How Can Emerging Technologies be Leveraged to Benefit Canadians?

The Impact of Emerging Technology on Developing and Accessing Assistive Technology

~Final Report~

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Key Message

THE IMPACT OF EMERGING TECHNOLOGY ON DEVELOPING AND ACCESSING ASSISTIVE TECHNOLOGY

Additive manufacturing has existed for over 30 years. Charles Hull invented 3D printing, a process of manufacturing that enables three dimensional objects to be created from computer images through the layering of materials. The relatively low cost and simplicity of 3D printing compared to traditional manufacturing techniques allow members of the general population to design and develop customizable products. This has led to a surge of 3D printed devices in medical and social applications.

Eight out of 10 persons with disabilities in Canada require some form of assistive technology and over 1.3 million Canadians with disabilities report not having the technology they need. This synthesis report highlights how 3D printers are being used to benefit Canadians with disabilities. Within Canada, 3D printers are:

- being used as a tool for innovation by researchers in designing and developing assistive technology;
- changing the way that some assistive technology is being manufactured, providing lower cost and faster delivery of customized devices;
- being used as a learning tool to enhance student engagement;
- being used by health professionals and engineers to create assistive technologies enabling enhanced participation and collaboration.

However, more engagement is required to explore the value of 3D printing, the environment in which it occurs, and the quality and functional outcomes of the resulting assistive technology. There are no structured guidelines; nor are there clear ways of understanding how Canadians with disabilities are benefiting from this tool.

Quantitative and qualitative data are focused on specific research objectives that involve the 3D printing technology itself rather than the broader questions that could influence public opinion, legal, policy, financial outcomes and distribution of resources. Further research is needed to identify and provide models that reflect and outline ways that Canadians can use this tool to address assistive technology needs. This report seeks to synthesize the available research to address knowledge on how 3D printing influences access, functionality, and usability with respect to assistive technology.

EXECUTIVE SUMMARY

BACKGROUND

The accessibility of additive manufacturing technology in the form of lower cost 3D printers has opened a gateway to innovation in access, development and design of assistive technology. Canada is utilizing this technology to address the demand for assistive devices in a variety of ways. Users of 3D printing, the applications and the corresponding implications have been explored, giving insight into possible pathways of leveraging this technology to further benefit Canadians.

APPROACH

This topic was explored using different methods of enquiry. An online search was conducted to evaluate Canadian related content on how 3D printing technology is being used to address assistive technology needs. An academic systematic review was conducted to explore peer-reviewed studies that identify how 3D printing technology was used to support the needs of persons with disabilities. Lastly, a survey was sent to over 200 potential respondents across Canada to obtain information regarding their awareness and use of 3D printing in relation to assistive technology.

FINDINGS

The online search, systematic review and survey provided evidence that Canadians are beginning to utilize and explore emerging technology such as 3D printing. However, mainstream use of additive manufacturing to meet assistive technology demands is limited to very small scale projects. Our research identifies three main applications of 3D printing as it relates to assistive technology.

Medical: 3D models and prototypes to evaluate and optimize currently existing medical devices such as prostheses and orthoses.
Education: To engage in the teaching and learning of design and development of assistive devices
Meeting demands locally and globally: providing assistive technology to end-users within the local and global communities.

Academic institutions are the most active users of additive manufacturing to address the need for innovation in assistive technology. Their research efforts include independent exploration of the benefits of technology with respect to solving design issues and partnering with local and global partners to address the demand for the technology itself.

WHO IS UTILIZING 3D PRINTING AND ADDITIVE MANUFACTURING TECHNOLOGY TO DESIGN AND BUILD ASSISTIVE TECHNOLOGY?

Our research shows that particular groups have access to this technology and are using it to solve assistive technology related concerns.
These groups include:

- Academic researchers
- Educators
- Community Members
- Entrepreneurs (technology and manufacturing)

Additionally, there is some evidence that Canadians with disabilities and caregivers are utilizing this technology to help support themselves and their loved ones. This population, however does not appear to be developing the technology independently. Canadians with disabilities are partnering with academics, and experts in the technology and manufacturing fields to collaborate in the design and development of functional and usable 3D printed devices. The evidence suggests that they do not often share their experiences making it difficult to learn from others about the benefits (and failures) of this technology when designing assistive devices.

HOW IS THE TECHNOLOGY BEING USED?

Canadians are using 3D printers to improve the curriculum, teach students how to interact with end users in developing design solutions, create entrepreneurial ventures, and collaborate to meet national and international needs for assistive technology.

Access to 3D printers is most prominent in educational institutions. Within the K-12 educational settings, children are being educated using models that are 3D printed to enable them to better understand the science and technology curriculum. This exposure to 3D printed models provides them early life experiences in the use of 3D printing which will in turn translate into better design knowledge when designing assistive technology. Universities and colleges are using 3D printers as a tool to help students understand, optimize, design and manufacture assistive technology. Students have the opportunity to consider the needs of persons with different abilities as well as understand the role of assistive technology in enabling inclusion and participation.

Businesses are being created that design and develop 3D printed products to meet the growing demand from medical, social and educational institutions for customized products. Entrepreneurial endeavors are capitalizing on the current lack of expertise and availability of equipment in the area of 3D printing to meet specialized product needs. This has led to the ability to upload prototype drawings that are then 3D printed and shipped.

Interdisciplinary collaborations, such as professionals in fields associated with health or disability partnering with professionals in fields related to design, reflect an optimization of resources. The varying perspectives and expanded expertise within these partnerships bring about better understanding of the problem in hopes that a better solution will be found.

Local and international collaborations are forming to innovate solutions to the identified need for assistive technology. Collaborative practices can better identify and address the needs, requirements and functional goals by combining expertise and reducing the financial requirements for infrastructure.

Research within the global context showed a move toward using 3D printing to meet the needs of persons with disabilities especially in areas with limited resources. When specifically examining upper limb prostheses from an academic research perspective however, it was evident that Canadian development of 3D printed prostheses appears more community based rather than research oriented.

IMPLICATIONS

Academic institutions are well situated to address assistive technology needs, but further investigation is required to optimize academic spaces, tools, expertise and resources to leverage 3D printing. There is evidence that while community resources exist, many find the design and printing of devices difficult and would require additional training to develop their own. Training protocols are required to enable increased access and a standardized quality control method would enhance quality and usability. Until these are addressed, the acceptability of 3D printing for assistive devices will be haphazard and lacking quality control. From a Canadian perspective, there is evidence that devices are being printed to meet assistive technology needs, but academic research into functional effectiveness and efficiency is lacking. University researchers must work with end-users and other collaborators to ensure that the technology being developed is meeting user needs, meets quality control standards and addresses functional requirements.

GAPS AND FUTURE RESEARCH

The awareness of Canadians with respect to how emerging technology can be leveraged to address the local need for assistive technology is in its infancy stage. Present studies lack general information regarding access to the technology, ethical implications of providing products made from this technology and the role of the government in supporting further development of its use to benefit Canadians.