

Level 2 [REDACTED] Project

Title of project

Will Bio Printing Be A Viable Medical Asset In The Future?

Your name: [REDACTED]

Candidate number [REDACTED]

Name of your school/college: [REDACTED]

Centre number [REDACTED]

Word count : 5013

A01 2 more specifics + details needed
A02 6 Secure evaluation of reference
A03 7 Discussion needs more PEA support.
Who said what?
A04 6 Clear + developed evaluation

21/unc

Will Bio Printing a suitable medical instrument in the future?

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(Pooler, 2019) (Shaer, 2015)

Introduction

Organic 3D printing is the process of 3D printing bio organic organs through the extrusion of stem cells. Like a standard 3D printing, the nozzle moves around on an x: y: z axis extruding a substance as it goes. This substance, in this case, is a stem cell which can be placed near a cell that it will take its form off. The substance will slowly build up along the base plate creating a functional organ. These printed organs will also have the capacity to be designed specifically for a certain person through the means of scanning or 3D design software's. ✓

In this the subject of the essay of which I am writing to answer the question "will Bio Printing a suitable medical instrument in the future?"

To come to my conclusion I will take areas of information from certain scores that I have deemed acceptable through a CRAVEN evaluation and use them to formulate a suitable argument on the subject. Subjects such as the destruction of bio prints from white blood cells will also be covered so as to gain a larger understanding from both pros and cons. I will also go into further less known benefits of the technology rather than just uses. These will include subjects like the issue of rejection technological hindrances and the prevention of physical and figurative costs such as the emotional torment faced by loved ones of organ transplant waiting list members. ✓

I have a deep interest in this subject from an article in a magazine about this. Later my interest was furthered deeper when I received a 3D printer for my birthday along with two years savings. Now I was compelled to do this subject due to the lack of significant medical advancements in the previous years and the slow but sure development of this field. This research I believe has many possibilities to better people's lives and having an interest in the subject I thought it may be beneficial to research this subject further through my Extended Project. ✓

I have gained all my information on his topic through websites across the internet that I have run through and have completed a CRAVEN evaluation on (see the research summary for further details). Any extra information may have been my personal opinions or facts I have collected through my research that have not been a large contender of the information. I hope this research proves useful and informative as well as successfully conveying the subject. ✓

Focus of project
clear

Research Summary

The Scientist

What are the pros and cons of organ 3D printing?

3D printing could be used to extrude a very fine substance and create small objects. By putting biomaterial into the extruder scientists could theoretically create cells. These can be used to create tissue and organs.

Scientists have successfully managed to create mini samples of tissue and bodily fluids on chips but a successful attempt on further advancements has been a struggle. These mini chips have been used to test pharmaceutical products to prevent use of animals.

Many Scientists are making progress of ears and other organs. Bowles are another product that are a goal of theirs as they can be used as a much needed organ transplant.

The cells produced by the printer would need to be cloned from the same tissue as the patient. A printed organ would be recognised as a foreign entity to the white cells leading it to be destroyed.

This source is a reliable entity as it has been entered by a well-known Science magazine. It has a good reputation: "The Scientist has won many awards, including most recently: 2018 ASBPE Awards of Excellence" and has a steady support of magazines published

Overall the Scientist seems a good and reliable candidate to answer the question asked "what are the pros and cons of organ 3D printing."

The Financial Times

Can you use 3D printing to create biological substances?

As more people are needing organ transplants the need for 3D printed organs runs higher. Even after a successful transplant the need for medication is still there to stop the immune system from destroying the foreign organ cells.

3D printed organs could use the biological cells from the patient to create an organ recognised as one of their own by the body.

In April 2019 a group of scientists in Israel claimed to have 3D printed the first human heart. Reports say that it was as small as a cherry and contained blood vessels.

Another option may be a form of reprogramming cells. Cells from fatty tissue have been reprogrammed into stem cells that may be able to become recognised as from the body. These cells have a possibility to be able to be 3D printed organs recognised by the body.

Stem cells have been successfully reprogrammed to create a sphere of liver tissue and the aim is to create a liver from this tissue but this is only a goal.

This source is notably reliable as stated by reviewers "These sources have minimal bias and use very few loaded words (wording that attempts to influence an audience by using appeal to emotion or stereotypes)."

The Financial Times has an average reputation, quote "Overall, we rate the Financial Times Least Biased based on balanced reporting and High for factual reporting due to proper sourcing and a clean fact check."

Smithsonian Magazine

Is 3D printing an option close in the near future?

A bio lab run by South Korean researcher Young-Joon Seol have a set of bio printers ready for their first project. These Printers are said to work as standard 3D printers although instead of a heated nozzles it uses very thin syringes to extrude human bio matter.

The Reporter stated that he saw a machine stated as "Similar to one of those claw games you find at highway rest stops". He claimed it contained six syringes and a biocompatible skeleton. The suggested form of printing from images and text is that they have scaffold plates of the printing ideas that will layered on top of with biomaterial furthermore creating the scaffold plate made of human tissue.

Staff workers have implanted skin, ears, bones and muscle onto lab animals with successful results of parts growing into and with the surrounding tissue.

Overall it seems that with this progress being made then the advancements in the future will soon be able to create bio printed organisms

As a reputational aspect, the media biased/fact check stated "Overall, we rate Smithsonian Magazine a Pro-Science source based on publishing research-based information on science. We also rate them Very High for factual reporting due to proper sourcing to credible research and a clean fact check record."

The same websites also states that the website contains little to no bias stating that "Smithsonian.com covers history, hard science, popular science, nature, and technology."

All3DP


How useful will Bio printing be in the future?

In the article, the author writes about the importance of 3d printing. The bio printer is said to mimic the actual environments of the human body so far allowing it to almost be recognised by the cells of the human body. The process of the development is tough but it is said to be soon done

The process of bio printing is a complicated one that is said to be crucial in the near future missing organs may be able to be printed leading to an easy fix for possibly things such as kidney failures. If this technology is further developed it has the possibility to print working limbs out of existing muscle tissue though this is only a possibility very far in the future as the existing technology would not fit the needed rescores. Furthermore this technology may be of use in the beauty field with facial implants. As a counter to plastic surgery the bio printing could be used to alter face or body shapes in a different way to the existing methods which can sometimes lead to more difficult facial expressions.

Unfortunately throughout my research I have failed to find a review for the website in question. As a result of this I will count it as information but also keep this score at arm's length being that I cannot state if it is exact fact. On the other hand though I have also failed to find any negative reviews on this subject so I cannot out write state that this score is unusable.

I will use this score in the knowledge that if it is wrong I will be wrong .This is a risk I am willing to take.



Discussion

Bioprinting uses

Though Bio Printing poses a wide range of benefits for the scientific and medical communities, its main focus of interest and most commonly known benefits are its uses. Bio printing has many different viable uses with most being aspects of tissue reconstruction. Organ transplants are a prominent focus of the scientists researching this. A small team of scientists in Israel have said that they have successfully printed a working heart. Though only cherry-sized, the heart has many necessary properties to be able to make the step to working organs such as its capillaries and chambers.

Tissue reconstruction is another method being researched into with researchers such as Young-Joon Seol and his team of scientists working on repairing tissue of injured animals with printed replacements. His lab has been reported to have a great deal of prototype printers working and animals with printed skin, bone, muscle and ears growing with the subject and resisting rejection. From this branch of bio printing, victims of heavy scarring or burns could be easily meandered along with the possibilities of a faster way to regrow tissue from wounds (such as trauma) than sowing it up and waiting for it to heal. This form of medicine if for larger wounds could be viable to create a structure for which the body could fill in and repair the trauma rather than trying to repair many different tissue types with a Bio printer. The prosthetics, like the ears implemented onto the subjects in Young-Joon Seol's lab, could be implemented to repair or replace damaged smaller organic body parts such as noses, ears with possibilities of eyes and fingers at the development progress in the future.

A less noticed option of bioprinting is the cosmetics industry. With the introduction of organic flesh replacements, many people may attempt to use bioprinting as a safer and more realistic form of plastic surgery. Other face and body alterations may be looked into as a result of this technology.

Rejection

Despite the bright looking future of bioprinting, the main problem in the development of this new technology is the difficult way to counter the forms of rejection. Rejection is caused by the white blood cells in the body, attacking and destroying any foreign entities that manage to get in. This unique ability has countless benefits through fighting germs and even detecting cancer but it also comes with the issue of rejection. The white blood cells recognise all foreign entities to be harmful. This leads to any biological implant into the body being destroyed before being used. This poses an immediate threat to organ transplants and in addition to bioprinting.

references
research

Many options for countering the problem have been tried and tested with most failing in unique ways. Some methods such as neutralising the white blood cells are more easily noticed in its flaws. Without rejection any and all illnesses posed as a threat to the body has a monumental chance to kill the host. This is made increasingly more dangerous when factoring in the fact that the white blood cells are at constant work neutralising any entities in the body. When you feel sick it is most likely the one time the white blood cells fail to protect you. This means that removing the white blood cells will cause a near immediate illness and possible death.

Other methods of overcoming rejection is the harvesting of the patient's original base tissue. Despite this method working, the main reason for organ transplants is a damaged organ leading to that organs cells to be corrupted and unusable. As well as this, the extraction of these cells is a tedious process.

To overcome this issue, the use of stem cells poses a viable option. With the stem cells ability to mimic the properties of cells around it, it would be an incredibly useful source to adapt the original working cells and clone them until they have enough for an organ. Another problem with this method is the ethical implications of obtaining these cells. While extremely common in embryos the collection of stem cells in other ways poses more of a threat. The only other well known source of stem cells is in human bone marrow. Bone marrow though possessing stem cells, have it in very little quantities along with the extraction being incredibly difficult and painful with possibilities of lasting damage in the patient. The last viable option for stem cells is a lab project going on currently. In this project scientist are attempting to mutate inused fat cells into stem cells. These, being a viable resource of the cells, could pose as the key in the development of bioprinting.

*need to cite
specific
references*

Technological hindrances

Throughout the research of this new technology, the issue of technological hindrances proves long lasting. Despite being not as antagonistic to the developing process this irritating hindrance is a big hurdle for developers to overcome. While developing with the time, the subject of bioprinting is still a relatively new one. This issue becomes increasingly difficult as we currently lack the existing technology to reliably trust on these machines to not fail. This poses an issue as time and money must be spent monitoring the prints for malfunctions leading to a loss in priceless material. As well as this, the printer needs to have its base plate delicately removed and the printed organ taken carefully. Furthermore the print still needs to be implanted to the patient's body through a surgical procedure taking possibly hours to perform and costing a large fee. All of this creates a system that on the outside seems easily reliable but in reality is prone to countless human errors.

Operating humans however are not the only flaw in the system. Due to lack of testing and possibly corrupted files, the print has a high possibility to curdle and flake off leaving an incomplete project being unfit for use and a mass of wasted filament. Other problems come in the form of colossal expenses. Through the rarity of this technology and the experimental nature of the process, resulting prices would be through the roof leading to countless people awaiting surgery who are unable to survive. In addition to this, the most viable option of stem cells for filament is incredibly expensive due to the incredibly unethical procedures used to

gain the substance. The stem cells used may also prove illegal with the main source being the harvestation of aborted fetuses.

A more important issue in the organ printing subject is the lack of supports. Through monitoring existing 3D printing we can see that the printed object tends to lose support and break when stretching over a 45 degree angle. In existing printing this process is countered by the use of support printed with the project in the same filament. This seems a viable option to bioprinting before looking into the cost and structural integrity of stem cells. The exterior supports of the print would lead to thousands if not millions of dollars of stem cells being wasted with no further use. In addition to this, there is a chance that stem cells have a lower structural integrity than other printed materials meaning it would need supports on ledges of possible less than 45 degrees.

Finally, printing times are a final issue with the process with plastic prints taking upwards of a week. These printing times will also be heightened by the smaller filament types with the extruder having to extrude clumps of stem cells.

Figurative costs

Figurative costs are another deep dwelling benefit of this technology. While many may not know what it means the benefits are relatively simple. Figurative costs are loss of valuable things. Unlike a cost in money though, these costs tend to be in time, emotions and pain. With the introduction of bioprinting many of these costs can be neutralised with things. With the main uses of bioprinting being organ transplants the parallels we draw to are compared to the systems in organ transplantation.

Money is a main issue and while it may seem to be a physical cost it still fits within this section. Due to the colossal waiting list to those looking for donations, the average person has to wait from three to five years for an available transplant. All of that waiting is including the sizing for the organ and transportation which all have possibilities to go wrong causing thousands of dollars and many years of hard work to be wasted. In addition, extra expenses are needed to be paid for the patient to live under critical conditions and damaged organs. These all lead up to countless amounts of money being spent every year for the attempt of a successful transplant. This issue can mostly be solved with bioprinting. While taking a small amount of time to create an accurate model, the bioprinting method can print an organ perfectly matched to the patient. The development time is also monumentally smaller with previous methods needing to find an organ of the right size and bioprinting being able to print an organ in under three days.

A secondary benefit to the increased timing is prevention in emotional costs in the family members. Throughout the process of the donation list, family members along with the patient themselves are forced to battle with the thought of impending death. This thought can lead to depression, anxiety, suicidal thoughts and other mental health problems. Despite not preventing all stress, bioprinting can speed up the donation project leading to a prevention of the waiting time and in turn the prevention of anxiety around the process. In addition to the prevention of unnecessary mental health issues, bioprinting also has no need for the death of a previous host sparing the waiting time and allowing the family to have an open casket funeral.

Conclusion/Evaluation

During my time writing up my Extended Project subject, I have learned many new things and developed a new understanding of the multiple layers a question can have. When first starting out on this project I believed that I had a clear motive in mind of showing the expanding technology of Bio printing, however as I began my research I began to struggle to develop a counter argument to my discussion. This proved even further as a disadvantage when I began to get stumped on the basis of not being able to think of any other points. Finally I began to create a plan and go in-depth on possible advantages and disadvantages of bio printing below the surface of just the uses. This deeper thinking posed as a crucial step in creating the sections of Figurative costs and rejection. Past this hindrance is where I began to get a grip on the project as I had now found a sense of security in the formulation of my plan. This assurance fuelled my motivation in completing the project, ultimately being the main reason the project was worked on and eventually completed.

When reviewing the project and looking at the troubles I had come through I think what is abundantly clear is the benefit of formulating a plan of action. With a plan on hand it helps you to ground all your thoughts together and slowly pick at and refine the original ideas to form a suitable argument that is coherent and professional. Looking at what helped me the most I believe that a plan should be all you need to write your project. When formatting your project plan I acts as a big help to structure what you are going to say with notes and evidence. This allows you to only need to shape those existing ideas into a piece of writing by bridging together already standing points instead of trying to build it all from scratch.

Another thing I believe is a must have to create a project is the time taken to delve below the surface of the question you are attempting to answer. When looking at a question at face value we struggle to form an argument as we try to work of minimal knowledge, however when we look below the face value we find the many crucial layers of positives and negatives that can fuel an argument and make a monumental difference between a meaningful argument and one with countless holes in it.

If I were to retake this project or advise another writing their own, I would tell them to take their time and try to formulate and whittle down the questions posed to be able to present the best you can do and elaborate on that point. By using this method from the start I would have been able to prevent the time taken to try and create a section from just from my heads with comparison to a structured section where I know what to say when and how to evidence it correctly effectively simplifying it and making it easy.

Bibliography

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Project Proposal form

Learner Name	<div style="background-color: black; width: 280px; height: 30px;"></div>	Learner number	<div style="background-color: black; width: 100px; height: 30px;"></div>
Centre Name	<div style="background-color: black; width: 320px; height: 30px;"></div>	Centre Number	<div style="background-color: black; width: 130px; height: 30px;"></div>
Teacher Assessor	<div style="background-color: black; width: 160px; height: 30px;"></div>	Date	<u>JUNE 2021</u>
Unit	<u>LEVEL 2 <div style="background-color: black; width: 130px; height: 30px;"></div> PROJECT</u>		
Proposed project title	<u>WILL BIO PRINTING BE A VIABLE MEDICAL ASSET IN THE FUTURE ?</u>		
Section One: Title, objective, responsibilities			

Title or working title of project (in the form of a question, commission or design brief)

The project I shall write is on the question "Will Bio printing be a viable medical asset in the future?"