Prescientific paper

On the utilisation of videogames in secondary school using the example of Minecraft and Kerbal Space Program

submitted by

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Abstract

This paper looks at the usefulness of videogames in a school environment and points out their flaws and advantages. It uses the example of the videogames “Kerbal Space Program” and “Minecraft” to demonstrate its points. Though humans have played various games for years, the question of whether we can incorporate videogames into education has only been relevant for the last 50 years. The popularity of this question arose again in the 2000s with the development of the Unity engine, one of the most common and easiest to use game engines.

The author describes the general strong and weak aspects of teaching with videogames and shows the difference between teaching with videogames and gamification. Aside from that, there is a section focused on the two selected games and their usage while teaching specific subjects — computer science in the case of Minecraft and physics in the case of the Kerbal Space Program. To get a greater understanding of the issue at hand, the author conducted two interviews with experts from opposing sides of the debate, Karen Schrier and George Koulouris. Both of them influenced the work at large. Finally, the author makes the supposition that, while more studies and research is necessary to assess the practical effectiveness of educational videogames, in theory, videogames, if used correctly, are helpful while teaching.

Abstract

In der vorliegenden Arbeit wird der Nutzen von Videospielen im Schulunterricht untersucht und deren Vor- und Nachteile analysiert. Die beiden Videospiele „Kerbal Space Program“ und „Minecraft“ werden dabei als Beispiel verwendet. Obwohl Menschen seit Jahrtausenden Spiele spielen, stellt sich die Frage, ob wir Videospiele in die Bildung miteinbeziehen können, erst seit 50 Jahren. Mit der Entwicklung der Videospielengine Unitiy-Engine bekam diese Frage in den 2000er Jahren wieder neue Popularität, da man damit sehr einfach und kostengünstig Videospiele für den Schulunterricht erstellen und modifizieren kann.

Der Autor beschreibt die allgemeinen Stärken und Schwächen des Lehrens mit Videospielen und zeigt den Unterschied zwischen „Lehren mit Videospielen“ und „Gamification“. Weiters zeigt der Autor mögliche Einsätze des Videospiels Minecrafts im Schulunterrichtsfach Informatik und Kerbal Space Program in Physik, basierend auf den österreichischen Lehrplänen der Sekundarstufe. Zum besseren generellen Verständnis des Themas Lehren mit Videospielen führte der Autor zwei Interviews mit den Expert*innen Karen Schrier und George Koulouris. Beide haben die Arbeit stark beeinflusst. Die Arbeit schließt der Autor mit der Hypothese, dass zu dem Thema mehr praktische Forschung nötig wäre um die Effektivität von Lernvideospielen wirklich gut beurteilen zu können, obwohl es schon vereinzelt Beispiele aus dem Unterricht gibt, bei denen Videospiele gut funktioniert haben.

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1 Teaching with games

Even in the Middle Ages, people were aware of the power of interactive learning experiences, for example, when they taught strategy and strategic thinking with board games. Then, in the early 19th century came the creation of kindergarten, by Friedrich Fröbel, which was based on learning through play. The children spend their time there learning in a fun environment.[1]

Explored in this chapter will be the differences between all the teaching methods that utilise games or their concepts and also all the points in which games excel, when it comes to teaching, and where they fail.

However, what can't be overlooked regarding using games for teaching is their historic success, which is to say, not much. The first learning machine/game was the teaching machine developed by Sidney L. Pressey in the mid-1920s, which administered multiple-choice questions that had to be answered correctly before the student could move on to the next problem.[3] Such a machine should be effective according to, for example,

Figure 1 Pressey's Teaching machine[2]

[1] cf. Shelton (2011 p. 83–106)

[2] Teaching machine (o.J)

[3] cf. Petrina (o.J.)

Skinner's behaviourism because it reinforces desired behaviour through positive affirmation.[4] However, as George Koulouris pointed out in the interview made for this work[5] , even with the "support" of so many great qualities such as promoting choice, interaction, positive affirmation (e.g., through a candy dispenser[6]), these machines never caught on. The production cost of the machines, practical ineffectiveness and the era of the Great Depression were some of the reasons why this happened.

1.1 The different approaches to games in education

Games vs Game-Based Learning (GBL) vs Gamification

© K.Becker 2016	Game	Serious Game	Game for Learning (G4L)	Gamification
Basic Definition	This term includes all the other categories ***except*** gamification.	A game ***designed*** for purposes other than or in addition to pure entertainment.	A game ***designed*** specifically with some learning goals in mind.	The use of game elements in a non-game context.
Purpose	Can be for any purpose.	Change in behaviour, attitude, health, understanding, knowledge.	Normally connected with some educational goals.	Often used to drive motivation, but can also be used to make something more playful and game like.
Concept Catalyst	Core Amusement.	Message.	Performance or Knowledge Gap	In learning it usually impacts HOW things are taught and administered rather than WHAT is taught.
Focus	Player Experience *(how)*	Content / Message *(what)*	Content / Message *(what)*	User Experience *(how)*

Figure 2 Terminology of learning + games[7]

The provided infographic/table (Figure 2) will clarify any misconceptions or mistakes in terminology. The most significant difference is between serious games/G4L and gamification, as the former are games while the latter only utilises concepts from games. While the "purpose" row shows that all of the "columns" can share some elements, the closer to the right side they are, the more specific and specialised they are. The "focus" row follows this rule and shows what the end goal of each "column" should be.

[4] cf. Skinner (1968)

[5] cf. George Koulouris (2019) 8:59-9:54

[6] cf. Benjamin (1988 p. 703–712)

[7] Becker (2016)

Gamification, in short, is the process of taking game mechanics, concepts, or elements and applying them in a non-game context. It's also defined as a set of activities and methods to solve problems by employing the characteristics of game elements. Gamification should improve user engagement, organizational productivity, flow learning, crowdsourcing, etc. Although the research suggests gamification has a positive effect on a number of people, individual and contextual differences exist. For example, badges boost morale, placement ladders incite competitiveness, and "side quests" (voluntary work) increase engagement.

Gamification and games aren't the same, although if someone wants to gamify their workplace, they must think like a game developer. In theory, gamification should break the stereotype that work, and fun are opposite sides of a spectrum. Gamification should unite fun and work to make the employees more involved in the company and interested in their work.[8] [9] [10] [11]

On the other hand, serious videogames carry a specific message that the player should absorb through the gameplay. It can be anything from ethics to morals, while G4Ls are specifically meant and tailored to teach some specific subject.

1.2 Pros and cons of serious videogames/G4L

In this subchapter, there will be presented the beneficial and detrimental aspects of serious videogames and G4L.

1.2.1 Visualisation and immersion

> *"When a person creates a spatial arrangement (including a mathematical inscription), there is a visual image in the person's mind, guiding this creation. Thus, visualisation is taken to include processes of constructing and transforming both visual mental imagery and all of the inscriptions of spatial nature."*[12]

[8] cf. Kumar (2015)

[9] cf. Paharia (2011)

[10] cf. Kapp (2012)

[11] cf. Interview with Karen Schrier

[12] cf. Presmeg (2006 pp 3-4)

The first thing that comes to mind is something that almost no other media can provide, and, if they do, it's on a much smaller scale: visualisation. The option to see what you are learning is, for many students, ground-breaking. For example, physics, can be made simpler with a visual representation of the experiment or process. But there is even more potential with games.[13]

Further, applying games in learning combines experiential project-based learning and technology utilisation in a real-life environment. Games can include a robust and rich backstory and visuals that immerse the pupils in an imaginary world. This helps to simulate a great variety of phenomena and subject matters. Experiencing something first-hand deepens the learning and creates a strong memory.[14]

1.2.2 Variety

As laid out by Keri Facer, in her speech in the “Haus der Kulturen der Welt”, schools should prepare students to be flexible, because the future is entirely unpredictable. Schools must build the capacity to play with time, experiment with how change happens, use subjects to face the future, not the past, as well as teach young people how to deal with emotions of working with the future, like nurturing, friendship, love, and community.[12]

Games can help with every single one of these points. Thanks to the variety of games, you will always find some that fit each criterion, and the persons involved genuinely enjoy the game. For example, building communities is a staple of an entire genre: MMO and MMORPG.[12]

One of the biggest problems of today’s education systems is “enlightenment-like over-specialisation”[15]. With its explosion of new information and the invention of the printing press and new publishing systems, the system needed a new form of education that enabled the scholar to deal not only with the preservation and analysis of what was already known but also the production, theorisation, and incorporation of fundamental knowledge.[16]

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[13] cf. Presmeg (2006)

[14] cf. Teaching with Games (o.J.)

[15] cf. Welt (2017)

[16] cf. Welt (2017)

1.2.3 Choices

It's hard not to emphasise this simple point. With the appropriate guidance, the learner can absorb much more information from the lesson if they try something for themselves. The feeling of agency and autonomy creates the impression that players can control every element, from all moments to the various actions the player may take. This feeling leads perfectly to the next feature of educational games.[17]

1.2.4 Motivation

This point is somewhat contested by many factors.

On the one hand, a study by the National Foundation for Educational Research shows that classes that used the games saw more engagement and motivation among students as well as teachers. Still, they themselves pointed out that this motivation may stem from the new method alone. That means the students were excited to try something new in the school. And to add insult to injury, the motivation didn't always help with learning at all. It just made the learning more interesting without speeding up or enhancing it in any way.[18]

On the other hand, many other researchers agree that motivation boosts academic performance.[19] [20] [21] The whole motivation point stands on the understating that the opposite of fun isn't work but depression; therefore, fun and work aren't mutually exclusive and can be combined.

1.2.5 Problems of educational games

As with anything, there are problems with teaching methods that utilise games. The most obvious is the previously mentioned cost of the game and the equipment that is required to run it. That is the problem Pressey faced in the mid-1920s, and it hasn't changed a bit. Public schools aren't funded for this type of technology. We can only hope this will eventually change.

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[17] cf. Lowe (2004 p. 257–274)

[18] cf. Sandford et al. (2006)

[19] cf. Kusurkar et al (2013 P. 57–69)

[20] cf. Hoskins a Hooff (2005 p. 177–192)

[21] cf. Wigfield a Cambria (2010 pp. 1-2)

Another problem is time. New teaching methods shouldn't take so much time to implement that they're unfavourable to use. Even though today's generation grew up with tablets in hand, you can still encounter young people who are unable to save a Word document. Furthermore, games, being games, are controlled differently, and people take time to adapt to them and learn the basics. Sometimes, adapting takes so much time that no time is left to learn the actual subjects. This is, for example, one of the biggest problems for Kerbal Space Program the game that is talked about in the next chapter. It's a complicated game and so to learn something with it requires hundreds of hours, which schools don't have.

Simply put, the second most significant problem is the unfamiliarity with the game's controls on both sides, both students and teachers.[22]

Moving on to the scales of "entertainment" and "effectiveness." The primary goals of educational games are fun and teaching something so not to tip the scales in any direction is complicated. If the game is too "amusing" and doesn't teach the subject properly, then it's irrational to use it in classrooms, although it can still be used in lunchbreaks or afternoon clubs. If the game is too "educational," and the students are bored and don't want to play it on their own, then it's pointless to introduce the game in the first place.[23]

The last issue is the unfamiliarity of this whole concept of teaching with video games. The text adventure, where the player plays a wagon leader guiding the of party of settlers, Oregon Trail is considered to be the first educational videogame, and that found its way into schools in the late 1970s. That's just fifty years ago. The science community needs more time to study and develop educational games before they are ready to be used in classrooms[24]

[22] cf. Sandford et al. (2006)

[23] cf. Sandford et al. (2006)

[24] cf. Zhen (o.J.)

2 Kerbal Space Program and its uses in the subject physics

Kerbal Space Program (further on, KSP) is a game developed by “Squad,” run on the “Unity” engine and published by the “Private Division” on the 24th of June 2011[25]. It is an almost genre on its own with unique and exclusive mechanics, use of real-like physics, and, most of all, a big learning curve. The physics and the learning curve are the biggest pluses for the game, as it almost forces the player to learn real-life physics and struggles of a spacecraft designer/builder/pilot, all in one, to be better at the game. While it is hard to start, once you learn the basics, the momentum carries you further and further.

First, you start with an underfunded Space Program (further on, simply SP), with only a few parts to build your first spacecraft (more of a "capsule" than a spacecraft), and a single, super inexperienced pilot. After you complete your first launch (and quite likely your first crash), you will learn that pilots die and (if not adjusted in settings) never come back and, of course, that parachutes are unreliable.[26] You will then use your science currency to purchase more pieces to improve your spacecraft and accept for-

Figure 3 Kerbit parachuting to the surface of Eloo[27]

eign contracts to expand your wealth and keep your SP running. Apart from building spacecraft and piloting them, you must manage your SP. Some examples of this are funding, policies that will influence public opinion about you, staff management, and

[25] cf. Kerbal Space Program (o.J.)

[26] cf. Kerbal Personnel Parachutes are Wrong. (o. J.)

[27] cf. Kerbal Space Program (o.J.)

completing contracts to support the actual existence of your SP. This way, the player/student has to deal with the consequences of their actions (apart from the not-so-real death of his kerbit astronauts).[28]

The game is a non-linear game, which means there is no real path/story, and also, in this particular case, no end. The "endgame," as most of the gamers would call it, are big space stations, with multiple stages and de- and then re-attachable parts, landing on other planets, and setting up orbiting (permanent) space stations.[22]

Thanks to this "endless game" possibility, the game has limitless potential.

Moreover, there is a wide variety of mods. Because the game was made using the wildly popular (and pretty easy-to-use) engine "Unity," it is relatively easy to create mods, which change the game to various degrees. Some add a vertical/horizontal speed meter, while others add one-hundred more pieces to use to build your space-craft. Not all of these mods are useable in the school setting, as they are fan-made and not always scientific, but the possibility means that teachers can modify the game as they see fit.

2.1 Hardware requirements

The minimal requirements for Kerbal Space Program are the following:

- CPU: Core 2 Duo
- RAM: 3GB
- VIDEO CARD: GrphSM3 512MB VRAM
- FREE DISK SPACE: 4 GB[29]

While there is no need for a quantum computer, for the ordinary school computer, it could pose a problem, should many objects and processes be on the screen at the same time.

2.2 The G4L version of Kerbal Space Program

The original game code does an excellent job of simulating many laws of physics, for instance, angular momentum, torque-induced precession, and conservation of angular

[28] cf. Kerbal Space Program – Create and Manage Your Own Space Program (o. J.)

[29] cf. Kerbal Space Program Requirements Test (o. J.):

momentum[30]. Nevertheless, there are some unrealistic things. For example, asparagus staging, or stable orbital physics (real-life physics are much more dynamic), as well as the weight and size of some parts[31]. These simplifications served to make the game more available for the general public, however, with the help of a mod, specifically Realism Overhaul, that rescales the size of the pods, engines, and other parts)[32], as well as uses real fuel and science experiments, the teacher can show the design as it is used in actual space travel. With or without Realism Overhaul, students can use the sandbox mode and calculate everything before launch and then test it to see if they made any mistakes. This Realism Overhaul version is free and, therefore, available for every student. Still, this is just a fan-made version and consequently contains errors as well. For example, it does not account for some of the deficient physics in the original game ("on-rails" physics and weather conditions).

Almost all the issues are fixed in the KerbalEdu version[33].KerbalEdu is a version of the game accessible in the "teacher gaming" store for 40€ for a regular customer and 17€ for students and teachers. This version combines Realism Overhaul with the Real Solar System mod and even adds a lot of helpful features. These features are explained shortly in the following paragraphs.

2.2.1 Energy spheres

Attachable feature, which will visualize the relation of the potential and kinetic energy of the ship.[34]

[30] cf. Randy (2016)

[31] cf. Hinton (2017)

[32] cf. Theysen (2019)

[33] cf. KerbalEdu (2014)

[34] cf. KerbalEdu - Features (o. J.)

2.2.2 Force arrows

A detachable feature that shows the direction of forces affecting your craft and possibly altering its path. The feature takes the form of holographic arrows.[32]

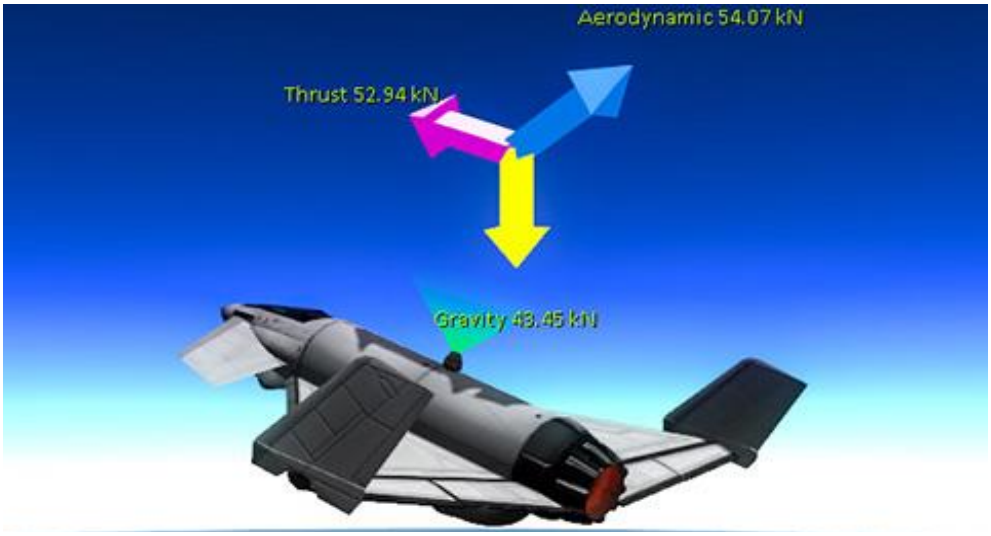

Figure 4 Force arrows[35]

2.2.3 Design helper

With its two tabs, Design data and Data select, it can help you with the assembly of the rocket. Design data will allow you to see the specific information of your choosing, to be displayed in the Design data tab, to permit more straightforward calculations and predictions — for example, mass, thrust, or delta-v of your vessel. There is a lot to choose from; the skill is to use the information you need. You can change what information will be displayed to the students in the Mission editor tab.[32]

2.2.4 Resource flow analysis

Activated by a click in the Design Helper, this function will help you manage your resources. It will show what parts use/produce what resource (like Oxidizer or Liquid fuel) and from/to which part.[35]

[35] cf. KerbalEdu - Features (o. J.)

2.2.5 Flight recorder

As the name suggests, it records various physical data about the flight. The data is stored in CSV form and is exportable. Almost every spreadsheet software can open it (e.g., Excel, etc.) You can also export a .png or a .pdf of the in-game graphs. You can use the flight recorder as part of the KerbalEdu lesson reporting, explaining the various stages and events that occurred during the flight.[36]

Figure 5 Flight recorder [36]

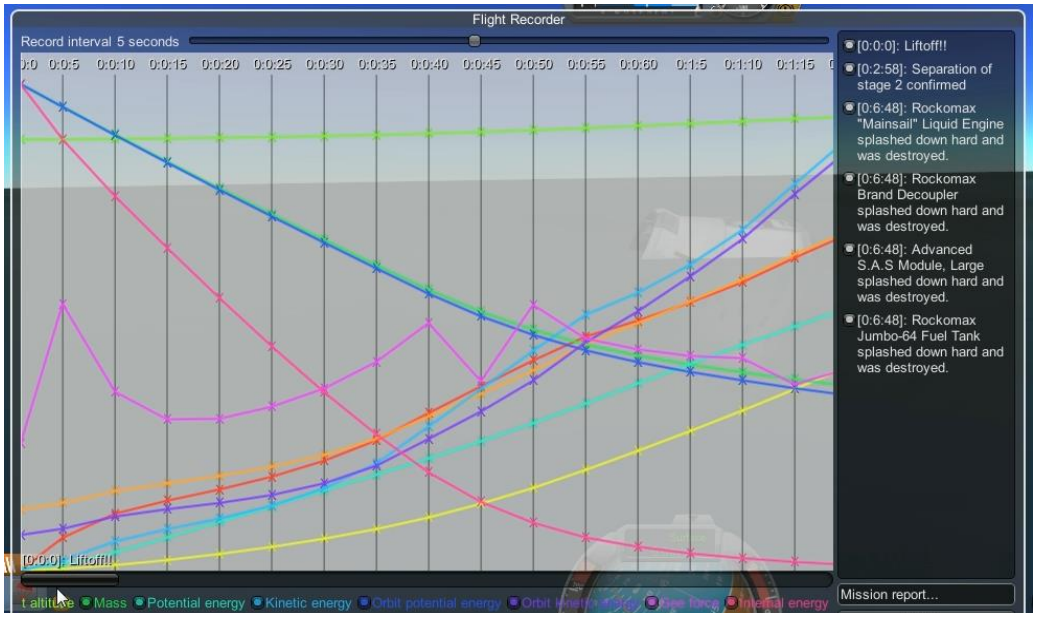

Figure 6 Flight recorder [36]

[36] cf. KerbalEdu - Features (o. J.)

2.2.6 Function tool

This can be used to demonstrate multiple physical laws and equations. It is a graphical interface for creating mathematical functions. These functions are evaluated in real-time during a trip, and their results are recorded in the flight recorder.[37]

2.2.7 Mission library

This includes pre-made lessons that encourage open-ended problem-solving. These missions can be found and launched from the KerbalEdu website, or they can be downloaded and then started manually. Examples include experiments that require students to upgrade existing aircraft designs or construct staged modules for specific missions' types.[37]

2.2.8 Mission editor

This is used to create custom missions for the students that are ideally suited for the lesson. With the feature to import saved versions from the game, complex scenarios can be created. For the lesson, aspects of the game can be disabled or enabled. In addition, there is a whole online community of fellow teachers and students.[37]

2.3 Usage of KSP to teach Physics according to the curriculum

With the educational version, it is possible to teach parts of the Austrian curriculum to kids between 14 and 18. The following parts were selected and translated by the author.

- The students should be able to explain, within the scope of thermodynamics, states and state changes of matter with the help of the particle concept, mastering the sustainable use of energy and he should be able to understand the meaning of the thermodynamic laws.[38] Thermodynamics is mostly relevant during descend/ascend, where the spacecraft must survive the generated heat. You can also check the generated heat in the flight recorder

[37] cf. KerbalEdu - Features (o. J.)

[38] cf. Lehrplan für die Allgemein bildenden Höheren Schulen (AHS)1

- With the help of the theory of motion, the students should be able to develop an understanding of processes, for example, in the traffic or the planetary movements.[39] This can be taught with the energy spheres and force arrows.
- The students should know the order of magnitude and assess their position in the universe.[40] KSP is perfect for this part of the curriculum because the best way to understand how small you actually are is to see it for yourself. “Teachers’ gaming” also provides lesson plans for teaching Newton’s first law of motion.

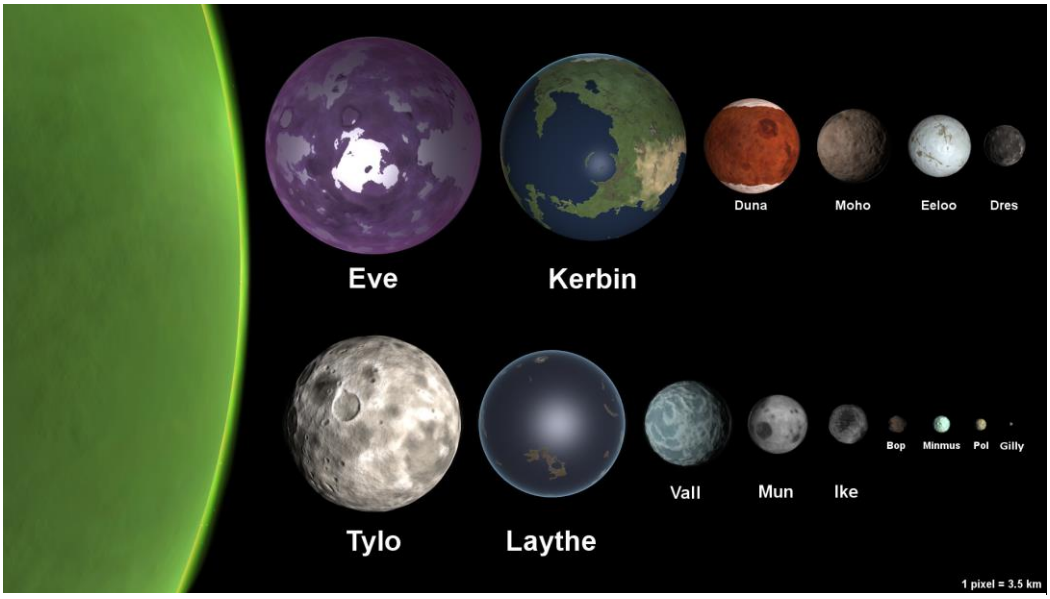

Figure 7 Order of magnitude of KSP planets. [41]

The cons of teaching with KSP are the same as those associated with all the games (Chapter 1 page 10-11), but it is worth pointing out the most prominent problem that students and the teacher will encounter: the difficulty of the game and licensing. In some schools, students have to bring their own devices, which can result in a lot of issues. For example, the school has to buy many copies, and it also has to be responsible for all of them because it bought them with the school’s discount.

Finally, to my knowledge, there are unfortunately no studies, that compare or test the helpfulness of KSP in schools. But a few users on Reddit and KSPedu forums have said they used them in their schools with a certain degree of success. One of them mentioned that, in his class, it was used to teach velocity.

[39] cf. Lehrplan für die Allgemein bildenden Höheren Schulen (AHS)1

[40] cf. Lehrplan für die Allgemein bildenden Höheren Schulen (AHS)1

[41] KerbalEdu - Features (o. J.)

3 Minecraft and it's uses in the subject Computer Science

Minecraft is a pixel-style, sandbox, survival game developed by Markus "Notch" Persson and released by Mojang in 2009. It is written in Java, bought by Microsoft in 2014[42]. It has multiplayer and singleplayer modes, and thanks to the programming language, it is easily modifiable. This game birthed the genre of the sandbox; it's effortless to play and has almost no hardware requirements. This makes it perfect for underfunded schools as an excellent alternative to other educational media.

There are two "modes" in the vanilla version of the game—creative and survival. In creative mode, the player is invincible, can fly, and has access to the complete roster of the blocks. This mode is used to build entire cities and serves "just for fun" purposes as it provides no challenges that the player doesn't establish him/herself.

On the other side of the spectrum is survival mode. In this mode, the player has a limited number of health points, s/he can respawn an unlimited number of times but loses everything at the moment of death; the player has a "hunger" bar and must consume substances so as not to expire. The player starts on a world generated by a random seed, featuring many different biomes, for example, frosty mountains, deserts, swaps, jungles, forests, icy lands, and many many more. The final goal of survival mode is to find twelve endern pearls and defeat the endern dragon.

[42] cf. Minecraft System Requirements (o.J.)

3.1 Hardware requirements

Minimal requirements for Minecraft are the following:

- CPU: Intel Core i3 3210 | AMD A8 7600 APU or equivalent
- RAM: 4 GB RAM
- HDD: 180 MB to 1 GB available space
- GPU: Intel HD Graphics 4000 or AMD Radeon R5 series | NVIDIA GeForce 400 Series or AMD Radeon HD 7000 series[43]

Thanks to the simplistic graphics and the configuration, the ordinary computer should be able to run Minecraft, as long as users don't blow up 5000 TNTs or set an entire forest ablaze.

3.2 The educational version of Minecraft

As mentioned before, Minecraft's easy program language allows almost anyone to create a mod for the game. A lot of these mods could be used but shouldn't be relied upon. Thankfully, in 2016, Mojang AB and Xbox Game Studios[44] developed an Education Edition. The product is affordable. The full game costs 4.5€ per user per year to use, depending on school size. The product offers a variety of lessons across many fields of science to players of all ages (from 3–5 up to 18+). The lessons range from Fairy Tale Reimagined to One Health/Vector Control.[45]

Each lesson comes with a lesson plan, which includes Learning Objectives (self-explanatory), Guiding Ideas (containing class discussions, mini-lessons, etc.), Student Activities (consisting of independent or cooperative activities and Extension Activities, with room for extra credit) and, finally, Performance Expectations (also self-explanatory). The teacher can add his/her notes to the lesson as well as refer her/himself to the provided External Links.

This edition provides a series of improvements, including but not limited to:

[43] cf. Minecraft System Requirements (2019, 18. September)

[44] cf. Education Edition (o.J.)

[45] cf. TeacherGaming (o.J.)

3.2.1 NPCs

Teachers can create Non-player characters (NPC), which will guide the students and provide instructions as well as web links to additional references. The teacher can also program the NPC to give a quiz or move and guide the students through the world.[46]

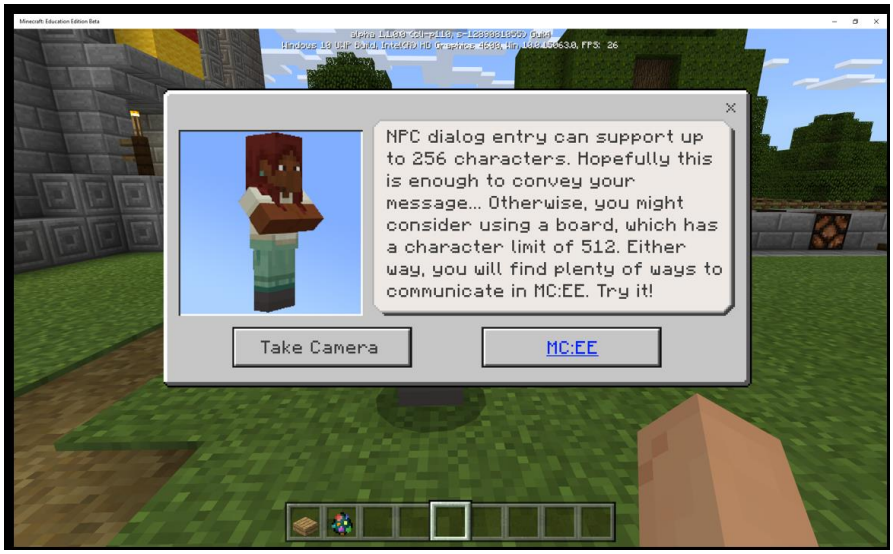

Figure 5 NPC[46]

3.2.2 Chalkboards

The chalkboard can be used to provide explicit instructions within the game; they come in 3 sizes. The teacher can set up who can and cannot write on the board.[43]

Figure 6 Chalkboards [46]

[46] cf. Education Edition (o.J.)

3.2.3 Portfolio

A camera and portfolio can simplify the collection of evidence of learning. Students can screenshot their work and document the development of their projects.[44]

3.2.4 Code builder

A code builder and a coding agent allow students to write code in a code builder, and the agents will then execute it in the game. The teacher can select the programming language in which the code builder will operate. The default setting is a scratch-like design, which is mostly used to explain the basics of programming (like if, else, true/false, etc.) in a simplified matter.[47]

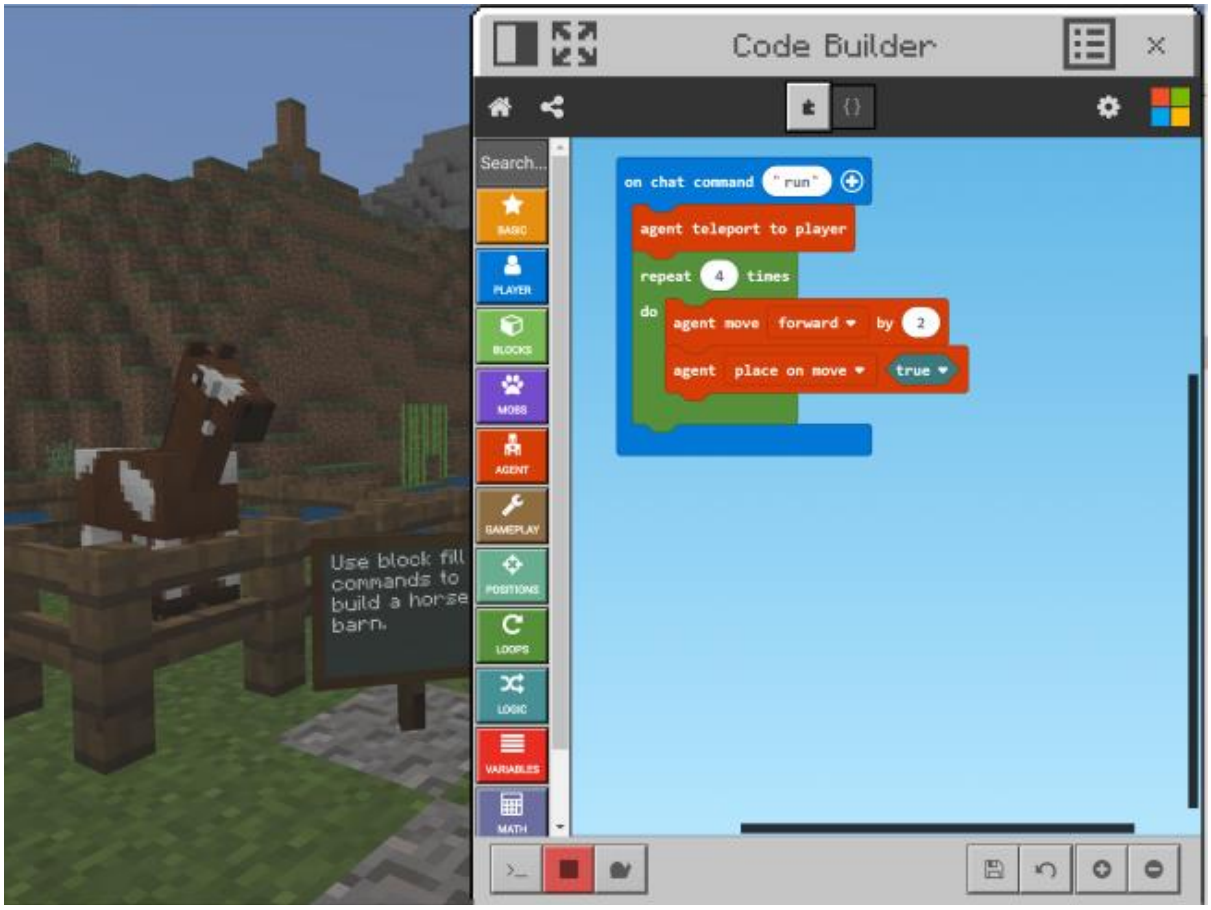

Figure 7 Codebuilder [47]

[47] Education Edition (o.J.)

3.3 Usage of Minecraft to teach Computer Science as part of the curriculum

With the educational version, it is possible to teach parts of the Austrian curriculum to kids between 14 and 18. The following sections were selected and translated by the author.

- The students should get to know applications of computer science in different professional fields, and thus find support in their career orientation and they should learn the appropriate use of communication and cooperation systems and evaluate their significance for myself and society.[48] Because of its sandbox nature and because the Minecraft Edu website provides a lesson for this specifically, it seems innate to use the game for this.
- The students should be able to name essential aspects of procedural, functional, and object-oriented programming and explain in an example."[49] This can be explained using the code builder. The advantage over, for example, just Sublime Text or Codeacademy, is the visuality of Minecraft. The students can see precisely what affects what and, therefore, should be able to remember it better. The disadvantage is that this visuality isn't present in the real working world.

At first, it doesn't seem like a lot compared to all of the KSP features, but Minecraft has way more means of usage, as it doesn't have to be utilized to teach only computer science. The website has a wast the list of lessons, where the possibilities are nearly infinite.

The flaws are the same as with all the educational games (Chapter 1, page 10-11), with the exception of difficulty and with the addition of teaching just concepts and nothing specific. With

The Microsoft website provides a lot of examples confirming the success of educational Minecraft. The game was used to boost motivation and speed of learning in PaRK International School[50], in Glenwood High School it was used to teach the kids

[48] cf. IFD - Startseite (o. J.):

[49] cf. IFD - Startseite (o. J.):

[50] cf. Park International School (January 24, 2018)

about today's technology and expand their horizons[51], Aldar Academies demonstrated how quick the roll-out could be[52], MRSM Tun Mohammad Fuad Stephens Sandakan used it to engage students in STEM fields (STEM is an acronym for the fields of science, technology, engineering and math)[53], and lastly, Charlotte-Mecklenburg Schools showed, the grand learning outcomes the game can have.[54]

There is only one problem with those examples: they aren't studies. The game was provided to the schools, and then they wrote an article on Microsoft's website. It undermines the power of those articles, as they are no more than stories because they don't provide raw data. So, it wouldn't be false to conclude that, to my knowledge, there aren't any studies that evaluate the effectiveness of Minecraft education unbiasedly.

[51] cf. Glenwood High School (January 24, 2018)

[52] cf. Aldar Academies (September 25, 2018)

[53] cf. MRSM Tun Mohammad Fuad Stephens (November 14, 2018)

[54] cf. Charlotte-Mecklenburg Schools (January 24, 2018)

4 Interviews

There were two interviews conducted. One with George Koulouris and one with Karen Schrier. Both of them were recorded, and a transcript was made for the one with Karen Schrier.

4.1 George Koulouris 17. 11. 2019

George Koulouris is an English entrepreneur, and a founder of Bitlearn.io, an educational service for adults[55]. He served the role of a sceptic because even though he is an online educator, in the interview, he mentioned that, as far as he knows, educational videogames hasn't had much success[56] and education and fun should be somewhat separate, because learning means, forcing yourself to do something out of your comfort zone.[57]

The interview was approximately 45mins, and at the start, George mentioned, that he doesn't like the sterile kind of interview, where he is just asked a bunch of questions, and he answers them because he is more in favour of the dialogue-like interview. In the interview, George compellingly presented his arguments about serious videogames, which were mostly concerns. These concerns stemmed out of his experience, with them as an online educator, but they originated from history as well. He mentioned the teaching machines (Chapter 1, page 6), and he allowed me to use this example.

4.2 Dr. Karen Schrier 22. 10. 2019

Dr. Karen Schrier is Associate Professor of Games/Interactive Media, Director of the Play Innovation Lab, and Director of the Games and Emerging Media program at Marist College. She has a doctorate from Columbia University, a master's from MIT, and a bachelor's from Amherst College.[58] She served the role of supporter. She wrote three books on education/games and used games to teach.

[55] cf. George Koulouris (2019) 0:20-1:45

[56] cf. George Koulouris (2019) 8:26-9:00

[57] cf. George Koulouris (2019) 6:30-8:10

[58] cf. Karen (o.J.)

The interview was 24mins, Karen was presented with nine questions to answer, which she answered in great detail. She explained the differences between gamification and serious videogames. She talked about developing some serious videogames, for example, Mission US, which is a text adventure used to teach morals and history.
She also mentioned that her colleague uses games in his all-boys school to teach literature (Protocols page 40). Her final take on this topic was that serious videogames are a versatile tool and can be used in a specific situation to enhance the teaching experience.

5 The final verdict

After analysing all of the provided research, the conclusion of the effectiveness of video games in education is inconclusive. Although theoretically, video games should be useful in education, there isn't solid proof.

While games differ in the positive aspects they provide, the problems mentioned in 1.2.5 are relevant in all of them. For example, "the unacquaintance with this whole concept of teaching with video games" is enough of a problem to stop video games from being used entirely. It doesn't matter how good the game is; if the teachers or the students aren't capable of playing them, then it doesn't teach anything.

It all comes down to "we aren't prepared yet," as most public schools don't have the proper equipment, or the teachers/students aren't used to working with computers. However, there is still a possibility of video games being beneficial to education. As mentioned before in the interview with Karen Schrier, she states that she uses games, like Call of Duty or Papers, Please to teach ethics. Neither are considered educational video games and are rather the opposite as Call of Duty has been falsely portrayed as a video game that increases violence in young people.[59]

While the option to teach with games is there, it is rather rare and challenging. Also, it seems that the usage of games can be more beneficial in case of more abstract subjects, like philosophy, than "every day" subjects that require highly specialized games, which can then fail in the scales of "entertainment" and "effectiveness."

It is still safe to say that games aren't used in school as often as they could be.

[59] cf. Stuart (2019)

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7 Table of figures

8 Protocols

Matouš:
And let's proceed.
Matouš:
So I already send you the question per email, but I'm gonna repeat them, so they are on the record, could you please tell me your name and give me a short description of how your work is related to serious videogames in education.
Karen:
Sure my name is doctor Karen or Kat Schreier. I am an associate professor and director of games at Marist College in New York United States. I have been researching teaching and designing games for the last twenty years.
I have been specifically focused on using games to teach to inspire to help people grow.
Karen:
My focus has been on using games for perspective-taking, empathy, compassion, and teaching ethics. I have also focused on teaching social studies, STEM you name it, I'm interested in all areas of teaching using games. One example.
Karen:
It's a book that I have coming out right now; it's the third book in a series. Its called “learning education and games” it's a free book that you can download from the ETC press and the third book will be coming out in the next month or so and it's called a “hundred games to use in the classroom and beyond” the other books the first book was on.
Different design and ….Different design.
Needs and considerations, and then the second book, was more about learning context and understanding how to incorporate games in general, but this third book is really on case studies of using games in the classroom.
Matouš:
Thank you very much.
Matouš:
Will move on.
Matouš:
The next question is: what can be taught with serious video games that can’t be shown or taught with other classical educational media like Audio-CDs or films? Is there any benefit for the students?
Karen:
Well, I mean again, it depends on the game; it depends on how it's designed.
Karen:
It depends on a lot of things, so, for example, you know you have to really think about, like what is the goal of the learning that you'd like them, you know what do you want the students to learn, who are the students.
Karen:
What are their needs, what are their preconceptions, what are their myths and then you want to design an experience for the that supports whatever gaps they have and helps them grow in a certain way, now does that have to be a game, not necessarily

are you know, it's a really about design it's about designing an experience that fits that particular class now each class could be different. You could have the same. You know the same grade students in the morning. Then the afternoon students, different sections of the class and the game doesn't work anymore, so a lot of it is about context and how it fits in, how the teacher uses the game and in terms of whether or not it's effective and beneficial and a lot of that is about a how it's designed and how it reaches. The goals that you want the students to reach.
Karen:
So I wouldn't say that you know it's just about the media you know it's not like all games are good at teaching, or all games are bad at teaching. Its really case by case basis.
But that said there might be some specific benefits to games.
Karen:
For example.
Karen:
Being able to take on different roles in a game being able to take on different perspectives being able to customize your character to express your identity through the game.
Karen:
To feel immersed in a story, to feel connected to other people by playing with them by sharing and collaborating with other players. There are all different ways that potentially games can be beneficial, but it really depends on the students, and it really depends on the game and how the game designers use different elements to make that experience come alive.
Matouš:
So the next question you sort of already answer. What negatives/positives do you see with serious videogames? So if you can now elaborate more about the negative side if you see of serious videogames.
Karen:
Yes, I mean again the positives could be that they learn and that they grow and that they can inspire each other and play together and connect but there's definitely negative there's negative to any experience you know sometimes you know people just won't like the game, or they won't connect with it, or they won't learn what you wanted to learn they might even dig in more to their preconceptions. There's a study that was done on a game where people.
Karen:
You know kind of backfired you know it's like the designers wanted people to understand what it's like to be poor financially insecure.
Karen:
And instead the some of the players actually.
Karen:
Became less sympathetic to people who were.
Karen:
Financially and insecure So I mean again game could backfire a game is a community and its social platform and just like any social space there are potentials for negative and toxic behavior whether it's negative communication and whether it's harassment whether it's you know something more extreme like doxing or violence or you know hate there are all different things that could happen, but again that could

happen in the classroom that could happen and in hallway in a bathroom in or in a playground so the same kinds of things that you could see.
Karen:
Where you could have a wonderful connection and positivity in love and care in space any social space, you can have the opposite, and that's the same social space.
Matouš:
Yes, it's still school.
Karen:
Yeah.
Matouš:
Yeah, so let's move on. Do you know any serious videogames? I presume you do, but if yes do you have a favorite that you think are most useful in class if more than one can you give me a like top three.
Karen:
Well, I mean. Have written about a ton you know hundreds, so I'll just give you one that I worked on an actually maybe just.
To be.
Totally transparent that I worked on this game, it's called mission US. It's the is or Modules at different moments from United States history, and in each of the modules you play as a character from that time, and you engage in tasks and quests that relate to that character, and you get to know different historical figures, and you've got to kind Dr.
Karen:
Relive the historical moments and understand a little bit more about what it was like to live during that time that what the tensions were, but you also get to meet.
Karen:
Really compelling ethical and historical choices, for example, there's one module where you play as Nat Wheeler who's a printer's apprentice, and he is walking around in.
Karen:
Boston in seventeen seventy, talking to people like Paul Revere and trying to understand the tensions that were leading up to the American revolution.
There's another module.
Karen:
It takes place in the early nineteen hundreds your playing as the woman, forgetting her name right now, but she is a recent immigrant and is trying to get acclimated to living in new york city with her family, her extended family, working in places like clothing factory trying to make a life for herself there, as they're trying to understand workers rights and it takes place around a lot of the changes in labor laws and the event called the triangle shirtwaist factory fire which led to a lot of changes and workplace safety, so again it's like you're playing kind like one person in there and try understand their story but you're getting a wider view of a historic moment from that very individual perspective, and I think it's a really interesting game it's really geared to middle school social studies students which I don't know what that translates to you there, but it's like. It's like against sixth grade through the eighth. Three to nine.
Matouš:
Can you please type the name of the game cause I didn’t catch it.

Karen:
Its mission US. And it's free. It's online; you can check it out.
Matouš:
Thank you very much.
Matouš:
Well, how often do you think should computer games be used in subjects like computer science and mathematics as opposed to humanistic subjects?
Karen:
I think you know again it depends on the class it depends on the student it depends on what you want to learn I mean some things are gonna be better to learn through
Karen:
Stand box type simulation where you're playing with different physics principles, or you might be trying a different computer science logic, but some things aren't good learned that way, so I don't think it's about the subject I mean you could use a game in history you can use the game in literature, but it depends on what the learning goals are so.
Karen:
The frequency of using a game it really depends on how effective it is and what you're trying to teach and what you're trying to get the students to do and whether or not a game is the best way to help them do that, so.
Matouš:
Don’t you think students spend enough time on computers already today?
Karen:
I don't know what that means like I guess what's too much, but I mean games don't have to be on computers you know they could be board games they could be a real-world games they could be card games they don't necessarily have to be computer-based games it could be on a phone and encouraging real-world interactions there are so many types of games I don't think games are the problem -
Matouš:
Yes, when I’m talking about games, I'm talking specifically about serious video games.
Karen:
All right, well again, some video games might encourage real-world interactions where you're playing with other people are your pairing up here working in a group to work on a game I mean it doesn't necessarily have to be.
Karen:
Just.
Karen:
What's happening on the computer so.
Karen:
I don't know, I mean, I don't.
Karen:
I don't know what's too much to make people's I mean people were working in industry or probably spending their whole days on computers too.
Karen:
What is I don't know. (Keeps repeating I don’t know)
Matouš:
We'll see, we'll see.

Matouš:
Are you familiar with the concept of gamification, I presume?
Karen:
Yes.
Matouš:
What are the negatives and positives of giving cation on the contrary to serious videogames? All right gamification is not a game it's taking.game like elements like badges or.rewards or incentives and applying them to non-game experiences like a doctor's office.or a work…
Karen:
It's just not a game a serious game is a game it's a game where you're learning something in the game you're playing a game to learn something the gamification taking some of the elements of the game and applying it but it's not.
Karen:
Not a game so.
Karen:
I don't.
Karen:
I don't know I mean the negative and positive could be.
Karen:
It depends on what you're trying to do.
Matouš:
Yeah.
Matouš:
Specifically, using gamification teach us subjects in school.
Karen:
I mean again, gamification is not a game, so it's like giving a student grade for a project. I mean, that's the type of gamification you're trying to incentivize someone to do something, so we've been gamifying.
Karen:
Whatever.
Karen:
Using give gamification in the classroom for a hundred years since we've started using grades, but it depends on like what it's for like is it.
Karen:
You know it it's not necessarily using the benefits of games; it's just using the benefits so.
Karen:
Motivation and rewards to try to get people to do things, so I don't know I mean I think that it just depends on the students depends on what you're trying to get them to learn your what you're trying to teach them.
Karen:
I can't really.
Karen:
It.
Karen:
Would have to be a very specific example of what.
Karen:

For me to explain what the negatives and positives might be but gamification is not a game.
Karen:
So it's just it's just different; it's just a different process.
Matouš:
okay.
Matouš:
If you do know any concrete school that works the day with a serious but game in their classroom regularly?
Karen:
Do I know any schools that regularly use serious video games? I don't know K too twelve class although one of my friends Paul?Dorvasy? He's a teacher.
In Toronto, Canada, at a private school for all boys and he does do some games work with them.
Uses games to teach literature and different ways.
And I could tell you more about that, but I use a lot of serious video games in my class.
You know I teach college, and I teach ethics, and I use games to help students apply ethical principles and concepts.
And to understand those concepts.
We don't necessarily play serious video games, we just play video games, and now any game could be used for educational purposes depending on the context and depending on how you modify it so.
We might use anything from call of duty to papers, please, to understand how ethical frameworks might apply to
a game.
Karen:
For example, how does the utilitarian approach.
Karen:
You know, if a decision in a game is ethical according to utilitarian ethics versus hedonism framework and you know trying to understand that.
Karen:
That decision in a game through a game environment.
Karen:
So I think that you could probably, you know got it depends on how you're using the game so.
Karen:
I think it could be used in a lot of different ways.
Karen:
Right.
Matouš:
I have one last question, but I don't think it matters, it is becoming redundant because the question is: a study by the American psychological association shows that video games can simultaneously make kids more impulsive and less able to concentrate or give close attention why should we then bring video games the classroom.
Karen:
I mean, I don't know this specific study it so I'd have to look at it but.
Karen:

Again I think it depends on the games some games could make students more.
Focused, it's just what game did they use; you know what game is it just.
I mean, when I watch my kids play a game, they're very focused and very.
Attentive to it, so I don't know just.
I'd have to really look at the study and unpack what can the game how they're.
Karen:
What they're doing after the game and before the game and how they're using it for teaching, and it just doesn't sound like.
Karen:
It was used for education and was used for just.
Karen:
Getting kids calm down like.
Karen:
That.
Karen:
I don't know I mean it.
Karen:
There are so many variables that it's hard to make such a broad claim like that.
Matouš:
If it's about the specification, my prescientific work actually focuses on Minecraft, and Kerbal space program does have any experience with those two games?
Karen:
A little bit in Minecraft, but not, you know I it's a lot on the I mean there's a lot about Minecraft.
Karen:
But it.
Karen:
The space program one.
Karen:
I think I might have played it once I'm not sure.
Karen:
But it was like a lot it might have if it's the game I'm thinking of is a long time ago what specifically do you want to know.
Karen:
If those games are perfect, for example, Minecraft in the subject of computer science and Kerbal space program and subject of physics.
Karen:
Yeah, no, I remember someone talking about that for physics like you have to build the Spacewalkers.
Karen:
Space rocket and make sure it has the right thrust and all these things to send it to the planet or wherever it is again, and I remember that yeah I mean and they sound good, but there's actually a chapter about Minecraft in the new book
that I'm editing, which talks about using Minecraft for education you might want to check that out.
Karen:
Sure
Karen:

When it does come out, it should come out for about two months.
Karen:
So just like Google learning education and games and my name hundred games to use in the classroom and beyond and you should be able to find it, it's free just download it.
Karen:
Okay.
Matouš:
Thank you for this one, and I will definitely check it out, and I think that's everything thank you for your time and thank your expertise.
I guess have a nice rest of the day.
Karen:
Thank you so much. Take care.
Matouš:
Bye.

Eidesstattliche Erklärung

Ich erkläre, dass ich die vorwissenschaftliche Arbeit eigenständig angefertigt und nur die im Literaturverzeichnis angeführten Quellen und Hilfsmittel benutzt habe.
Prag, am 13. Februar 2020

_____

Unterschrift