

Designing a professional e-portfolio to promote 3D printing-based entrepreneurial thinking as a case study: A technical writing project

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Abstract. The purpose of this project is to design a professional e-portfolio in the form of an interactive website that could be potentially accessed by budding entrepreneurs looking to get information to start a 3D-printing based business locally in the Aizu/Fukushima area. 3D printing here is used as a case study to understand how such technical content could be positioned most optimally in a professional context and with maximum impact. This paper outlines a process that leads towards the final design of the website and will focus on the technical writing, design, and usability principles. Adoption of such principles is expected to make the website more interactive and usable in the target situation. This website is geared towards helping anyone who wants to start a new 3D printing business. In this research, we will limit our consideration to help people living in Aizu to revitalise the Aizu area for the 3D printing business. The content in the e-portfolio includes types of 3D printers, 3D printing technologies, sharing of 3D models, with the web design based on various types of concept mapping schemas, faceted search, SWOT analysis, etc. From this information, users can search for and browse what they want towards customising their preferences. Users can also contact the administrator for business consultations and website requests for start-ups. This is a work-in-progress paper, as the design of the e-portfolio has been left at a preliminary level, with more focus on content placement and organisation, but without any usability testing.

1. Introduction

This project highlights the importance of technical writing as a professional discourse in the communication of technical information for budding entrepreneurs who are interested in taking up 3D printing as a profession. 3D printing is a case study, and the idea is to explore how the design of the e-portfolio in the format of a professional website could assist in organising and delivering the necessary information on 3D printing-based processes and related business initiatives. Research suggests that visual elements and aesthetics on websites play a central role in helping university students take decisions on professional matters. This project is part of a project-based language learning context with the purpose that focuses on development of professional communications ability. In a Japanese language learning

context, the use of e-portfolio towards fostering integrative knowledge and pedagogy for professional development has been researched and widely acknowledged [1].

Two other points merit a mention in this context. The use of website design as an organisational schema and pedagogical strategy towards technical writing skills development has been acknowledged in research [2]. Further, development of entrepreneurial abilities with ICT and technical presentations as is seen to be part of the e-portfolio described here has also been researched, and its merit as a strategy established [3]. Further, the use of 3D printing in a project-based language learning situation for different case studies has also been widely researched [4]. The added criteria that we have built in this project (as an extension of the earlier projects on this theme) is the way we want the information quality and presentation schema in the design of the e-portfolio to positively influence budding entrepreneurs who might be interested in using 3D printing to initiate start-up activities. Thus, we wanted to build a comprehensive set of information that focused both on the 3D printing process-based technicalities and the necessary business fundamentals.

The idea with this project is to help students work on an e-portfolio towards content design but present it in the form of a publicly available website for future usability analysis with potential entrepreneurs and local citizens. So, in this context, the significant difference between an e-portfolio and a website must be highlighted.

- It costs less to maintain a digital portfolio.
- Digital portfolios are easier to use out of the box and to maintain over time. However, they are limited on customization options.
- If you're looking for a tool that you can edit anytime, with any device, digital portfolios are the best choice.
- If you're looking to easily personalise your content, as opposed to customising a user experience, digital portfolios are the way to go.
- If privacy is a top priority, digital portfolios have more options when it comes to sharing and publishing your work with others.

Source: <https://my.bulbapp.com/featured/website-vs-digital-portfolios/>

1.1 The purpose of the project

The effectiveness of professional websites as a marketing communication tool has long been researched {[5], [6]}.

With this e-portfolio on 3D printing, we wanted to focus on how research on this topic emphasised the importance of the framework for accessing website quality: web accessibility, web usability, web attractiveness, web credibility, web controllability, web efficiency, web helpfulness and web learnability. With this study, we wanted to explore whether and to what extent designing such a professional website focused on the technical 3D printing and related business processes and are feasible and reasonable in a non-native project-based language teaching and learning context.

1.2 The importance of designing an e-portfolio

Research has categorically mentioned that e-portfolio could foster authentic students learning via their active behaviour and not being overly dependent on teacher feedback. Work integrated learning experiences as is available with e-portfolio design, provide an opportunity for students to augment their theoretical training with practical skills for the market, by

learning about career options, business opportunities, technical challenges, and requirements, and make the transition process towards the workplace smoother [7].

Designing an e-portfolio helps learners to develop deeper learning and also knowing newer things. It will help in more active involvement of students in the selection and design process by enabling students to document and track their learning. This self understanding process allows the students to plan and process towards their future goals.

1.3 Importance of e-portfolio design for economic revitalization

Designing an e-portfolio plays an important role in serving the purpose of assessment of competencies, skills, knowledge and abilities and achievements in specific fields which leads to economic revitalization. This e-portfolio design with the given purpose could be used towards strategizing economic revitalization for remote areas. Also, this e-portfolio has planned to include content that could potentially propose guidelines for local economic development practitioners. It is designed to foster economic development efforts which can be practised locally by enthusiastic people.

1.4 3D printing-based revitalization initiatives benefiting society

3D printing or additive manufacturing is the construction of a three-dimensional object from a CAD model. This mode of manufacturing is revolutionising the small- and large-scale industries the world over [8].

Revitalization through 3D printing can happen as most goods will be designed on computers and manufactured in the homes of consumers, thus reducing both the costs and environmental impacts of transportation. 3D printing can help build sustainable cities of the future, and provide more affordable housing options, including more customised, and affordable products (saving on transportation cost), and complex part designs that are locally manufactured. Eco-friendly products built with recycled materials could be in huge demand in the future. So, additive manufacturing can be applied to create on-site eco-friendly solutions with zero waste. Manufacturing industries can hire freelancers if needed, depending on the demand or requirement of the product in the market thus reducing unnecessary costs to the company.

2. Technical Documentation & Layout of the e-portfolio

The following section outlined the planning stages and associated documents that led to the goal of preparing information for potential entrepreneurs interested in the 3D printing business.

2.1. Infographic Design & what it demonstrates

Infographic or information graphic is a visual representation of information or data in pie charts, bar graphs and text that gives an easy to understand and overview of a topic for people [9]. The idea behind the design of this infographic is to explore the extent to which students in this project could summarise the basic ideas, concepts, and messages, to woo the budding entrepreneurs into 3D printing business. In other words, we used this infographic as an e-marketing and e-entrepreneurship marketing tool; in other words, as a form of communication tool {[10], [11]}.

Our infographic has the contents which are needed in starting a 3D printing business with various factors like starting with what 3D printing is.



Figure 1. Infographic as an e-entrepreneurship tool

Next, we have explained about the two types of applications 3D printing provides i.e.; design process applications which includes (a) creating or customising anything according to one's desire and (b) prototyping for industrial design which basically are working models for entrepreneurial ideas of new products. For example, in healthcare, 3D printing can be used to produce prosthetic limbs that are customised and creating tissues, surgical tools etc. 3D printing can also be used in art to make the sculptures according to one's desire. Going forward, the infographic shows what are the various productions in which 3D printing includes handicrafts, automotive, healthcare, fashion, and household products, therefore making it easy to take on clients from different industries with visual representation of 3D printing potential and its world-wide market growth in those industries. In the last section of the infographic, the steps to start the 3D printing business with various factors like funding, getting licence, required manpower, and the available resources have been demonstrated. Next, is choosing the 3D printing niche to run the business successfully by making products like jewellery, toys, eyeglasses etc. Later, we mentioned some open source designing software, types of 3D print machines, 3D printing technologies like FDM, SLA, SLS are included. This infographic should be usability tested for immediate impact with budding entrepreneurs and anyone who sees the information as useful or not useful with the purpose in mind.

3. Designing the e-portfolio as a publicly available webpage

We have made our web page design schema using mind maps which are diagrams used to visually organise information. We discussed how our website should be structured so that it's easy for people starting a 3D printing business to find the information they need. We organised the layout of the page by creating a concept map. Researchers have long considered

concept maps for teaching technical writing to computer science majors. In other words, it's an established and traditional tool to develop the schema towards full-fledged technical information design {[12], [13]}.

3.1. Concept Map 1: Describing the Webpage Layout

We organised the layout of the page by creating a concept map. Each node represents a page, and some pages have subpages. We aim to make it easier for users to find the information they are looking for by grouping related information into sub-pages. We also tried to include the faceted search principles when designing web pages [14].

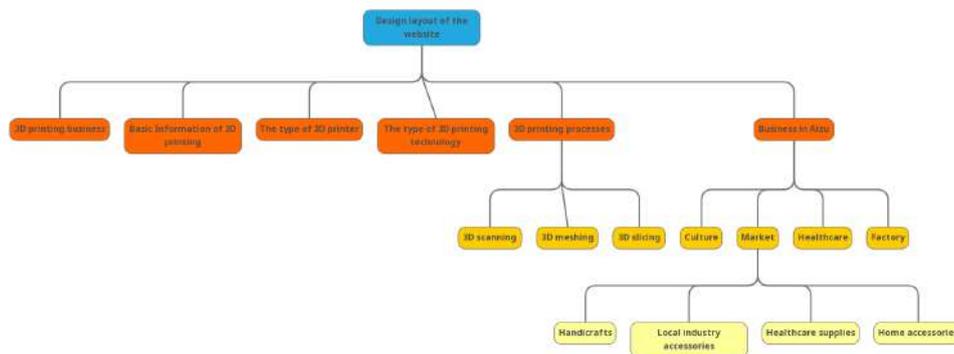


Figure 2. Concept Map Describing the Hierarchical Schema of the Webpage

This concept map is the first draft planning schema, based on which the final webpage design was made.

3.2. Concept Map 2: Explaining Technicalities Related to 3D Printing

The second concept map discussed technologies and information related to 3D printing. We researched the types of 3D printing technology, printer types, commonly used materials, etc., and briefly explained the characteristics of each. These are the information users need to get started on the process of understanding the 3D printing business. Off-course this should be taken as a starting point. The next version of the e-portfolio should present a comparative analysis between similar types of 3D printers, the pros and cons of choosing between such printers; a comparative analysis between the 3D printing materials and approaches and be able to choose the best suitability given the product ideas in mind of the entrepreneur. Right now, in its current form, we have not been able to provide a comparative analysis, in a way that could potentially lead to an appropriate decision-making process. So, the design and purpose of the e-portfolio should be differentiated between content that provides information versus content that helps with decision-making, and not only content types, but presentation approach as well, plays a significant role in such decision-making process. Research has shown that the changes in content led to changes in both strategies and mental

representations, which in turn led to changes in decision outcomes, even though measures of the subjective utilities of the options remained unchanged [15].



Figure 3. Concept Map Describing the Clusters of Information on 3D Printing Processes

3.3. Concept Map 3: Analysing the Entrepreneurial Technicalities

The third concept map described the entrepreneurial technicalities involved in starting the 3D printing business. There are mainly two factors considered to be involved in such analysis: (a) analysing business potential and (b) 3D printing business types. When analysing the factors related to business potential, some of the major factors to plan for before you starting the business have been mentioned. The 3D printing business type clusters described what is needed to start such a business. The idea is to design the e-portfolio or website in a way such that each of the blue categories as is seen in Figure 4 should appear as a linked page, providing the detailed explanation of the entrepreneurial technicalities, as may be required by any budding entrepreneur. This paper does not provide an opportunity to dig deeper into the content, but primarily the final idea will centre around intelligent search and information retrieval on the website. Such an intelligent semantic web search platform was not available for this website as the focus was on 3d-printing based information organisation,

but future studies should investigate how such search mechanisms could be embedded like what we find in e-commerce, e-tourism websites, using recommendation systems [16].

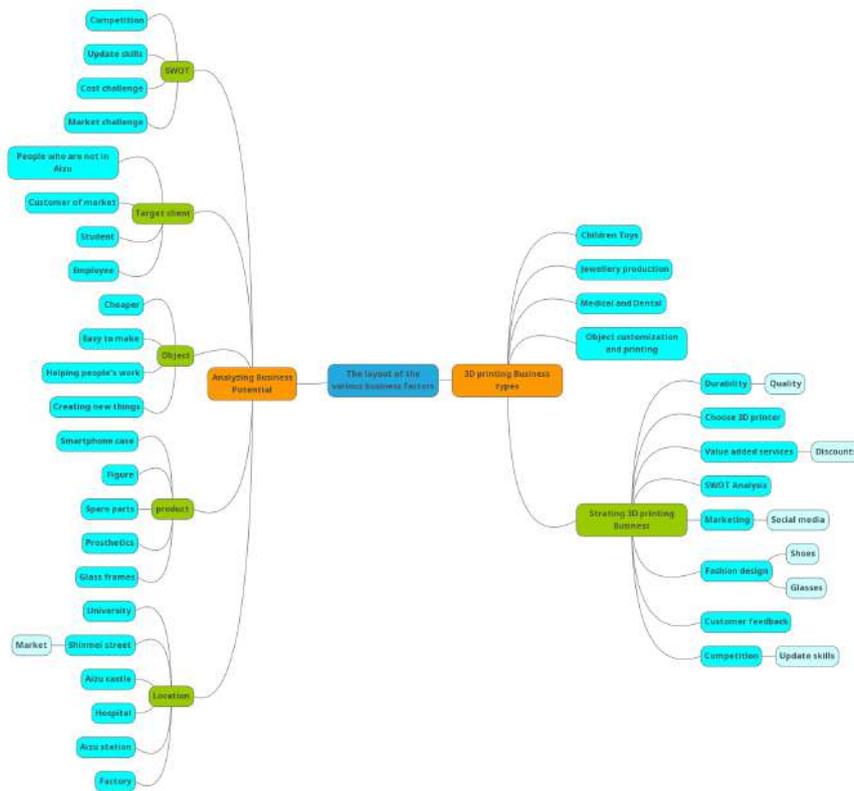


Figure 4. Concept Map Describing Information Clusters on 3D Printing Business Issues

3.4. Major Screenshots from the Webpage

What we ideally need, based on Figure 5 screenshot, is a faceted search mechanism. Faceted search is becoming a popular method to allow users to interactively search and navigate complex information spaces [17].

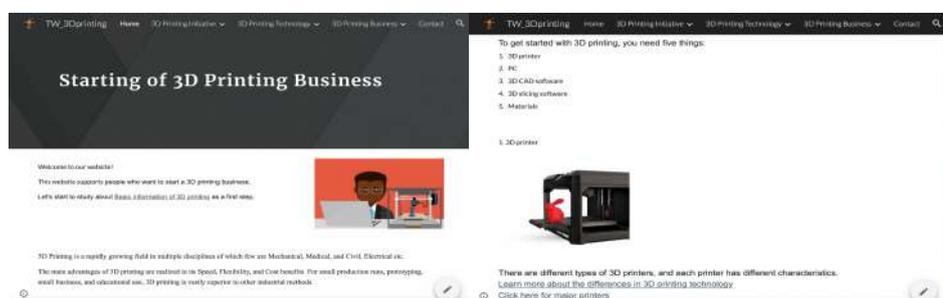




Figure 5: Example Screenshots from the 3D Printing Webpage

4. Understanding of the local business context in 3D printing?

4.1. Business SWOT Analysis

SWOT stands for Strengths, Weaknesses, Opportunities, and Threats. We used the handicrafts business as an example to analyse SWOT. It is easy to make unique products because it gives designers more freedom in design and you can use various materials. Furthermore, once designed products can be mass-produced. However, they need to learn the technology to design 3D models and buy a 3D printer, so they need to consider the cost.

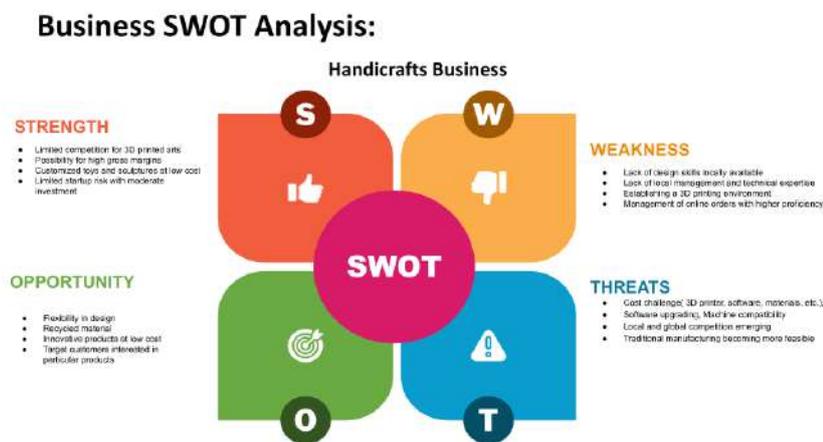


Figure 6. Business SWOT Analysis

4.2. Product SWOT Analysis

In this section we have discussed product SWOT analysis of toys like *Akabeko*, a fantasy creature in the Aizu area. Strengths here are durable versatile complex toy designs with less weight, which provides the opportunities like creating local traditional designer jobs through innovative toys with unique materials. But weakness and threats would likely also have for example depending on the cost and efficiency of 3D printers there will be a limit in usage of

materials leading to question in durability, eco-friendly material usage of the product and local traditional handicrafts industries may oppose 3D printing as competition. It's not easy to convince people that 3D printed products are a replacement for original handicrafts.

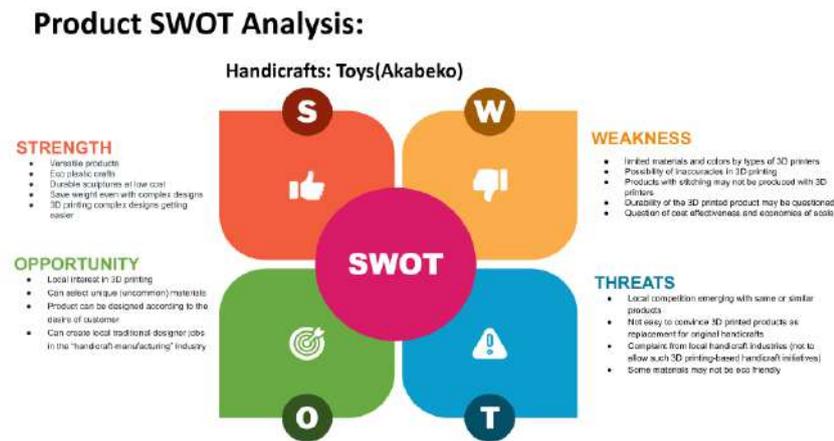


Figure 7. Product SWOT Analysis

5. Future Opportunities with 3D Printing

5.1. Efficiency of the e-portfolio

This e-portfolio helps anyone who wants to start a 3D printing business get the information they need. Users can use it to learn a lot of knowledge about 3D printing. In addition, users can learn about local areas and local businesses. In the future, with the participation of many companies in this e-portfolio, the 3D printing business will become more active, and investors will use it as well.

5.2. New technology Information and how to source the raw materials?

Development of computer technology has intensified the spread of 3D printing in almost all fields of manufacturing, and recently even also in private households of remote areas. Sourcing of raw materials which are needed to start and run 3D printing business is the primary requirement in remote areas. These areas generally lack flexible transportation facilities. Since 3D printing needs various materials to manufacture products, they need to be transported within the time and demand. Depending on the type of niche using those budding manufactures must know about raw material stock from time to time so that they can manufacture the product on demand within the limitations.

5.3 Connecting budding entrepreneurs with investment specialists, governments and local markets

The purpose of this website was to join business communities, making connections on social media like twitter, Facebook etc., thereby promoting the 3D printing businesses; become

known by enlisting the services to the persons who invest in consumer level manufacturing for example spare parts, prototypes for educational institutions, etc.

5.4. Better evaluating the SWOT analysis

The small-scale and highly customised production was demonstrated as one of the biggest strengths of 3D printers. Opportunities that 3D printing will provide in such areas like Aizu are in fields including education (lab equipment, tools), healthcare (prosthetics, tissues, plastic organs), fashion (jewellery, glasses) and many others. But there are challenges, as well. Aizu is a relatively remote place. It will take time to get a technician to repair the 3D device if there is any problem leading to delaying the manufacturing of the product in time. Reliability will be seen as a threat for 3D printing as it is a new environment for the people of Aizu, and so awareness has to increase among the general public if wide scale adoption of 3D printing has to happen in the future.

6. Limitations of the Current Study

The challenge with the current e-portfolio or website was that it was limited in scope with only the first version of the website that could be completed by the end of the course. We could only implement the current schema of the concept map in terms of creating the web pages. However, the usability testing of this version of the webpage could not be done within the scope of the course; and neither could be as a result, update the webpage based on initial feedback received. Further, another major challenge is that the website in its current form, has not created a social media platform where budding entrepreneurs and freelancers and investment specialists and other people knowledgeable in the content areas could talk to each other on relevant topics. Also, future studies should investigate creating an intelligent search platform as part of this website whereby relevant information could be retrieved at a faster pace. Finally, although not possible as part of any single course, such community projects should also involve the students in making more valuable posters, infographics, and interactive educational videos in Japanese to educate the public, and that could be part of the website.

7. Conclusion

The idea of this paper was to discuss a college project on technical writing where students learn how to act as consultants when discussing and presenting ideas and concepts on a technical project such as 3D printing. 3D printing is simply a case study that is extremely popular the world over because of its diverse use and potential in various manufacturing contexts and ability to cut down on costs, and work through customised design complexities. 3D printing has thrown the manufacturing industry wide open. The global additive manufacturing market is all set to go from 600 million dollars to 3 billion dollars in 7 years. With the introduction of new materials and faster manufacturing processes, 3D printing will spread across borders and open both traditional and innovative manufacturing in near future. What we wanted to explore with this project is students' ability to present technical ideas and business opportunities in easy-to-understand language for people who may be interested in economic revitalization through such entrepreneurial initiatives. However, for future such projects should undergo extensive usability testing with faceted and intelligent information search criteria built in to answer frequently asked or customised questions. That in turn means more in-depth information gathering that relates to more specific questions about raw materials, 3D printers, technologies, manpower, cost-benefit analysis, government support,

funding, licences etc. Thus, it means that the basic website information should be linked with the external and more peripheral information available on the local government or other websites. That could lead the entire exercise towards more intelligent search and information retrieval exercises.

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