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Augmented Reality in Medicine and Education

As technology advances many new technologies have emerged and one of the most exciting ones is Augmented Reality (AR). It has many applications in the medical field and in education that can completely change our approach to learning in each respective field. The use of AR has been rapidly increasing as the technology becomes more available due to its multiple cases of evident success in the learning experience. In the online paper ‘The development of augmented reality (AR) in anatomy course. International Journal of Education in Mathematics, Science, and Technology’, they explain how many students taking anatomy courses struggle to gain a full understanding of the anatomy of the human due to models being 2d where in real-life humans live in a 3d world. AR was able to bridge this gap and helped students visualize anatomical systems in the 3d space, which drastically improved learning and retention of information. In another research article, ‘The effects of augmented reality applications on the academic achievement and motivation of secondary school students. Malaysian Online Journal of Educational Technology’, they performed an experiment on 7th graders learning cells and cell division where half of the students used the traditional method of learning, and the other half used AR programs to do the learning. In their research they discovered students performed better on the post-test when learning via AR. In another example of AR in education, ‘Augmented

reality applications in education: Arloopa application example', they provided students with their program Arloopa which allows for people to produce AR content and games and through interviews discovered that 90 percent of students found the resource helpful and recommend it for other students. In a different approach than students using AR in the research article, 'Predicting quality of English language teaching through augmented reality competencies and TPACK model components among Kuwaiti undergraduates. Contemporary Educational Technology', they devised a study where they tested undergraduate students, planning on teaching English, in AR competency and determined that the more competent they were with AR technologies the higher quality of English teaching they performed. Lastly in two more articles, 'Augmented Reality in Education: Interactive Classrooms' and 'Augmented Reality and Virtual Reality In Medical Devices', they display multiple sources of AR programs that could be used in education and in medicine in each article, respectively, as well as described each of them. These two sources are what I performed textual analysis on due to their structure and content.

For many years people have been successful using more traditional methods of learning for education and medicine, and those methods continue to be used in schools today as they were long before. With recent improvements in technology, education has begun to shift to new methods one of which being the use of Augmented Reality. Many students fail to grasp hard to imagine concepts like math in the 3-d space for example. The benefit of AR is the ability to visualize concepts in the third dimension as well as provide the ability for hands-on-learning in new ways. Another benefit of AR that is extremely evident in the medical field is the use of models in anatomy. Previously anatomy classes have used life size models to show various systems, but these models are limited due to the intertwining of various organ systems. With AR there are programs that can switch back and forth between multiple systems while keeping the

same model as well as allowing views from all angles. Another use provided by AR is medical scans which previously were shown on a 2-d screen or print where in AR they allow for a 3-d visualization that doctors can use to spot illnesses easier. While these previous studies have had positive implications, I believe it will be extremely beneficial to gain a broader understanding of the ways AR can be used and its general benefits by synthesizing and analyzing previous papers and resources.

My goal in this research is to gain a more general understanding in the resource of Augmented Reality to determine if it should really be adopted by more people and how it could be implemented. I have performed textual analysis on various sources which have given me insight into the realm of possibilities that AR has to offer. I have also performed critical analysis on various resources relating to the topic which has provided further understanding. Following, I will structure my paper to have my methods of research, the results I have found from these methods and then conclude my findings to add the critical conversation surrounding AR. By the end of my research, I will answer what the various general benefits and successes of Augmented Reality in medicine and education and its implications?

Methods

My methods for collecting primary data included searching the web for information surrounding Augmented Reality with the intention to perform a textual or critical analysis on the sources that would give me insight into the successfulness of AR as well as provide me with various programs developed with AR to grasp the various use cases that AR provides. To perform my literary analysis, I picked two sources, 'Augmented Reality in Education: Interactive Classrooms' and 'Augmented Reality and Virtual Reality In Medical Devices'. I decided on these sources because of the rich information they provide as they give various AR programs

which has helped me understand the reach that this technology has to offer. With each of the sources I analyzed how they were structured and what their goals were by creating them. I followed multiple of the various links displayed on the sites and noted the usefulness of sending me here. As for the other sources, I used critical analysis to gain a further understanding into what these sources offered in the sense of Augmented Reality. My process of critical analysis includes breaking down the sources into as simple as possible, figuring out what the papers are good at explaining and what they are bad at, then finally determining why the writer would write this or what significance it has. Towards the end of the critical analysis, I found it most helpful to link back any beneficial information to my research question and process how this information is furthering my understanding of AR. All in all, the process of analyzing these sources have given me insight into what AR's capabilities are and where it can be used.

Results

First in my textual and critical analysis of Augmented Reality in Education: Interactive Classrooms I read through the page and took note of the structure; the structure is a list of various educational AR programs. What this tells me is that the applications for AR in education are extensive and wide-reaching. Also, by asking why the writer would create something like this I learned that AR for education must be a beneficial resource to at minimum a wide audience because compiling a list of AR resources would otherwise be unintuitive and pointless. Next, in my textual and critical analysis of Augmented Reality and Virtual Reality In Medical Devices I processed the paper and like the previous source it was a list, but in this case, it was a list of medical AR programs. This tells me that the AR applications in medicine are also extensive and wide-reaching. Similar to before, during my critical analysis of this sources I asked the same question as above, why would the writer make this? The answer that I found is that enough

people in the medical field find these resources beneficial enough that they would want a source like this to easily find new resources they could adopt. The two previous were extremely beneficial because the list structure showed me that AR in education and medicine were beneficial enough to make it worth it to be compiled into a list.

Augmented reality apps for education					
Schools and colleges, both on-campus and remote, use augmented reality to supplement current curricula and add interactivity. Below is a list of augmented reality apps for education:					
<ul style="list-style-type: none"> • Human Anatomy Atlas 2021 – 3D models and simulations of male and female anatomy help students and healthcare professionals understand how the human body works. Users can perform virtual dissections, view animations, explore muscle action, and more. • Holo-Human – This AR app provides users with a collaborative environment to explore human anatomy models, including internal and 360-degree views. Teachers can also create lesson plans. • VR Frog Dissection: Ribbit-ing Discoveries – In biology classes everywhere, students dissect frogs to learn about bodies. Through a fully immersive experience, this app substitutes this practice to allow teachers and students to study the anatomy of a frog through virtual dissection. • GeoGebra Augmented Reality – From geometry and algebra to statistics and calculus, this interactive tool supports science, technology, engineering, and mathematics (STEM) education through AR features that allow students to explore shapes and 3D functions, use critical thinking skills, and more. • Expeditions – With hundreds of AR tours, this versatile app enables teachers and students to create and explore interactive, virtual environments. • Exoplanet – This app, developed by a professional astronomer, provides an interactive catalog of known planets orbiting stars in the Milky Way. • Star Walk – Users of this AR app can see and identify constellations and stars in real time and learn about interesting astronomy facts and daily statistics. • Touch Surgery – Doctors and surgeons can use this app to prepare for surgical cases and learn about different procedures. • 4D Interactive Anatomy – Students can test their knowledge and faculty can create custom quizzes using this 4D interactive anatomy app. 					
Date of Final Decision	Submission Number	Device	Company	Panel (lead)	Primary Product Code
12/20/2019	K190929	xvision Spine system (XVS)	Augmedics Ltd.	Orthopedic	OLO
12/05/2023	K233568	Ceevra Reveal 3+	Ceevra, Inc.	Radiology	QIH
11/29/2019	K192186	I-Portal Neuro Otologic Test Center, I-Portal Video Nystagmography System, I-Portal Portable Assessment System - Nysragmograph	NeuroIgn USA, LLC	Ear, Nose, & Throat	GWN
11/25/2022	K213215	VSI HoloMedicine	ApoQlar GmbH	Radiology	LLZ
11/17/2022	K220905	xvision Spine System	Augmedics Ltd.	Orthopedic	OLO
11/16/2021	DEN210014	EaseVRx	AppliedVR, Inc.	Physical Medicine	QRA
11/10/2021	K210344	inVisionOS	PrecisionOS Technology Inc.	Radiology	LLZ
11/05/2021	K210859	NextAR Spine Platform	Medacta International, SA	Orthopedic	OLO
11/04/2022	K221659	Luminopia One	Luminopia, Inc.	Ophthalmic	QQU
11/02/2023	K232176	STELLAR Knee	PolarisAR Inc.	Orthopedic	OLO

On the left is a screenshot of the list in Augmented Reality in Education: Interactive Classrooms and on the right is a screenshot of the list in. They show list for AR applications in education and medicine, respectively

Next, I will cover what I found through critical analysis of the remaining four secondary sources. In the source Predicting quality of English language teaching through augmented reality competencies and TPACK model components among Kuwaiti undergraduates I learned that AR has been proven to be beneficial in determining the quality of teachers, in this case English teachers. It appears that the reason to produce this paper was to share their findings of this certain program so that others may adopt something like it. My takeaway is that AR can be used to test the quality of teaching as well as measure other benchmarks in a new way. In the source, The development of augmented reality (AR) in anatomy course, my analysis found that AR has been

proven to be a more beneficial teacher to certain topics. In this paper they covered teaching anatomy which is a difficult course due to the extensive amount of visualization required. The results from the students via questionnaire completed by a class of 30 are as follows in the table they provided.

Table 4. The result of Large Class Trial

Aspect	Percentage	Criteria
Content Quality	88 %	Very Good
Language	85.7 %	Very Good
AR Media	92.7 %	Very Good
Means	88.8 %	Very Good

Table of questionnaire results from 30 students when asked their thoughts on the AR usage in the anatomy class

This inclines me to believe that AR is good at helping visually intensive topics in education. Next, in the source, The effects of augmented reality applications on the academic achievement and motivation of secondary school students, I found that yet another visually intensive topic was better taught with the help of AR. The article states that,” the students thought that the augmented reality application helped them learn the subjects, facilitated the concretization of abstract concepts, and provided active learning experiences “(The effects of augmented reality applications on the academic achievement and motivation of secondary school students).The students who used AR to learn about cell division and cells had a better time retaining the information than the students who learned the traditional way as well as the approval of the students using the program which further certifies the usefulness of AR. Finally in the source Augmented reality applications in education: Arloopa application example, I found that students

generally students thought of AR as making the learning more fun. While this paper has concrete proof of what they said based on a given experiment with testable results I was wary to focus on their own conclusions as it happens to be that they are an AR development resource used to produce AR content, meaning they benefit with successes in AR. I focused on the analytical results and learned that AR is generally greatly appreciated by students with its major drawback being the cost barrier behind various AR products. These results have allowed me to gain a more general understanding of AR and the various applications in education and medicine.

Discussion

Augmented Reality is a computer program that allows for 3d visualization to the user of non-present objects. It is a very modern technology and new use cases are being discovered every day. The use of AR in schools and in medicine is on the rise and its effectiveness is promising but still not fully known. Many tests have stated they have seen beneficial results and various applications have been appearing more often. The goal is to gain a more general understanding of the promises this technology has to offer as well as the various applications it can or is being used in.

Through my use of critical analysis and textual analysis I have found some significant supporting aspects as to how effective AR is and its applications. Through my critical analysis of the two sources, Augmented Reality and Virtual Reality In Medical Devices and Augmented Reality in Education: Interactive Classrooms. I discovered that they used lists to display AR applications in medicine and education. Respectively. This helped me verify that the use cases for AR are widespread and plentiful, enough for that it to make sense to compile a list of resources so that the public can find it easier. Then through critical analysis of the remaining four sources (Predicting quality of English language teaching through augmented reality competencies and

TPACK model components among Kuwaiti undergraduates, The development of augmented reality (AR) in anatomy course, The effects of augmented reality applications on the academic achievement and motivation of secondary school students, Augmented reality applications in education: Arloopa application example), I discovered that AR is a beneficial resource and also excels at providing visualizations for typically difficult subjects to visualize. I came to this conclusion because I found that in all the test performed every single one consistently showed that AR works at its intended purpose. In the test from, The effects of Augmented Reality applications on the academic achievement and motivation of secondary school students, they did a pre and posttest on cell division and showed that students who used AR performed better the students who didn't which is concrete evidence that AR is effective. As well as for less concrete evidence that AR is effective was found in, The development of augmented reality (AR) in anatomy course, they discovered through a questionnaire that students generally thought that AR was fun and engaging which tend to produce more effective learning and understanding. All in all, I am confident in saying that AR is a successful resource that has multiple implications and applications in education and medicine.

Conclusion

Finally, we have discussed the effectiveness of AR and its implications but through my research I have been able to draw a couple more conclusions. First, I believe that although the technology is cool it raises red flags in privacy and ethical standpoints. Unfortunately, many of the things that can be used for good can also be flipped around and be harmful to society. Secondly, although not covered in this research a major piece of AR which I am sure we will see more of is the use of AR in marketing. AR can help people imagine the product in their own room which will incentivize more consumers to make the purchase. As for further research suggestions, I

believe people should continue to document ways that AR has helped people as well as research new fields that AR could be used for. For example, from my own experience in construction I could see the benefit of using AR to teach electrical apprentices various principles like visualizing a three-way switch which is almost always confusing for newcomers and was much easier to understand visually. All in all, AR is still a new modern technology, and further research is very important to gain a full understanding of what AR has to offer.

Works Cited:

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