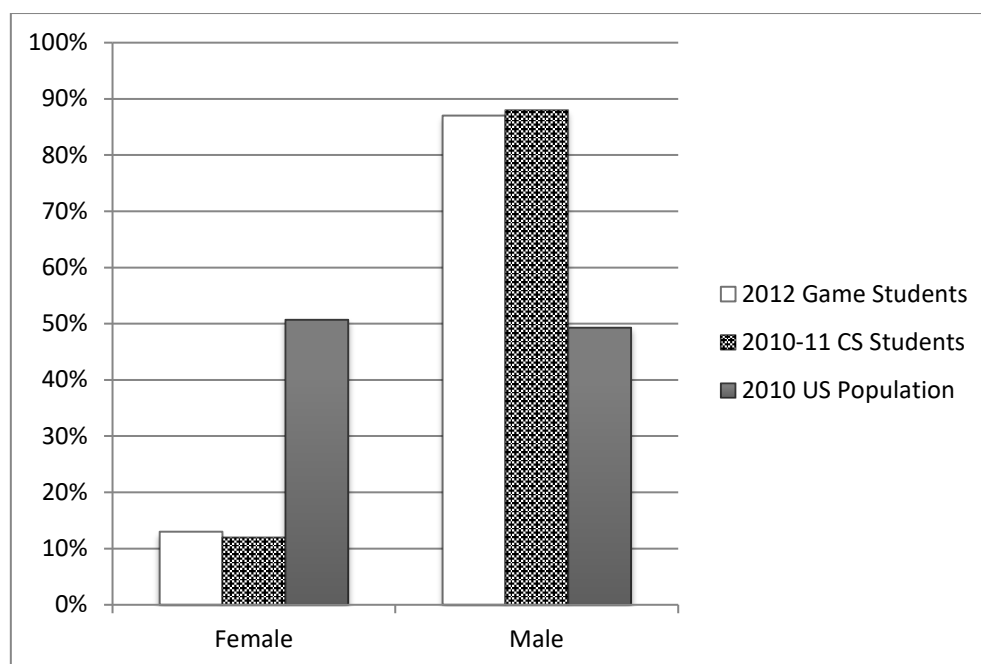
As part of the analysis, the data from this study was compared against data from the 2010-11 Taulbee survey for undergraduate computer science students, where applicable, and against the data of the U.S. Population (Computing Research Association, 2012; United States Census Bureau, 2011a, 2011b, 2011c). When data from the U.S. Population was not available from the Census Bureau, we reference data reported in peer-reviewed, published research.

Gender

According to the 2010 United States Census (United States Census Bureau, 2011a), the ratio of males to females in the general population is nearly 1 to 1, with males being 49.1% of the population and females 51.9%. The Taulbee survey results indicated that the male (88.7%) to female (11.3%) ratio in undergraduate computer science majors is roughly 9 to 1. As the data from this study indicates, the male to female ratio in undergraduate students studying games is the same.

For assurance, a one-sample chi-square test was conducted to assess the significance between the distributions of observed gender of the game students versus the expected distribution of gender in the U.S. population. The results of the test were extremely statistically significant at $\chi^2 (1, N=261) = 151.23, p=0.0$. The same test, when applied to game students and computer science students, resulted in $\chi^2 (1, N=261) = 0.102, p=0.75$, indicating that there is no statistical difference between the two groups.

Figure 4. Sex of game students, computing students, and US population



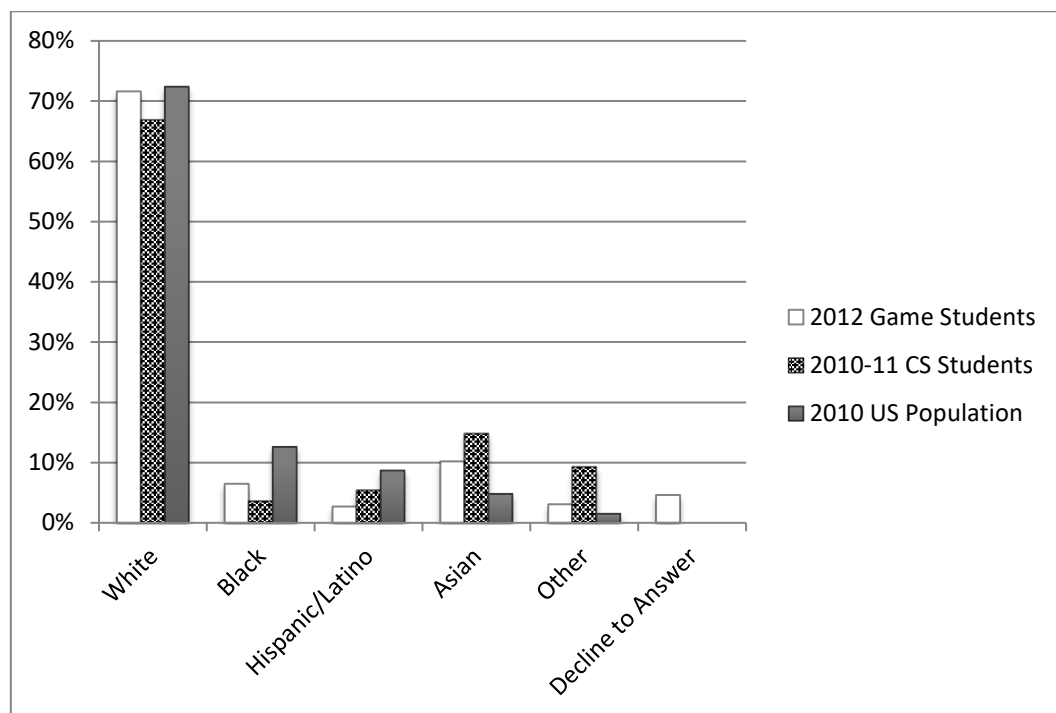
Ethnicity

With respect to ethnicity, the data indicates that ethnicity is more equitably represented compared to the U.S. Population than the ratio is for gender (United States Census Bureau, 2011b). Blacks and Hispanic/Latinos are underrepresented, while Asians are overrepresented when compared with the US Population.

A chi-square test for the five groups indicated in the chart results in $\chi^2 (4, N=242) = 32.56, p=0.0$. This indicates that there is an extremely significant statistical difference between the game students and the U.S. population; however, with the “Other” expected value at 3.63, the p value may not be reliable. The chi-square test for the game students and the computer science students also indicates an extremely statistically significant difference, $\chi^2 (4, N=242) = 28.53, p=0.0$. All expected values were greater than 5, with the p value deemed reliable. Therefore, additional chi-square tests were conducted to comparing various ethnic groups separately. Though caution must be taken given the number of students who declined to answer, the results indicate the following:

- No significant difference between whites and non-whites, $\chi^2 (1, N=242) = 2.88, p=0.09$,
- A very statistically significant difference between blacks and non-black, $\chi^2 (1, N=242) = 6.83, p=0.01$,
- A very statistically significant difference between Hispanic/Latinos and non-Hispanic/Latinos, $\chi^2 (1, N=242) = 10.28, p=0.00$,
- An extremely statistically significant difference between Asians and non-Asians, $\chi^2 (1, N=242) = 11.72, p=0.00$.

Figure 5. Ethnicity of game students, computing students, and US population

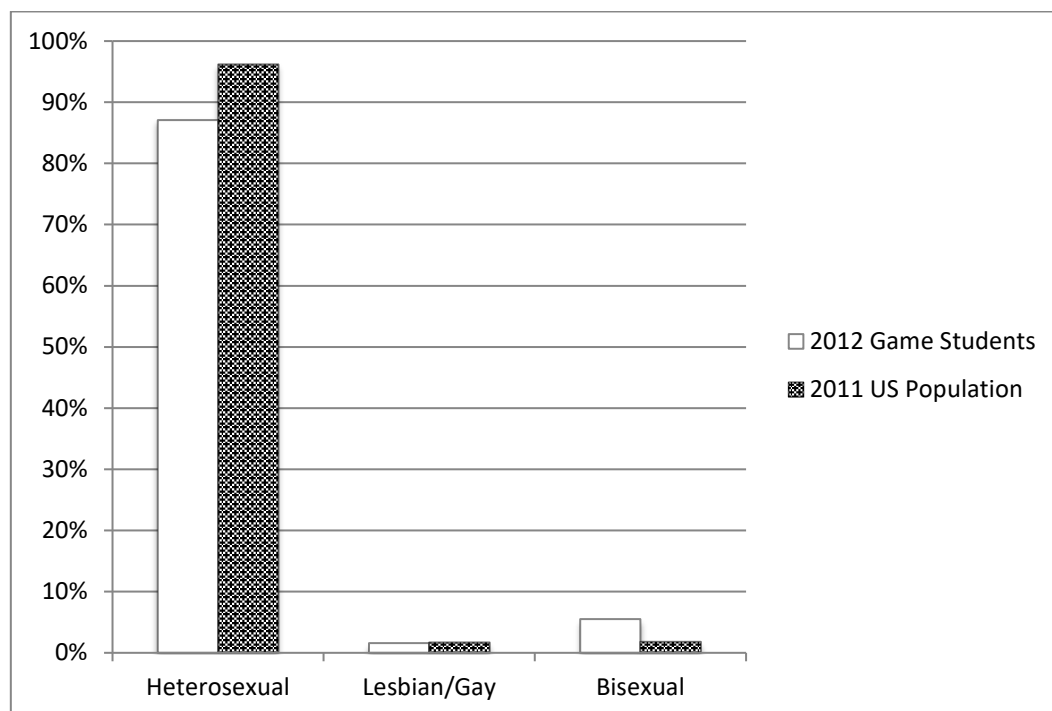


Sexual Orientation

According to the Williams Institute (Gates, 2011), 96.2% of the U.S. population identify as heterosexual, 1.7% as lesbian/gay, and 1.8% as bisexual (Figure 6). Compared to the population of game students, the lesbian/gay population is nearly identical; however, there appears to be a higher percentage of students who identify as bisexual rather than lesbian/gay, thereby decreasing the heterosexual percentage. The chi-square test indicated an extremely statistically significant difference between the sexual orientation of the game students and the U.S. population, $\chi^2 (2, N=240) = 22.03, p=0.0$. However, two of the expected values were slightly less than 5 (4.32 and 4.08 for bisexual and gay/lesbian, respectively), therefore the test may not be reliable. Therefore, another chi-square test was conducted comparing heterosexuals and those self-identify as LGBT in both populations. This comparison resulted in $\chi^2 (1, N=242) = 13.20, p=0.0$, confirming an extremely statistically significant difference.

No data on sexual orientation could be found for computing students, and thus is not included in this section.

Figure 6. Sexual orientation of game students and US population



Religious Affiliation

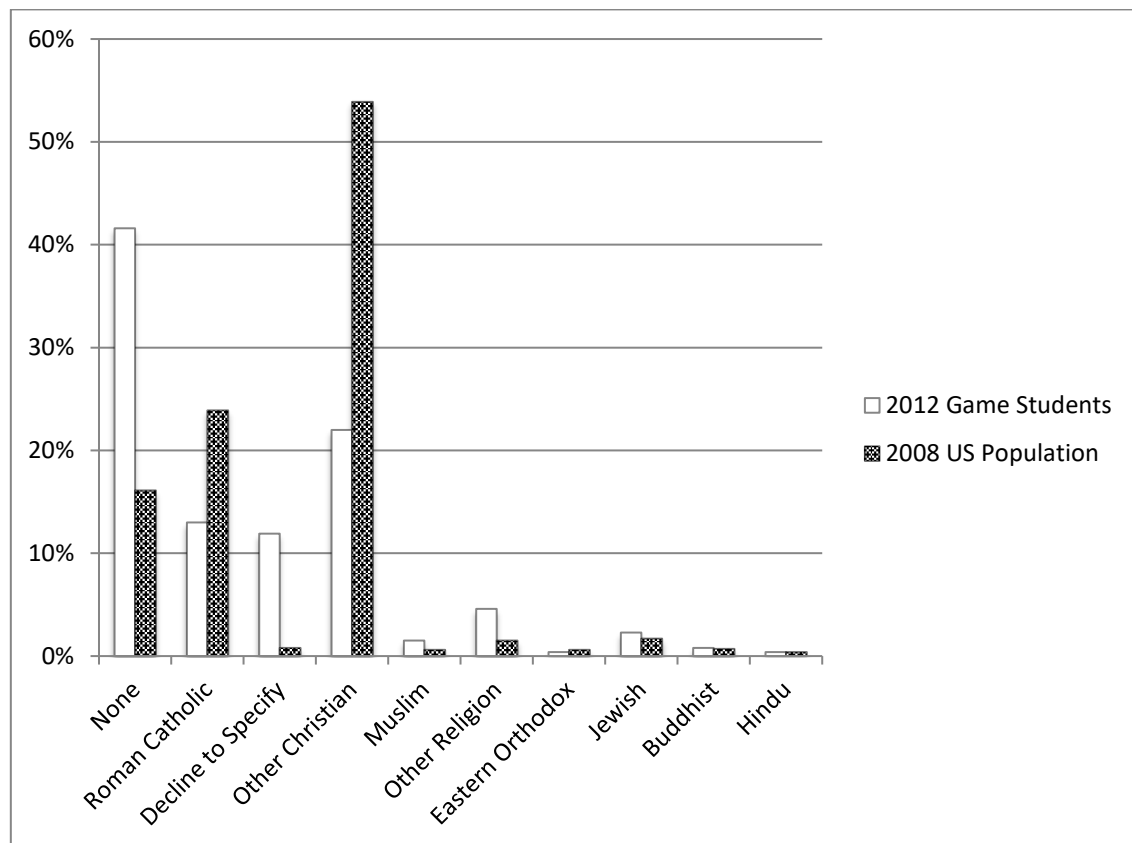
Compared to data reported by the Pew Forum on Religion and Public Life, the religious affiliations of the U.S. population compared to affiliations held by game students differs

significantly. Over 40% of game students claim no religious affiliation compared to only 16.1% of the population.

The chi-square value was calculated and resulted in $\chi^2 (9, N=255) = 594.00$, $p=0.0$, indicating extremely statistically significant difference. However, the test may not be reliable, since several of the expected values were less than 5. Therefore, a chi-square test was performed comparing the groups indicating religious affiliation and those that stated they had none. The results indicated an extremely statistically significant difference, $\chi^2 (1, N=224) = 161.65$, $p=0.0$.

No data on religious affiliations could be found for computing students, and thus is not included in this section.

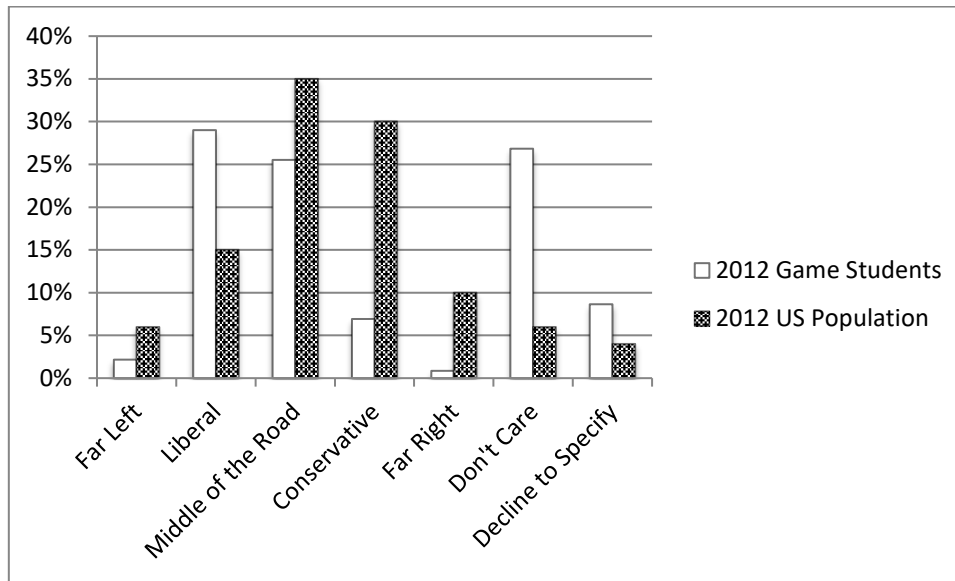
Figure 7. Religious affiliation of game students and U.S. population



Political Views

Compared to the Gallup Politics poll reported in January 2012 (Gallup Politics, 2012), there are a number of differences between the political views of game students versus the U.S. population. The chi-square test for the two groups resulted in $\chi^2 (5, N=231) =$

439.63, $p=0.0$, indicating extremely statistically significant differences between the two groups.



Disabilities

According to the U.S. Census Bureau (2011c), 78.7% of the US population does not have a disability, compared to 74.3% of game students, and 6.3% of the US has a mental illness, while 8.4% of game students do. Chi-square tests on these groups indicate an extremely statistically significant difference for those with mental illness, $\chi^2(1, N=253) = 23.98$, $p=0.00$. For the non-disability category, we chose not to conduct a chi-test due to the difficulty in mapping categories between the population data and the game student data.

Blind and partially sighted constitute 3.1% of the game students and 3.3% of the population. Deaf/hard of hearing constitute 3.1% of the general population, but only 1.1% of the game students self-identified with being deaf or hard of hearing.

Unfortunately, due to how the data is reported by the U.S. Census Bureau, categories do not match the categories in the survey, and thus data cannot be compared for statistical significance.

Summary

Through this analysis, we find that there is no significant difference in the ratio of males to females in students studying computer science and games. However, there was an extremely significant difference found in this category between students studying games and the U.S. population, with males outnumbering females at an 8 to 1 ratio.

Results also indicate that for ethnicity, there may be a statistically significant difference between game students and computing students as well as game students and the U.S. population. Though no statistically significant difference between whites and non-whites could be found, the results indicate that blacks and Hispanic/Latinos are underrepresented and Asians are overrepresented.

Similarly, there is a statistically significant difference in sexual orientation (comparing heterosexuals and LGBT data results) between the U.S. population and game students, with results indicating that heterosexuals are underrepresented when compared to the U.S. population.

This analysis indicates that there is another extremely statistically significant difference in both the religious affiliations and the political views between the two populations. For religious affiliation, results indicate that those with any religious affiliation are highly underrepresented in the game student population. For political views, in the game student population, those with liberal reviews are over-represented, while those with conservative and moderate views are underrepresented.

Disabilities were difficult to interpret due to the inability to sufficiently map the categories among the U.S. Census Bureau data and our data. However, results indicate a significant difference between those with mental illnesses in the two populations, with result indicating a higher rate of mental illness in game students than in the general population.

With respect to perspectives on diversity, participants agree that workforce diversity is important to the future success of the game industry and they equally agree that a diverse workforce has a direct impact on the games produced. They agree that the game industry workforce is diverse. They mostly agree that the program at their university is diverse. Fewer agree that their project teams are diverse or that their program would benefit from more diverse students. However, there was no strong consensus on having discussed diversity in one or more of their courses.

Discussion

In many respects the results of this study align with the results from the IGDA survey of game industry employees and with information available on demographics in the science and engineering (S&E) workforce, and in the computing workforce in particular. Like the S&E, computing, and game workforce (S&E Indicators, IGDA 2005), women, blacks, and Hispanics/Latinos are underrepresented and Asians are

overrepresented. As with the IGDA study (IGDA 2005), the participants in our study agree that workforce diversity is important and that their programs are adequately diverse. Some of the results from this work contrast with the demographics from the industry surveys. Most saliently, heterosexuals are underrepresented in our results, which contrasts with the IGDA survey (2005). We also find that the game student population has a higher percentage of disabilities at 25.7% than the game industry employee population at 13% (IGDA 2005). Of these disabilities, mental illness, cognitive disorders, and sight disabilities are more common among the game students than the game employee population. Hearing and mobility disorders are on par with those in the game industry.

The results from this work also provide new information about the game industry pipeline. We find that students with moderate and conservative political views are underrepresented in the game student population, and that students with a religious affiliation are also underrepresented. This result is striking given that one of the universities where students were solicited is a Catholic institution. Also surprising is that respondents indicated that diversity has not been discussed in their classes, particularly given the importance attached to diversity in both academia and the private sector in the technology field. Understanding the game industry pipeline is crucial both because employees in the game industry overwhelmingly have a post-secondary degree (IGDA 2005) and because holders of degrees in computer sciences and mathematics and engineering often work in the field in which they earned their degrees (S&E Indicators, 2012, p. 16).

Given that computing academics have used games as a way to attract students to the field and to improve retention in select courses by increasing motivation, these results are informative. The game student population is in many ways no different from the computing student population, in that women and most racial and ethnic groups are underrepresented in both. While it has been shown previously that game topics can improve interest in and motivation for computing, the demographics of the students who choose games as a speciality remains similar to the existing population of students. This suggests that games may not have the potential for diversifying the computing field.

Further, the lack of representation in the game and computing fields, and in the game industry and computing pipeline, is troubling for many reasons. The field of computer and mathematical sciences is expected to grow dramatically through 2018. The Bureau of Labor Statistics projects that there will be a 25.6% increase in demand in

this field (S&E Indicators, 2012, p. 12). In general, those with S&E degrees have had lower rates of unemployment than other college graduates and much lower rates than people without college degrees (S&E Indicators, 2012, p. 29). A lack of diversity also impacts the potential innovation in the computing field. Studies indicate that teams with equal numbers of men and women are more likely than any other type of team “to experiment, be creative, share knowledge and fulfill tasks” (Ashcraft and Blithe, 2009, p. 10). As noted in the same report, a lack of diverse team members means that those who are inventing technology are not representing the target audience for the products, which can cause mismatches between products and the customer base.

Limitations of the Study

This study was primarily a demographic study. However, considering threats as defined by Campbell and Stanley (1963), both internal and external threats to its validity exist. First, the instrument was developed based on previous studies, including the IGDA Diversity study. Participants from the four institutions may not be representative of the entire population of game students in the United States, with the number of participants at higher cost, private institutions (N=193) being greater than those at the public institution (N=68). Likewise, students in their first year of studies had a higher participation rate than for each of the other years of study, and this may influence the outcomes of the study as well, since first-year students are more likely to change majors than students in their later years of study.

Care was taken in selecting grouping categories such as age. However, the instrument has not been validated which may affect the results of the questions asking for perspectives in diversity.

Some of the questions posed are sensitive in nature. Participants may or may not choose to respond to these truthfully or may have chosen the “Decline to Answer” or “Decline to Specify” choice available on several of the required response questions. The entire study is based on self-reports provided by participants, and care must be taken when interpreting the results. Additionally, though care was taken in choosing survey questions and choices that are unambiguous, there is a risk that the participant may have misinterpreted the questions or choices. Therefore, we provide the complete survey in the Appendix for review.

Several significant differences, particularly in the categories of sexual preferences, religious affiliation, and political leanings) could be related to the

exploratory nature students may undertake while at college. Though the differences are noted here, further research is needed to determine if this potential variance exists.

Future Research

With the results of this initial survey, we have the first steps of understanding the undergraduate population of game programs. As an obvious future direction of the work, it would be nice to study more institutions in the United States and other institutions outside the United States. This would allow verification or refutation of the results obtained here.

Furthermore, a longitudinal study would gauge whether the population of game students is changing over time in any of the aspects considered. Considering data from a number of years would further address the problem of having many freshmen in this survey. If over time, the demographics do not change much, then the potential problem of having a large number of freshmen in the data pool does not impact the demographics of the students who eventually earn game degrees.

Lastly, we have shown that many of the problems with diversity that have been identified in traditional computer science are also seen within the students studying games. Given that the average household owns one dedicated game console, and that forty-seven percent of all game players are women, it appears that the participating with games is not translating into the desire to study and create new games (ESA Facts, 2012). Investigating why certain populations are underrepresented or overrepresented among game students is extremely worthwhile, given the needs of an industry that generated \$7.3 billion in revenue in 2011 (ESA Facts, 2012). Even though the study of the reasons why has proven to be a difficult task in the computing field and might have the same issues in the new context, it still warrants attention and discussion.

Conclusion

In our study we determined benchmark information about demographics of undergraduates enrolled in game degree programs in the United States. We found that the population of game students was similar in many ways both to the population of computing students and to employees in the game industry. In all three populations, women, blacks, and Hispanics/Latinos are underrepresented. Our study provided novel insight into some aspects of the game student population, identifying that heterosexuals, those with moderate or conservative political views, and those with religious affiliations

are underrepresented and people with disabilities are overrepresented among our study respondents. Like game industry employees, students in gam degree programs agreed that diversity is important and believe that their environment is diverse.

In some ways our results are discouraging, since they suggest that games may not be a potential avenue for improving the diversity of the population employed in computing. However, with efforts being made within the game industry to understand diversity and its impact on game design and consumption, the results could be used as a point of information for addressing needs early in the employee pipeline process. If corrective action is desired, recruitment and retention of underrepresented populations in undergraduate game degree programs could serve as part of the solution.

Acknowledgements

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Appendix

1. Age:

- ☐ Under 18
- ☐ 18-24
- ☐ 25-30
- ☐ 31-40
- ☐ 41-50
- ☐ 51-60
- ☐ 60+

2. Are you a full-time or part-time undergraduate student?

- ☐ Full-time undergraduate
- ☐ Part-time undergraduate
- ☐ I am not an undergraduate student.

3. Sex:

- ☐ Female
- ☐ Male
- ☐ Prefer not to specify

4. Is English your native language?

- ☐ Yes
- ☐ No

5. What year are you in your studies?

- ☐ First year
- ☐ Second year
- ☐ Third year
- ☐ Fourth year or more

6. Please indicate the areas of game studies most closely related to the degree you are pursuing:

- ☐ Game Design
- ☐ Game Software Development
- ☐ Game Art
- ☐ Game Sound
- ☐ Game Production
- ☐ Undecided
- ☐ Other _____

7. What type of studies are you pursuing?

- ☐ Bachelors Degree in games (i.e. Game Design, Game Development, Game Art, etc)
- ☐ Bachelors Degree in a related field, with a concentration in games
- ☐ Bachelors Degree in a related field
- ☐ Other (Please specify) _____

8. What area of the game industry are you most interested in pursuing?

- ☐ I do not intend to pursue a career in the game industry.
- ☐ Undecided
- ☐ Administrative
- ☐ Artist
- ☐ Audio
- ☐ Business Management
- ☐ Consultant
- ☐ Human Resources
- ☐ Level Designer
- ☐ Marketing/PR
- ☐ Press
- ☐ Producer
- ☐ Quality Assurance
- ☐ Software Development (Programming, Software Analysis, Software Engineering, etc..)
- ☐ Testing
- ☐ Other (Please specify) _____

9. What was your favorite subject in high school?

- ☐ Art (Drawing, Sculpting, Graphic Design, etc.)
- ☐ Engineering
- ☐ English
- ☐ Foreign Language
- ☐ Mathematics
- ☐ Music (Orchestra, Band, Choir, etc.)
- ☐ Physics
- ☐ Science (Chemistry, Biology)
- ☐ Social Studies (Civics, History, Geography, etc.)
- ☐ Technology Courses (Computer Science, Multimedia)
- ☐ Other _____

10. With which group do you most closely identify?

- ☐ Arab
- ☐ Black
- ☐ Chinese
- ☐ Filipino
- ☐ Hispanic/Latino
- ☐ Japanese
- ☐ Korean
- ☐ Native American
- ☐ South Asian (e.g. East Indian, Sri Lankan, etc.)
- ☐ Southeast Asian (e.g., Vietnamese, Cambodian, etc.)
- ☐ West Asian (e.g. Iranian, Afghan, etc)
- ☐ White
- ☐ Other
- ☐ Decline to Answer

11. Do you agree or disagree with the following statements?

	Strongly Disagree	Disagree	Agree	Strongly Agree
The game industry workforce is diverse.				
My program at my university is diverse.				
Project teams in my game degree program are diverse.				
In one or more of my courses, we have discussed diversity.				
A diverse workforce has a direct impact (broad appeal, quality, etc.) on the games produced.				
My program would benefit from more diverse students.				
Workforce diversity is important to the future success of the game industry.				

12. Have you been medically diagnosed with and/or consider yourself as a person with a disability in any of the following ways? (check all that apply)

- ☐ Deaf or hard of hearing
- ☐ Blind or partially sighted
- ☐ Mobility impaired (e.g. paraplegia, quadriplegia, cerebral palsy, ALS, etc.)
- ☐ Mental illness (e.g. anxiety, obsessive compulsive disorder, post-traumatic stress disorder, bipolar, depression, schizophrenia, etc.)
- ☐ Cognitive disorder (e.g. dyslexia, ADD/HD, specific learning disability, autism, Asperger's, etc.)
- ☐ Other (please specify) _____
- ☐ Yes, but decline to specify
- ☐ No
- ☐ Decline to Answer

13. If you have ever been diagnosed with a cognitive disorder, please specify:

- ☐ Dyslexia
- ☐ ADD/HD
- ☐ Learning disability
- ☐ Autism
- ☐ Asperger's
- ☐ Other (please specify) _____
- ☐ Decline to specify

14. Please indicate your religious preference:

- | | |
|----------------------------------------|---------------------------------------------|
| <input type="radio"/> Baptist | <input type="radio"/> Muslim |
| <input type="radio"/> Buddhist | <input type="radio"/> Presbyterian |
| <input type="radio"/> Church of Christ | <input type="radio"/> Quaker |
| <input type="radio"/> Eastern Orthodox | <input type="radio"/> Roman Catholic |
| <input type="radio"/> Episcopaleon | <input type="radio"/> Seventh Day Adventist |
| <input type="radio"/> Hindu | <input type="radio"/> United Church of |
| <input type="radio"/> Jewish | Christ/Congregational |
| <input type="radio"/> LDS (Mormon) | <input type="radio"/> Other Christian |
| <input type="radio"/> Lutheran | <input type="radio"/> Other Religion |
| <input type="radio"/> Methodist | <input type="radio"/> None |
| | <input type="radio"/> Decline to specify |

15. With which political views do you most closely identify?

- ☐ Far Left
- ☐ Liberal
- ☐ Middle of the road
- ☐ Conservative
- ☐ Far right
- ☐ Other _____
- ☐ Don't care
- ☐ Decline to specify

16. With which sexual orientation do you most closely identify?

- ☐ Heterosexual
- ☐ Lesbian/Gay
- ☐ Bisexual
- ☐ Decline to specify

17. Do you identify as Transgendered?

- ☐ Yes
- ☐ No
- ☐ Decline to specify