

A Finance-Based Self-Learning Online Platform for Holistic Evaluation of Innovation Projects

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Abstract— This paper outlines the development and the implementation of an online finance-based self-learning platform to augment the application of finance concepts by non-business undergraduate students undertaking innovation project-based modules. This online self-learning platform has two key objectives; (i) to empower students in multi-disciplinary fields to self-study finance concepts using online learning platforms and to subsequently apply them in project-based modules, (ii) to increase efficiency in teaching finance-based contents with limited resources, especially in this COVID-19 environment with an online mode of learning. This online self-learning platform allows involvement of faculty without any finance background to embed a bite-sized content as supplementary topics for students to self-learn at their own pace. The efficacy of the online self-learning platform was determined through pre and post quizzes to identify student's current and acquired finance knowledge. Quantitative data obtained demonstrate that there is significant improvement in the post-quiz scores; the mean of all the modules improves by 28% for post quiz score, and paired t-test for pre and post quiz scores are significant. These results as well as feedback received from students, demonstrate the effectiveness of the implemented online self-learning platform to augment the application of finance concepts by non-business undergraduate students.

Keywords—blended-learning, finance concepts, innovation projects, self-learning

I. INTRODUCTION

At the Singapore Institute of Technology, Design Thinking and Lean Management are project-based undergraduate modules that are taught across two different schools, namely Health and Social Science (HSS hereafter), and Engineering (ENG hereafter), respectively. These modules, while innovative in nature, need to be holistically evaluated if the proposed innovative changes are justified, not just from a technical perspective but also from the financial perspective. Studies have shown positive impacts of financial literacy and negative impacts associate with financial illiteracy. [1, 2, 3] The students undertaking these modules have no financial background nor any financial topics embedded, and hence it is vital to equip such students with financial knowledge.

A. Overview of Design Thinking (Innovation) Module

Designing typically involves the transformation of an idea, needs, or wants by consumers or the marketplace at large, into

a product that satisfies these needs [4]. More recently, the concept of design thinking as a method of problem solving that can be carried out by anyone in any profession and during any stage of life is getting very popular [5]. An innovation achieved from design thinking can manifest itself as a physical product development, a website development or even as a continuous improvement project on an existing process [6].

In the nursing programme, students are expected to propose different products and services based on their clinical placement immersion experience or after much long periods of research and development. The aims of the Design Thinking (Innovation) module in nursing programme is to equip students with design thinking skills in the healthcare context. Students will be taught the design thinking methodology from the Institute of Design at Stanford d.school and learn to apply the five (5) design thinking principles: Empathize, Define, Ideate, Prototype and Test, in their respective group projects. Embedded in this module is a compulsory clinical immersion, where students will be expected to complete an innovative project proposal that applies design thinking principles for empowering healthcare stakeholders or helps improve existing healthcare services.

Through observation and ethnographic research, students will develop empathy and understanding of users more insightfully. They would subsequently explore and define a design challenge based on users' needs within the clinical practice education. Students will be facilitated to go through the iterative process of ideation of a range of creative solutions, building and testing a prototype, collect feedback from users and evaluate/re-evaluate the prototype.

However, there seems to be a reluctance in students who want to continue pursuing their innovation because they do not have any business background knowledge to resolve the funding strategy and financial planning to further their work. The importance of diversity in skill sets required to bring a new device to the market is addressed by Fogarty [7] *"Particularly in this day and age, you need people from different disciplines.... To bring this whole team together, you have to understand value allocation. All of these people create value....if you think, just because you had the idea, you brought all the value, you're not going to be successful."* To pursue innovation, the question must be asked as to whether it makes sense to continue with the tasks and not just from a technical perspective but also in financial terms.

For innovators or aspiring young entrepreneurs with no financial background, developing a sound funding strategy can be challenging and complex. Design thinking offers a frame to work on solving complex challenges, reproducing knowledge through action with the goal of changing existing situations into preferred ones. All of this together distinguishes the design thinking approach from the usual business or technology driven concepts. Nonetheless, the design thinking methodology acknowledges the business viability of ideas and tries to integrate these perspectives. Fruitful innovation should embody human desirability, technological feasibility, and economic viability.

B. Overview of Lean Management Module

On another front, lean management modules are taught in ENG with the objective to acquire knowledge in continual improvement tools that will enhance the productivity of any business process. Such tools include identification and elimination of inefficiencies (also known as ‘the Eight Deadly Wastes’) that do not add value to the creation of the final product, value-stream mapping, root cause analysis as well as improvement tools that promote flow and pull demand. The outcome is to achieve a significant improvement in productivity in terms of efficiency, cycle time and cost savings. Lean management has become a vital continual improvement methodology for building a stable organization that evolves constantly, helping to identify actual problems and removing them, and most importantly, ensuring that every employee is involved in this continuous improvement process.

While the tools for lean based improvements and lean management are well-known [8], there seems to be minimal emphasis on analyzing the financial aspects when embarking on improvement projects. These include capital budgeting aspects such as capital expenditures and cash flow to capital expenditure ratio, as well as cost benefit analysis aspects such as net present value, payback period and return on investments. Research suggests that there is a major focus on attaining technical competency for engineers and minimal focus on attaining competency in non-technical skills [9]. Statistical analysis of the survey results clearly indicated that engineering curriculum need to be revised to introduce relevant business subjects, such as finance, economics and marketing to prepare engineers to operate and succeed in the global market.

C. Problem Statement

Prior to the implementation of a commercially viable solution of continual improvement innovation projects, it is crucial to answer the question if it is worth spending the money to develop this new solution and what is the expected payback period. Especially if one is faced with numerous potential innovation projects, an organization needs to prioritize and decide which projects to pursue, given the limited resources. The answers to these questions require the knowledge of finance concepts to obtain clarity to the prioritization of projects to pursue.

This project aims to develop a holistic approach to project evaluation by enhancing the financial knowledge aspects, namely in two key areas: (i) Design Thinking, and (ii) Lean Management. Online tools such as website and mobile application were developed as they offer a range of material for students to learn Finance concepts including resources such as animation video clips, financial tools, and case

studies, which are suitable for non-business students to financially evaluate potential innovation projects. The remainder of this paper is organized as follows. Section II outlines design and development of finance-based self-learning online platform. Section II describes an implementation and evaluation. Section III highlights results and discussion. Section IV concludes.

II. DESIGN AND DEVELOPMENT OF FINANCE-BASED SELF LEARNING ONLINE PLATFORM

A. Implementation

In some courses, the project evaluation tools together with basic finance concepts are taught face-to-face. The contact hours to teach these materials are usually around 8 to 12 hours. By developing the finance-based self-learning online platform with comprehensive resources, the contact hours previously used to deliver the content can now be used for other meaningful purposes.

The online platform was developed and deployed both as a website and a mobile application, providing students with an easy access to the contents. The website and mobile application were developed in house by Singapore Institute of Technology interdisciplinary students (i.e. ICT, Accountancy, and Communication Design). These platforms were developed with the aim to equip non-business students with a basic understanding in managing finance and improve their confidence in evaluation of innovation projects. However, the e-learning option does not compromise the contact hours of design thinking and lean management content in these modules as it permits students to conduct self-guided learning outside of the classroom contact hours. There are three main sections on the self-learning platform, namely: (i) animation video clips (covered in *Section IIB*), (ii) financial calculators for project evaluation (covered in *Section IIC*) (iii) case studies (covered in *Section IIC*). Fig 1. shows a screenshot of the main page of the finance self-learning website. The main page allows students to freely navigate to any of the three main sections listed through the top navigation bar. In order to ensure the security and authentication of usage, the website was made available through the Singapore Institute of Technology’s library portal.



Fig 1. Screenshot of the main page of the finance self-learning website

B. Animation video clips

To facilitate student self-learning of the various finance concepts, the platform included eleven animation video clips, as follows:

1. Introduction to Finance

2. Financial Statements
3. Funding Options
4. Introduction to Investment Decision
5. Net Present Value (NPV)
6. Internal Rate of Return (IRR)
7. Profitability Index (PI)
8. Accounting Rate of Return (ARR)
9. Payback Period (PP)
10. Summary of Project Evaluation tools
11. Overall summary

Clip numbers 1 to 4 provide the foundation and basic concepts of Finance, clip numbers 5 - 9 provide explanation of the 5 main financial tools for project evaluation, while clip numbers 10 to 11 reinforce all the concepts. Fig 2. shows example of the animation video clips.

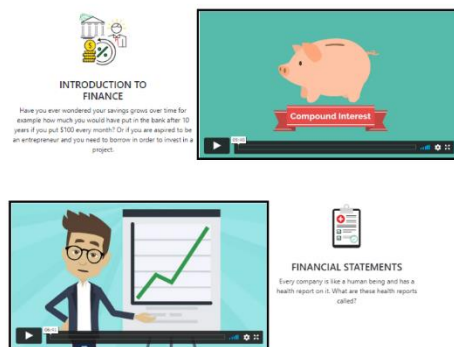


Fig 2. Example of animation video clips explaining the financial concepts

C. Financial calculators for project evaluation

The platform provides financial calculators implementing the various formula based on the five main financial tools for project evaluation, which allow students to find answers without having to manually calculate them. Students can use the financial calculator for case studies provided on the platform (further discussed in Section III) and/or as a stand-alone financial calculator for their own future potential innovation projects. Several financial calculators are provided to automatically compute the various financial concepts. See Fig. 3 for example of financial calculators available in the proposed online platform.

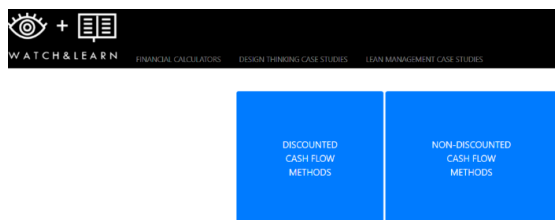


Fig. 3 Example of financial calculators provided on the website

D. Conceptualized case studies

The platform also includes two comprehensive case studies provided for students to apply the knowledge learnt from the video clips. The first case study is tailored for design thinking module, while the second case study supports the lean management module. However, both cases are not exclusive and can be used by either student taking design

thinking or lean management modules. There is also an option for student to use the in-built financial calculator and reveal the solution for the various case studies. Fig. 4 shows an example of the case study provided, while Fig. 5 depicts the financial calculator.

Prototyping methods like wireframe creation from the designer's toolkit was applied to the user interaction design of the website platform interface. Wireframes served as the skeleton of most digital products. It served as a base and provided a general idea of the construction of what is being constructed.

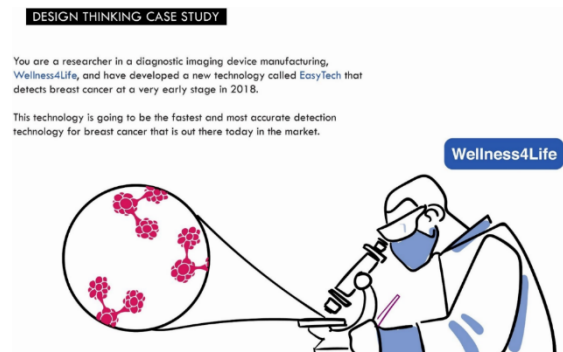


Fig. 4 Example of case study provided on the website

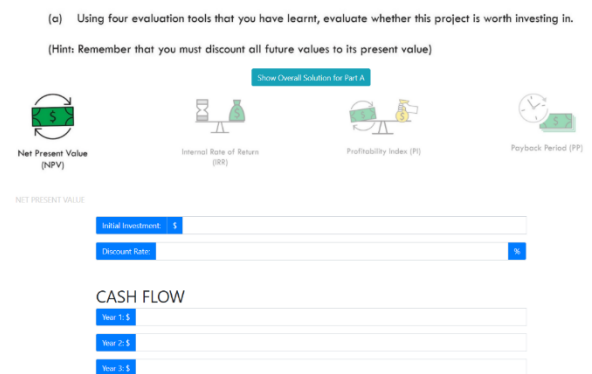


Fig. 5 Example of financial calculator for the different case studies

Beyond the layout skeleton of the design, the content and copy about financial literacy, design thinking method and lean management concepts formed the muscle of the evaluation tool. As this website is targeted at millennials, it was designed to be the simplest and most intuitive financial website for innovation projects. That aside, even if the website would be used by other segments of the population (i.e. working adults), the exploration should take on a different direction, that focused on systematizing our web experience to be more modular and targeted for mobile browsers. New type styles, new touch interactions, new guidelines for flows and page content, and a new set of standard HTML components were included to enable a better mobile experience, allowing the design to be developed faster while keeping our visual language consistent.

III. IMPLEMENTATION AND EVALUATION

A. Methodology

The platform was rolled out to students taking design thinking and lean management modules in 2020 and 2021. The assessment of knowledge gained from the self-learning platform involved two quizzes, namely a pre-quiz to identify student's current finance knowledge, and a post-quiz to identify the acquired finance knowledge after using the self-learning online platform. Students were asked to answer ten True or False questions (as listed in Table I) for both pre and post-quizzes. Students were taught design thinking with and without the project evaluation tool. Hence, they were able to provide insights whether this tool was indeed useful and aid their decisions in innovation initiatives. A similar assessment approach was conducted for students undertaking Lean management modules. The learning outcomes in both design thinking and lean management modules remained unchanged pre and post implementation of the online financial tool. There was also no formal assessment conducted on the financial aspects in these modules. As a self-learning financial tool, it aimed to enhance the students' group project work and subsequent continuous improvement project endeavors in future.

Information, such as the quiz score, was recorded through the platform. Subsequently, the results were anonymized prior to analyzing the pre and post quiz scores, and then compared using the paired Student's t-test, a statistical parametric test on the means of quantitative data, in this case the quiz score) based on the normality assumption. The statistical t-test aims to show whether the improvement in the post-quiz score is significant. As the underlying options for the questions are True or False, individual question analysis was performed using binomial test to ascertain the significance in the difference. Additional information related to the video viewership were also collated and analyzed. This included information such as the number of unique viewers (represented by unique viewers), and the average duration of the video watched across all plays in percentage (represented by mean percent).

TABLE I. PRE AND POST-QUIZ QUESTIONS

Question no.	True/False questions
1	Verify this statement: Simple interest is only paid on principal, while compound interest is paid on the principal plus all of the interest that has previously been earned.
2	Verify this statement: Based on time value of money, future value is always smaller than present value.
3	Verify this statement: There are three sections to the statement of cash flow, which are Cash flow from operating, investing and financing activities.
4	Verify this statement: The easiest way for a start-up company to raise fund is via stock market.
5	Verify this statement: Net Present Value (NPV) is the sum of the present value of any project and the initial cost.
6	Verify this statement: The rule of thumb for Net Present Value (NPV) is to accept the project as long as the NPV result is a positive figure.

7	Verify this statement: Non-discounted cash flow methods for project evaluation are internal rate of return (IRR), Accounting Rate of Return (ARR) and Payback Period (PP).
8	Verify this statement: Using internal rate of return (IRR) for project evaluation, you should compare IRR with the cost of borrowing (the interest rate applied on your funding like the bank's interest rate). To accept the
9	Verify this statement: Profitability index (PI) is an analysis of the cost vs benefit ratio of a project.
10	Verify this statement: Payback period (PP) calculates how long it takes you to recover your investment in a project. The faster the payback period the faster you recover back your money.

In addition to quantitative analysis, qualitative analysis was performed using qualitative data gathered from student feedback surveys conducted online after the post-quiz. The Students' interest in the finance-based online self-learning platform was examined using a bipolar 5-point Likert scale [10]. The scale has two bipolar adjectives at either end of the scale and a neutral option connected with intermediate answer options, ranging from 1 (Strongly disagree) to 5 (Strongly agree).

B. Design thinking modules: Application of Finance concept self-learning platform and quizzes

The platform and tools were rolled on two separate runs of the design thinking modules:

- 1) OTY3916 Healthcare Design Thinking running in Trimester 2 AY2019/2020 January to April 2020
- 2) NUR3006 Health Innovation and Informatics running in Trimester 2 AY2020/2021 January to April 2021

The learning activities in the modules included identifying appropriate proxy companies and subsequently analyzing each one via a top-down assessment. Students were then required to list the operational information, including the company's key milestones, and to reconstruct its operating plan via a top-down analysis. In a top-down analysis, an overview of the model was developed based on available information. Each part was refined (with additional information and assumptions added) until the entire model could be validated.

The financial tool developed would aid in planning of the financial model adjusted based on the learning and observations from the proxy company analysis. Additional risks or potential concerns identified should be addressed in other parts of the business model or innovation planning. All aspects of the business model or innovation plan are then reviewed and adjusted. The whole process is iterative based on design thinking principles, and the financial model needs to be refined several times before it is ready for review by potential investors.

C. Lean management: Application of Finance concept self-learning platform and quizzes

In the case of the Lean Management modules, the project evaluation was implemented in three (3) separate modules, namely:

- 1) SIE3007 Lean and Quick Response Repair running in Trimester 3 AY2019/2020 May to August 2020
- 2) MME2161 Lean Manufacturing and Six Sigma in Trimester 3 AY2020/2021 May to August 2021
- 3) SIE3007 Lean and Quick Response Repair running in Trimester 3 AY2020/2021 May to August 2021

The SIE3007 module has a group project component in which industries would host the student team to apply the lean concepts on real-life scenarios. Hence, the financial aspect would form one of the evaluation checklists for students to conduct. The financial analyses tools developed in the app/website aided in making a holistically informed decision if a proposed improvement recommendation was economically worthwhile. It also gave additional insights into the Return On Investment (ROI) and payback period. Such information enhanced the quality of work that was shared with the industry hosts, in the form of a technical report and a technical presentation.

The MME2161 Lean Manufacturing and Six Sigma module also benefitted from the developed financial analyses tools. However, as the module runs on a compressed six-week timeline (as opposed to the conventional thirteen-week timeline), the financial aspects were introduced in a classroom setting but nevertheless provided students with a holistic view for such continuous improvement endeavors.

Both these lean modules were intentionally scheduled to run just before the students embark on their Integrated Work Study Program (IWSP) [11] in Year 3, with the aim that the lean management concepts will provide the students an opportunity to provide quick wins in their IWSP organizations. The developed financial analyses tools further enhanced the value-add to the IWSP organizations when students embark on their lean based continuous improvement projects.

IV. RESULTS AND DISCUSSION

A total of 77 design thinking students and 151 lean management students learning performance and feedback were collated and analyzed. The study aims to ascertain the usefulness of the finance self-learning online learning platform in helping non-business students to self-study finance concepts.

A. Quantitative Data Analysis and Findings

Table III shows the results of statistical analysis of pre- and post-quiz scores from the design thinking and lean management students, separately, as well as of all students combined. Based on the paired t-test, there are significant differences (all $p < 0.001$) between the pre- and post-quiz scores for both the design thinking modules (6 versus 6.7) and the lean management modules (5.6 versus 7.6) separately, and all combined (5.7 versus 7.3). While the mean pre-quiz

score of students taking design thinking modules is higher than the mean pre-quiz score of students taking lean management modules, the lean management modules achieved a higher improvement in marks (+2) versus the design thinking modules (+0.7). Results of analyzing each of the questions independently using binomial test is shown in Table IV. Nine (9) out of the ten (10) questions show a significant improvement in the post-quiz score.

Table V shows the results of analyzing the video viewership information collected throughout the different periods. The results show that ~46% of the students watched the videos (average # of unique viewers divide by total number of students). The results also demonstrated that while students do not always complete viewing the videos, on average they watch more than ~78% of the videos, which essentially facilitates them to capture the essence of the videos. The most popular video with the highest number of unique viewers across all 4 time periods is the Introduction to Finance video (Clip #1). This is most probably because it is the first video on the platform, and it is the first video that students click.

These findings suggest that the platform does facilitate to enhance students' learning of the finance-based concept. Specifically, the results suggest that by using the self-learning platform in their design thinking and lean management modules and applying it to their projects, students are able to improve their finance concept proficiency, resulting in an increase in their post-quiz scores

B. Qualitative Data Analysis and Findings

In order to further ascertain the usefulness of the finance self-learning online learning platform in helping non-business students to self-study finance concepts, students were asked to complete an online feedback survey after the post-quiz. The list of survey questions are as indicated in Table II below.

TABLE II. QUALITATIVE SURVEY QUESTIONS

No.	Survey Question
1	The design of the 'online financial tool' was appealing and highly motivating to use
2	The 'online financial tool' was engaging
3	The 'online financial tool' challenged me intellectually
4	The content in 'online financial tool' was easy to follow and understand
5	The 'online financial tool' was intuitive, easy and free from excessive delay
6	I would recommend the 'online financial tool' to my peers
7	The 'online financial tool' should be continued for all future trimesters
8	Overall, I am satisfied with 'the online financial tool'

Overall, students' feedback was very positive. As illustrated in Fig 6. ~71.9% of the students stated that they were satisfied with online financial tool, and ~58.5% of students recommended that the online financial tool be used in subsequent trimesters. More than 71% of students found the online financial tool to be easy to follow and understand.

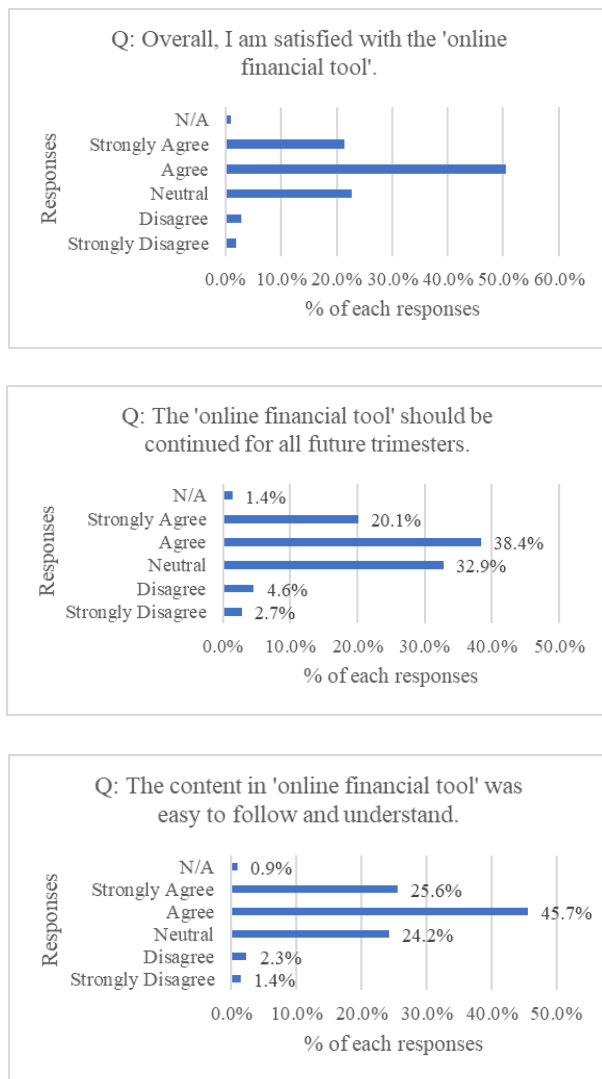


Fig. 6 Survey responses assessing the usefulness of the finance self-learning online learning platform in helping non-business students to self-study finance concepts

Some positive feedback from students are listed below:

- *"It was simple enough to understand, even for someone who does not have background financial knowledge"*
- *"I learnt that the world of finance has many different aspects to explore and there are many different financial tools to guide in making the right decisions on different aspects."*
- *"The graphics in the video makes it more engaging"*
- *"As a visual learner, having short videos where key pointers and formulas show up within the video makes us understand the concept better"*
- *"The most engaging part of the online financial tool would be the terminology that was used. It is something that I can relate to the real-world aspect"*

Students also provided some constructive feedback and points for improvements such as:

- *"To include online interactive assessment and financial games to test our understanding"*
- *"Include real-life examples or start-up stories"*

- *"More exercises after every topic to make students understand the concept better"*
- *"Have more practice questions"*
- *"Show more examples of applying the financial tool for real-life applications"*

Lastly, students were asked to reflect on what they have learned the most from using the online financial tool and some comments from students were as follows:

- *"The different case studies that was available for us to read and tackle so that we would know how to handle different situation in the future"*
- *"How to make wise decisions about making investments"*
- *"How to apply different formulas to different scenarios and how to interpret the values obtained from the calculation"*
- *"I've learned how to deem if an investment is making profit using the different tools"*
- *"Financial knowledge application for our future such as financial planning for a project"*

V. CONCLUSION

This paper presented an online self-learning financial platform that empowers non-business students to self-study finance concepts. With the aid of the online self-learning tool, the students were able to enhance their group project work and industry involvement and use it to continuously improve their project endeavors in the future. Quantitative data obtained from the pre- and post-quizzes demonstrated that there was significant improvement in the post-quiz scores, while qualitative data showed that students appreciated the tool and agreed that the usage of the tool improved their learning. Overall, the results demonstrate the effectiveness of the implemented self-learning platform. As industries continue to dynamically transform, universities are also ramping up efforts in deepening students' applied learning and to produce industry-ready graduates. One such effort is to equip students with transferable skills including design thinking and innovation skills. Thus, the foundational knowledge of basic financial concepts obtained through the use of this online self-learning tools will further enrich these students' transferrable skills. For future scope, interactive exercises, for example pool of short answer type of questions banks and more case studies are to be added on the platform. In addition, analytics tool to further gauge students engagement will be explored.

VI. REFERENCES

- [1] A. Lusardi and P. Tufano, "Debt literacy, financial experiences, and overindebtedness," *Journal of Pension Economics & Finance*, vol. 14, no. 4, pp. 332-368, 2015.
- [2] M. Miller, J. Reichelstein, C. Salas and B. Zia, "Can you help someone become financially capable? Ameta-analysis of the literature," *The World Bank Research Observer*, vol. 30, no. 2, pp. 220-246, 2015.

- [3] V. Stango and J. Zinman, "Exponential growth bias and household finance," *the Journal of Finance*, vol. 64, no. 6, pp. 2807-2849, 2009.
- [4] V. Singh, S. Skiles, J. Krager, K. Wood, D. Jensen and A. Szmerekovsky, "Innovations in Design Through Transformation: A Fundamental Study of Transformation Principles," in *International Design Engineering Technical Conferences*, Philadelphia, PA, 2006.
- [5] U. Johansson-Sköldberg, J. Woodilla and M. Çetinkaya, "Design Thinking: Past, Present and Possible," *Creativity and Innovation Management*, vol. 22, no. 2, pp. 121-146, 2013.
- [6] T. Brown, *Change by design: how design thinking transforms organizations and inspires innovation*, New York: Harper Collins, 2009.
- [7] T. Fogarty, "From the innovator's workbench," 27 1 2003. [Online]. Available: <https://biodesign.stanford.edu/resources/learning/bio-design-speaker-series.html>.
- [8] Purdue University, "Lean Six Sigma Online," [Online]. Available: <https://www.purdue.edu/leansixsigmaonline/blog/lean-tools/>.
- [9] D. Q. Nguyen, "The essential skills and attributes of an engineer: a comparative study of academics, industry personnel and engineering students," *Global Journal of Engineering Education*, pp. 65 - 77, 1998.
- [10] A. DeCastellarnau, "A classification of response scale characteristics that affect data quality: a literature review," *Quality & Quantity*, vol. 52, no. 4, pp. 1523--1559, 2018.
- [11] M. F. Yeo and C. Lam, "Singapore Institute of Technology - Integrated Work Study Programme (IWSP) Model," in *Practical Learning in Hospitality Education*, Queensland, University of Queensland, 2021.

TABLE III. ANALYSIS OF PRE AND POST-QUIZ SCORES FOR ALL IMPLEMENTED MODULES

	N	Pre-quiz score Post-quiz score			Paired t-test			Results
		Mean(SD)	Mean (SD)	Mean difference	t	df	p	
All modules	228	5.7 (2.0)	7.3 (1.5)	1.6	10.7	227	< 0.001	Difference is significant
Design Thinking Modules	77	6 (1.4)	6.7 (1.6)	0.7	3.7	76	< 0.001	Difference is significant
Lean Management Modules	151	5.6 (2.2)	7.6 (1.3)	2	10.6	150	< 0.001	Difference is significant

TABLE IV. RESULTS OF INDIVIDUAL QUESTION ANALYSIS

Question #	Pre-quiz score Post-quiz score		Mean difference	Binomial Paired t-test			Results
	Mean	Mean		t	df	p	
1	0.82	0.94	0.12	-7.88	227	< 0.001	Difference is significant
2	0.54	0.51	-0.03	0.85	227	0.4	Difference is not significant
3	0.64	0.90	0.26	-13.34	227	< 0.001	Difference is significant
4	0.74	0.79	0.05	-1.86	227	< 0.1	Difference is significant
5	0.34	0.43	0.08	-2.52	227	<0.05	Difference is significant
6	0.43	0.82	0.38	-14.86	227	< 0.001	Difference is significant
7	0.39	0.57	0.18	-5.46	227	< 0.001	Difference is significant
8	0.48	0.61	0.13	-4.12	227	< 0.001	Difference is significant
9	0.56	0.82	0.26	-10.21	227	< 0.001	Difference is significant
10	0.70	0.94	0.24	-14.81	227	< 0.001	Difference is significant

TABLE V. RESULTS OF ANALYZING VIDEO VIEWERSHIP DATA

Period	Module	# of students	average # of unique viewers (per video)	average % length watched	Most popular video
Jan - April 2020	OTY3916	44	4.18	70.36	01 Introduction to Finance
May-Aug 2020	SIE3007	38	17.63	78.90	01 Introduction to Finance
Jan - April 2021	NUR3006	33	40.81	81.10	01 Introduction to Finance
May - Aug 2021	MME2161, SIE3007	117	41.63	81.00	01 Introduction to Finance