Artificial Intelligence in Games

Luca S. Rijneveld

Breda University of Applied Sciences

Abstract

For our research we will focus on the acceptance of Artificial Intelligence across the subdomains of the game academy, is there a difference in how accepting the subdomains are when it comes to this new technology. To answer the research question, a survey was conducted to measure the knowledge, attitude and acceptance of Artificial Intelligence students and staff at Breda University of Applied Sciences, out of those participants we selected the once relevant for our research. Interviews with industry professionals were conducted to further analyse if there is a difference across the different disciplines. The statistical analysis was conducted using ANOVA, which provided us with a p-value of 0.163. The subdomains of the game academy at Breda University at Applied Sciences should be treated as different disciplines, the way they interact with AI is vastly different, therefore policies created on the bases of the findings in this research paper should be tailor per subdomain.

Keywords: Artificial Intelligence, Games, Games Industry, A.I. Acceptance

Artificial Intelligence in Games

Introduction

Artificial intelligence (AI) is intelligence demonstrated by machines. The term "artificial intelligence" had previously been used to describe machines that mimic and display "human" cognitive skills that are associated with the human mind, such as "learning" and "problem-solving". Now AI is described by researchers in terms of rationality and acting rationally. AI applications include Googles search engine, recommendation systems used by Amazon, Netflix and YouTube, Self driving cars or the ability to understand human speech, like Siri, Alexa and Google Assistant.

There are a lot of different domains when it comes to AI in games, some would be AI playing games (Alpha Go, Alpha Star) or AI in games like a Non Player Character. For our research we will be looking into AI that helps with game development. Back in 2002 a paper was published titled "New Challenges for Character-Based AI for Games". With character based AI we mean the following. "It is a category that is especially meaningful in games, to distinguish systems that seek to simulate the behavior of a single agent from strategic AIs or turn-based game-opponent AIs." (Isla & Blumberg, 2002). This paper touched on the question: "How do the simulated creatures perceive their world, and how is their perception of the word-state limited realistically? How are the creature's reactions handled, and how do they go about satisfying their goals? What are their goals?" (Isla & Blumberg, 2002). This type of AI, AI that plays games or controls a character in games, is used by researchers to measure intelligence. This AI can contribute to the art of game creation in such areas as pattern finding and planning.

Another AI application in games is ANGELINA (Cook et al., 2016). This AI is known as the game designer AI. Michael Cook published a two part paper on ANGELINA. ANGELINE is reliant on a learning method called evolutionary computation. This specific type of machine learning tries to improve on what has previously been learned, good

solutions to the problem evolve into new algorithms to create even better solutions.

For my research I will be taking a look at the attitudes of Game students at Breda University of Applied Sciences (BUas) when it comes to AI in they domain and how accepting the sub domains of the game study, Programming, Design Production, and Visual Arts are to this new technology. Is there a difference in the sub domains of the game academy when it comes to AI acceptance? I predict that there will be a difference, mainly that the Visual Art students of the game academy will be less accepting of Artificial Intelligence compared to Programming and Design & Production students of the game academy.

The methods applied for this descriptive research will be both qualitative and quantitative. For our quantitative research we designed a survey including validated questions to measure acceptance, knowledge, and attitude towards artificial intelligence. Out of all of those question we will focus on acceptance. The qualitative research will be done by conducting interviews and will be used to strengthen the quantitative research. Through analysis on this data we can compare the acceptance between subdomains of the game study. The hypotheses will be tested by conducting a survey and applying statistical analysis to the collected data from the survey.

Method

We investigated the prior knowledge and opinions on the subject of AI of a variety of students across multiple domains at Breda University of Applied Sciences using an online survey.

Participants

The participants of the online survey were 371 people in total, 105 of those are students of the game academy. Participation was voluntary and participants were informed of the goal of the survey in the preface of the questionnaire. Not all responses were anonymous due to the fact participants could fill in their student number to join a

give-away to win a BUas hoodie as compensation. Therefore the survey is anonymous unless provided otherwise by the participant. The focus of our research it on the acceptance of AI, not all 105 students of the games academy filled in the section pertaining this topic in the survey. After cleaning and aggregating the data we are left with 94 students for out statistical analysis. Viewing the demographic data we can see the frequency of students and staff that filled in the survey. The graphs show more data for Design Production and programming compared to Visual Arts. The majority of participants in are sample data are aged 18 - 24. We have students and staff members that filled in the survey, in this case and for obvious reasons there are more students that participated compared to staff, this because there are more students compared to staff. The majority of our participants state that they have less then one year work experience in the games industry with the second highest being 1-5 years of experience. Every participant in our sample check "I consent" when filling in the survey. Table 1 summarizes the demographic section of the survey with the answers being the possible variables for participants to chose per question.

Materials

A questionnaire on the knowledge, attitude, and acceptance of AI in the different domains at BUas was developed using "Qualtrics", a source provided to us by BUas to conduct our research, and distributed amongst the students of the university. Distribution was conducted using various methods, face to face, posters, emails and online messages. The face to face distribution made use of a poster with a QR code where as the online distribution made us of a link to the survey. We used one link to distribute the survey and one QR-code, Qualtrics provides these after deploying a survey for data collection. Qualtrics hosts the survey online, meaning that the participants used an electrical device to answer the questionnaire, this could be a phone or a laptop. Participants that gained access using the QR-code often used a mobile phone for the process, participants acquired by social media were more likely to access the survey through the link.

Survey Design

The survey was design in the following order. First we asked for consent to use the participants data for statistical analysis. Second we gave an introduction to artificial intelligence. The survey included demographic questions (Q4.1 - 4.5). Table 1 summarizes the demographic questions and the answers provided to participants. Following the demographic questions is an introduction to AI in the games domain and a question to specify which subdomain the participant belongs to (Q9.2). Those are all the subject variables included in the raw sample data, to answer the research question we will focus on Q9.2 ("What subdomain of the Games program do you belong to"). The variable is divided into the subdomains of the game academy, Programming, Design & Production and Visual Arts. After collecting all the relevant demographic data and giving a clear introduction to our topics the survey conducts questions to measure the knowledge, attitude and acceptance of BUas students. These will be our dependent variables. Relevant for the proposed research question are the measurement relating to acceptance (Q17.1 - 17.5), see Table 1. The questions used to conduct the research have been derived from the validated source "Initial validation of the general attitudes towards Artificial Intelligence Scale" (Schepman & Rodway, 2020), in order to make sure our survey measures acceptance accordingly. Measurements were done by using the Likert scale, measuring acceptance on a scale of 1 to 5, 1 being "Strongly Disagree", and 5 being "Strongly Agree". The Likert scale measures the level of agreement or disagreement of participants on a symmetric agree-disagree scale for a series of statements, AI acceptance in our case. The range of the scale captures the intensity of the participants feelings towards our variable of interest.

Table 1

Demographic Questions

Questions	Answers
What gender do you identify as	
	Male
	Female
	Non-binary/ third gender
	Prefer not to say
To which age group do you belong?	
	<18
	18-24
	25-34
	35-44
	45-54
	55-64
	>65
What is your role?	
	Student
	Staff
How long have you been working and/ or studying in your domain?	
	<1 year
	1-5 years
	5-10 years
	>10 years

Table 2

Artificial Intelligence Acceptance Questions

Questions	Answers
I intend to use AI to automate repetitive tasks	Likert Scale of 1 to 5
I intend to use AI to assist me with creative tasks	we used for all these questions
I intend to use AI in my learning activities	
I intend to stay informed about emerging AI technologies	
How much do you agree with the following statements?	
-I intend to use AI to automate repetitive tasks in the future	
-I intend to use AI to assist me with creative tasks in the future	
-I intend to use AI in my learning activities in the future	
-I intend to stay informed of emerging AI technologies in the future	
-I intend to work with AI in my future career	

Procedure

Students and staff participated in the survey during their free time or when they saw fit. A significant portion of the survey was conducted at BUas, especially in our case. After giving the participants access to the survey the process and order described in Survey Design took place, first giving consent, receiving information about the term "Artificial Intelligence", answering demographic questions, receiving an explanation on "Artificial Intelligence in your domain" joined by answering domain specific questions if needed, this is where the participants answered the question Q9.2 ("What subdomain of the Games program do you belong to"). Following this were the question measuring our dependent variables, knowledge, attitude, acceptance. Participants often had the option to ask questions if questions where formulated in a way that was not clear for them. Responses were recorded regardless of survey completion. Only one submission per participant was allowed. Informed consent was given by selecting "I consent" at the start of the survey. The

study does not involve vulnerable subjects and the risks of informational or psychological harm are minimal, ethical oversight was deemed unnecessary apart form thorough discussion with our project lead Nitin Bhushan.

Results

A total of 105 game academy students out of the 371 students who participated (response rate 28.3%) filled in the survey, of whom 94 contributed to the AI acceptance section of the survey. 41 of those participants belong to the Design & Production domain, 31 to Programming and 22 to Visual Arts, as show in Table 3.

Table 3

Participants per subdomain

Programming	Design & Production	Visual Arts
31	41	22

As stated in the survey design, to measure the acceptance of game students we applied the likert scale to our survey. Of the questions regarding acceptance 7 out of 9 (77.7%) show "Somewhat agree" was the most picked answer, Neither agree nor disagree was the most pick answer for the remaining 2 questions (Q17.3 & Q17.5.3), see figure 1. We need to compare the answers given across subdomains to test the null hypothesis. The null hypothesis states that there will be no difference in AI acceptance across the subdomains of the games academy at BUas. The results of the survey were evaluated using an ANOVA test. An ANOVA test is a way to find out if the results of our survey are significant. It helps in figuring out if we need to reject the null hypothesis. It is important that we use ANOVA for our hypothesis testing instead of a t-test, t-tests work when there are two groups, but in our data we have three subdomains and there for three groups. In order to test if the acceptance is the same across domains we test if the mean of the acceptance is the same. The means being the same, means that we have to accept our null

hypothesis, if there is a difference in the means of the domains we can reject our null hypothesis. To get the mean of AI acceptance per student we aggregate the data so that we only have a column with the selected subdomain of the participant and a column that includes the mean of their acceptance to AI. figure 2 plots the means against the subdomains, from this plot it seems like Programming and Design & Production have a mean that is very similar, were as the AI acceptance of Visual Arts seems to be lower.

Figure 1

Acceptance of AI by Staff and Students of the game academy at BUas

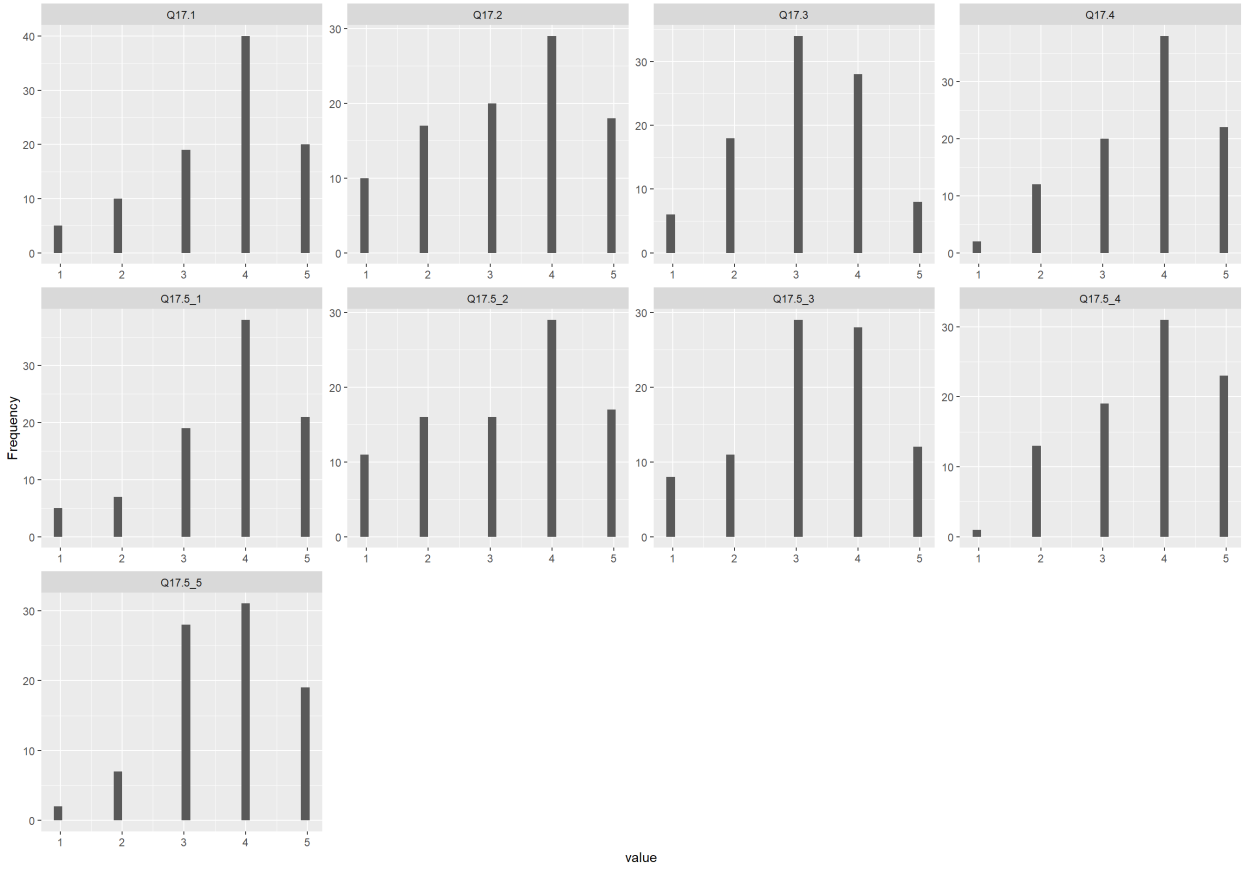

Figure 2

Mean per Subdomains

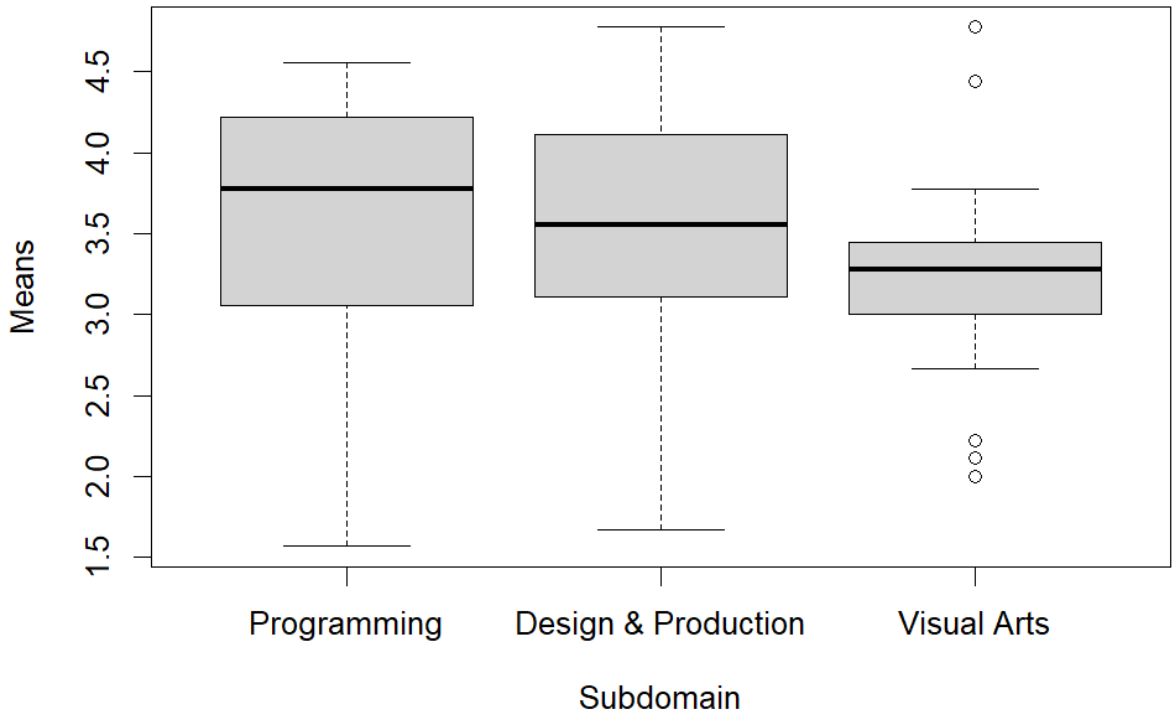

Table 4

ANOVA Summary

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subdomain	2	1.95	0.9732	1.852	0.163
Residuals	91	47.81	0.5254		

Applying ANOVA to the data we can create a summary which can help to determine whether any of the differences between the means are statistically significant, see Table 4. The summary displays a p-value of 0.163. In statistics, the p-value is the probability of obtaining results at least as extreme as the observed results of a statistical

hypothesis test, assuming that the null hypothesis is correct. The p-value serves as an alternative to rejection points to provide the smallest level of significance at which the null hypothesis would be rejected. A smaller p-value means that there is stronger evidence in favor of the alternative hypothesis. Generally, a p-value of 0.05 or lower is considered statistically significant. To elaborate more on the p-value the data was analysed using Tukey's range test or Tukey Honest Significant Differences (TukeyHSD), TukeyHSD creates a set of confidence intervals on the difference between the means of the levels of a factor with the specified family-wise probability of coverage. The intervals are based on the Studentized range statistic. Using TukeyHSD on our sample data provides us with insight into difference between each combination, see Table 5. The first column of the TukeyHSD summary shows the difference between the means of each combination of subdomains. Design & Production - Programming has a difference of 0.02108513, Visual Arts - Programming has a difference of -0.32716567, and Visual Arts - Design & Production has a difference of -0.34825080. The last column of the table 4 show the adjusted p-value for every combination, Design & Production - Programming has an adjusted p-value of 0.9917995, Visual Arts - Programming has and adjusted p-value of 0.2428300, and Visual Arts - Design & Production has an adjusted p-value of 0.1694812. The difference in mean levels of subdomain can be visualized in a graph, see figure 3. I also included a regression summary table to combine with the ANOVA summary table, ANOVA is a special case of regression where all the independent variables are factors. The regression table will give the same results as the ANOVA table, see table 6. The results show that the p-value is not under 0.05. The results in the regression table show that the mean acceptance of AI in the games industry is 3.55696 for programming. Programming is the default value as it is missing from the table. Design & Production has a slightly higher mean of acceptance of AI, the mean is higher by 0.02109, where as Visual Arts has a lower mean of acceptance, lower by -0.32717. These same results can be found in table 5 in the column "diff".

Table 5

TukeyHSD Summary

	diff	lwr	upr	p adj
Design & Production-Programming	0.02108513	-0.3899732	0.4321435	0.9917995
Visual Arts-Programming	-0.32716567	-0.8086207	0.1542894	0.2428300
Visual Arts-Design & Production	-0.34825080	-0.8046838	0.1081822	0.1694812

Figure 3

Difference in mean levels of subdomain

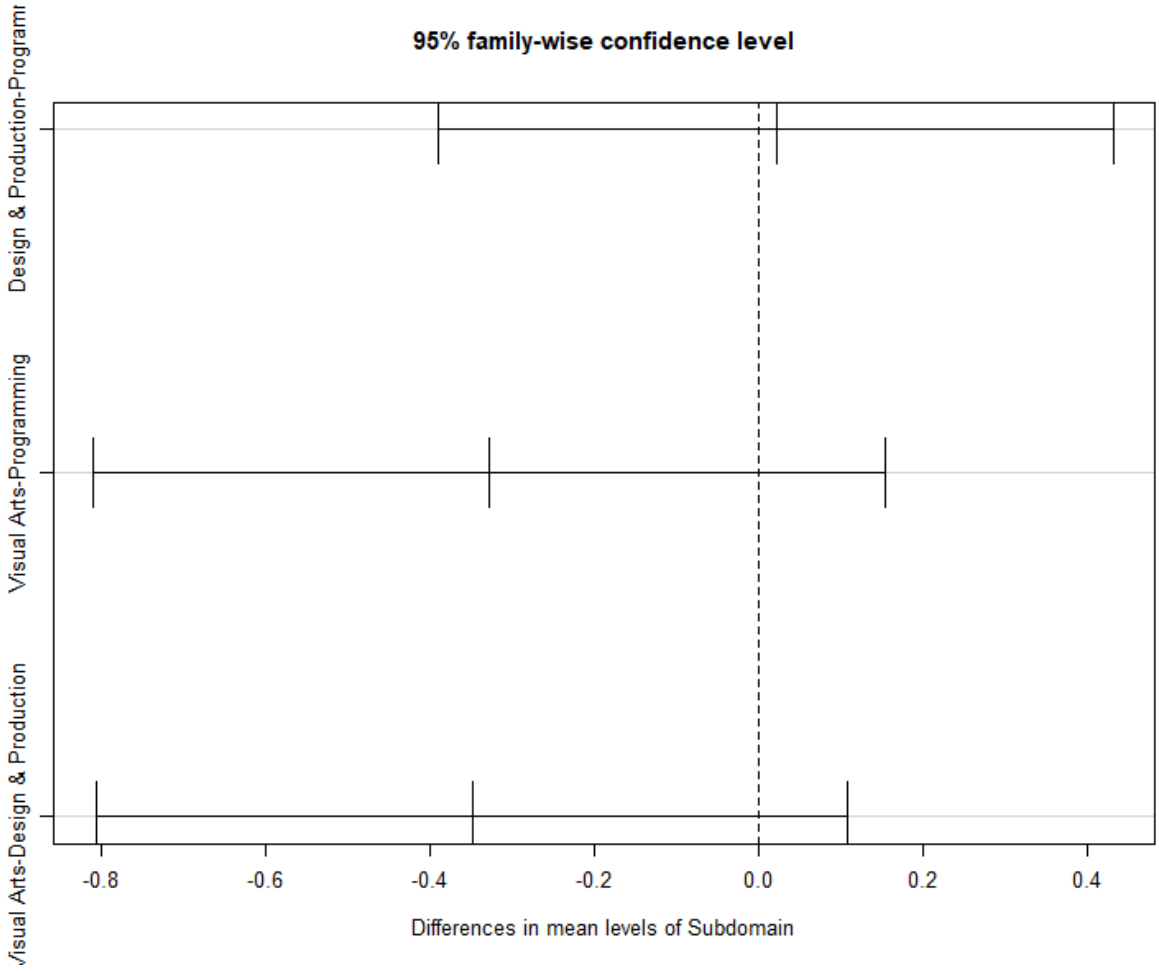

Table 6

Regression Table

Residuals:				
Min	1Q	Median	3Q	Max
-1.98554	-0.46321	0.05106	0.53306	1.54798
Coefficients:				
	Estimate Std.	Error	t value	Pr(>|t|)
(Intercept)	3.55696	0.13019	27.322	<2e-16
Subdomain Design & Production	0.02109	0.17252	0.122	0.903
Subdomain Visual Arts	-0.32717	0.20207	-1.619	0.109

Discussion

The statistical analysis shows that our data when analysed has a p-value greater then 0.05, this means that the difference in mean of acceptance across the subdomain of the games academy is not great enough to conclude that the acceptance of AI is different per subdomain. The results of this survey demonstrate that the mean of acceptance of AI is close to 3.5596 which is the mean of acceptance for Programming, the default value according to the regression table 6. Applying the Likert scale to this mean means that the acceptance of AI by game students is placed somewhere between "Neither agree nor disagree" and "Somewhat agree", leaning to the positive side.

The sample size consists or 41 Design & Production students, 31 Programmers, and 22 Visual Arts students. The research in this paper is conducted to inform policy makers at Breda University of Applied Science about the state of AI acceptance in the game academy. However, in our sample size we can see that Visual Arts students are underrepresented compared to Programming students and Design & Production students. The distribution of students across the subdomains varies for each year and the lower

response rate of Visual Arts students can be a factor that influenced the results of the statistical analysis. In future research it would be recommended to research how many students are studying in the given domain and how the are divided over the subdomains, this way the sample size will be more representative of the game academy and will ensure that the results properly reflect the acceptance of AI across subdomains. With the sample size used for the results in our research the p-value was greater then 0.163 and therefore we can conclude that there is no significant effect of subdomain on AI acceptance. However, the regression table 6 does provide us with the information that the difference between the default value and the mean of Visual Arts (-0.34825080) is greater then the difference between the default value and the mean of Design & Production (0.02108513). Including more Visual Arts students into the sample size might increase this difference. The results show the mean of Programming and Design & Production being very close to each other, increasing the sample size will not change this.

The quantitative data has all been gather using the survey that was distributed to BUas students and staff. However, there is also qualitative data that has been gathered. When asked about the topic AI in games Joe Hobbs and Arnaud Lejeune had two very different responses. Joe Hobbs is a lead prop artist at Ubisoft Annecy, France. Ubisoft Entertainment is a french video game company with development studios across the world. It is know for video game franchises like Assassin's Creed, Far Cry, For Honor, Just Dance, Rabbids, Rayman, Tom Clancy's and Watch Dogs. Joe Hobbs attended Full Sail University where he per sued a Bachelor of Science (BSc) degree in Game Art, he later went on to study at the University of Hertfordshire where he received a Postgraduate degree in Game Art and Design after studying there between the years 2016 and 2017. In September of 2017 he started as a Junior Prop Artist at Ubisoft, there he worked on games like "Tom Clancy's The Division 2" and has been a Lead Prop Artist since January 2019. When reaching out to Joe with a message in which I explained the focus of the research being

conducted and asked if he would be willing to answer a few questions like, how accepting is the industry when it comes to these new technologies and perhaps why the industry might not be very accepting to this concept he answered with the following message "Hey sadly I am just an artist and I am not really qualified to talk on this topic" (J. Hobbs, personal communication, October 19, 2022). After this initial response I followed up with another message. In this message I explained how we have Visual Arts students, a big portion of the game academy is Visual Arts and therefore his opinion on the matter could be helpful for our research question. Here I asked how accepting the industry is towards AI, in his case the visual arts industry inside of the games industry, how he feels about these technologies and if he had any tips regarding AI in the games industry that students at BUas should know about before entering the industry after graduating. His response "We do not use AI to produce art. It is too unpredictable and we need more control." (J. Hobbs, personal communication, October 19, 2022) This response is interpreted as negative when it comes the question "Are Visual Artist accepting of AI in their domain". The response does not indicate that there is no AI acceptance at all, but the statement "We do not use AI to produce art", points to no acceptance in the Visual Arts domain.

Arnaud Lejeune is a Data Scientist at Ubisoft Montréal. He per sued a specialized master in Big Data from Télécom Paris from 2018 till 2019. Here he learned about Machine Learning, Deep Learning, Data Engineering, and Data visualization. When reaching out to him he told me how he is involved with teams that are closed to analytics and User Research, meaning they use machine learning for analysis. They do everything related to player tracking (how players interact with the game), think of text chat, games sales, and activities. Usually that would mean using Machine Learning for clustering, for Natural Language Processing for use cases such as toxicity detection or sentiment analysis, or time series based things like sales forecasting or churn detecting. He sent me some other use cases in which AI was used for game creation or where AI was actively being

implemented into games. AI that gets implemented into games has been discussed in the introduction, Reinforcement Learning, AI for path finding, audio generation, terrain and map generation, and bots. "These, very very cool use cases, are much harder to implement in-game though. Because they take time, money and usually too much compute time to be used directly in-engine. But there are a growing number of use cases out there. So I would not say that the industry is not accepting of the concept, rather that it takes a lot of time to find the right way to use it. But there is definitely a growing number of Data Science, Machine Learning Engineer and Applied (ML) Scientist roles out there" (Arnaud Lejeune, personal communication, October 18, 2022). This response seems to be more positive about AI in the games industry compared to the previous interview. When asked about tips for students when it came to AI in the game industry, Arnaud Lejeune answer with the following: "If the question is: What there is to know about the field, in the industry... I think it is always very important to keep in mind that the end product is a game, and AI is only one of many means to it. Hence it is usually not a core part of the game, and what you are working on can get deprioritized and that can be frustrating sometimes. So it is really important to consider that and not have that in mind." (Arnaud Lejeune, personal communication, October 18, 2022).

The qualitative research here is very different, Arnaud Lejeune seems to be positive about Machine Learning and AI in the games industry, he gives a lot of use cases of AI that gets used to analyse games and player behavior but also AI that gets implemented in games, that gets used for creation. Job Hobbs on the other hand, someone that works on art, makes the statement that for his work, they do not use AI as it is too unpredictable and they need a level of control in their work. Arnaud Lejeune has a technical background with a master degree in big data where as Joe Hobbs has a degree in Game Art. The difference here is that one has a technical degree and the other a degree that focuses on the creative side of the game industry. For future research I recommend conducting more interviews, have the qualitative data collection process be more extensive, including one

professional for each subdomain of the game academy to compare their opinions with the results of our quantitative data analysis.

Conclusion

The mean of the acceptance of AI across the three subdomains of the game academy is not big enough to conclude that there is a difference in acceptance. The mean is around 3.5, meaning there is still room for improvement. the students are currently slightly leaning to a positive side, providing workshops, courses and seminars on AI and how it will impacts their industry might be beneficial, hopefully it will have an positive effect on the students that makes them more accepting of AI bringing the mean closer to 4 or 4.5. The interview with Arnaud Lejeune gives us useful use cases that provide us with insight on how AI is impacting the games industry and it can serve as a guide of what type of workshops or seminars should be given to student. Looking at the subdomains and the difference in their means I would propose treating them very differently. Visual Artist should be given knowledge how they can use AI to their benefit, some industry professionals are not even using this tool yet as stated by Joe Hobbs. Programming should be given workshops on implementing AI into games in a way that improves the game and the experience. Those two uses of AI are drastically different. Design & Production falls a bit in between, giving them workshops on how AI can be beneficial from a creative and technical standpoint could improve their willingness to use AI more.

Limitations

The majority of the research limitations have already been stated in the discussion section. The sample size was not representative and it would have been beneficial to conduct more interviews with industry professionals to gain qualitative data that represents every subdomain in the games academy.

References

Cook, M., Colton, S., & Gow, J. (2016). The angelina videogame design system—part i. *IEEE Transactions on Computational Intelligence and AI in Games*, *9*(2), 192–203.

Isla, D., & Blumberg, B. (2002). New challenges for character-based ai for games.

Schepman, A., & Rodway, P. (2020). Initial validation of the general attitudes towards artificial intelligence scale. *Computers in Human Behavior Reports*, *1*, 100014. https://doi.org/https://doi.org/10.1016/j.chbr.2020.100014