

# Analysis of the Factors Affecting Successful Completion of Asynchronous Online Learning Programs

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**Abstract:** Within a year of its launch, the University of Moratuwa's open learning platform ([open.uom.lk](http://open.uom.lk)) has over 180,000 registered participants, providing free and open access to a series of asynchronous online courses in software development. Nearly 17,000 people have completed the two foundation courses: Python for Beginners and Web Development for Beginners. Considering the low overall completion rate compared to the total number of registered users, it is important to study the factors contributing to successful completion while promoting meaningful learning. To support the learning process, there are multiple activities like lecture videos, lecture notes, coding playgrounds, lecture slides, assessments, and discussion forums. Thus, this study investigates student behaviour to understand activities that are high in cognitive load and promote active engagement. The study is carried out using learning management system (LMS) user logs and feedback from completed and ongoing students. The elaborative logs with user activities and time stamps help identify the pace of completion by students with different capabilities and learning patterns. The study's findings will be useful to educators because they will be able to design similar LMS platforms that optimise student performance and promote effective learning outcomes. Furthermore, it would be useful to evaluate how students would manage the load in asynchronous online learning programs. Understanding how the learning and assessment activities are related to the completion of the course would enable predicting completion rates and times to properly plan for the employment opportunities for the successful learners.

**Keywords:** E-Learning, Online Asynchronous Learning, Student Performance

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## 1. Introduction

### 1.1 Introduction to online learning

Online learning is a method of delivering teaching and learning content to students via electronic methods. The devices used may include computers, tablets, and smartphones. Online learning can be synchronous or asynchronous. In the synchronous mode, the students and instructors interact in real time while in the asynchronous mode, the students can access the content at their own pace. The content may be in different formats such as recorded video, tutorials, automated assessments.

Many advantages of online learning over traditional e-learning methods can be identified. Online learning programmes may be designed in a self-paced manner, thus making them more flexible. The high costs incorporated with developing physical infrastructure may be cut down significantly by shifting to online learning methods. It is likely that there will be more ways that the students can engage with the teaching and learning content in an online learning setting. Some of these components would include recorded interactive videos, interactive tutorials and automated assessments and quizzes.

### 1.2 The importance of online learning

Online learning has become increasingly popular in recent years, especially with the pandemic situations that the society has encountered. It has proven to be a massive experiment with adopting online learning methods substituting traditional learning activities. That experiment has yielded positive results and the effectiveness of online learning has been showcased.

Online learning can help students to develop important skills including time management, self-discipline and critical thinking (Clark & Mayer, 2016). The methods in online learning can effectively support a wide range of user groups differing in age, gender, ethnicity and many other factors.

### **1.3 Historical evolution of online learning**

The concept of distance learning has been in existence for a long time (Mayer, 2019). Correspondence courses were offered as early as the 1800s, which is the earliest reference to evolution of online learning. In the correspondence courses students could learn at their own pace which made the courses popular especially among the students from the rural areas. Since those students found it much convenient to follow the self-paced method delivery.

In the 1900s, with the invention of radio and television, new paths were identified to deliver learning content. Distance education was slowly gaining popularity with the usage of radio and television as medium of communication and delivery. These distance methods allowed students to learn from subject experts even though they were not physically present at the same place and hence provided increased interactive learning experience.

With the introduction of computers in the 1960s the concept of computer-based learning was introduced. These types of courses enhanced the online learning concept and provided more personalised learning experience.

With the development of the internet in the latter parts of the 20th century, online and distance learning methods were gaining more and more popularity. Online courses offered a more convenient and affordable learning option than traditional forms of distance education, and they quickly became popular with students of all ages.

### **1.4 Recent trends in online learning adaptation**

Online learning has gained worldwide popularity in recent years and has become essential in the field of education. Universities, colleges, schools and other institutions were left with no choice but to switch to online mode, especially as the pandemic was in full effect.

The recent growth of popularity of online learning is expected to continue. Increasing number of people are on mobile devices and have access to the internet. Many online courses are now available and optimised for mobile platforms increasing the reach.

The concept of microlearning focuses on short, focused modules of content. This type is gaining popularity and it is convenient especially for the users on mobile platforms to follow a learning content in a shorter period of time.

Social media platforms provide increased support for online learning. Instructors and students can use social media to connect with each other, share resources, and collaborate on projects.

Online learning platforms are becoming more personalised, allowing students to learn at their own pace and in their own way. This personalization can help students to be more engaged and to learn more effectively.

### **1.5 Cognitive aspects of online learning**

Cognitive aspects of learning should be considered in any form of learning. They are especially important in online learning settings. If the students are new to the online learning methods, it will be important to pay considerable attention to the cognitive aspects.

In online learning, attention is one of the most important cognitive aspects (Ayres & Sweller, 2014). Many potential distractions may be present in an online environment such as social media, communication platforms and other web content. Students need to be able to manage these distractions in order to be successful in online learning.

Other cognitive aspects including the ability to store and retrieve information, interpret information from senses, logical thinking and problem solving are vital in an online learning setting (Brunken et al., 2010; Azevedo & Alevan, 2013)

### **1.6 Active engagement**

Benson (2022) reported a strong correlation between procrastination and key outcomes like course completion and course grade. The case study, going against the claims of previous studies which did not report such a definitive relationship, provides an important insight on success or failure of online asynchronous courses.

Active engagement is highly important for effective learning in an online environment. Unlike the conventional setting, the students and the teachers are not in the same physical location which makes it difficult to maintain active engagement. This especially becomes a concern when the learning mode is asynchronous.

It is important to track student engagement especially in online learning settings. It will actually be challenging to maintain high levels of engagement in online learning programmes. New and innovative approaches have to be used in the delivery of online courses to maintain student interest and engagement.

Possible methods of assessing student engagement includes tracking the participation in student discussions, completion of assignments, attendance and conducting surveys on student engagement.

### **1.7 More related work**

Arnold and Pistilli (2012) proposed a signalling method to communicate to the student on how they are doing in a course, using a prediction method based on grades, demographic information, past academic performance and student efforts. Seaton et al. (2014) conducted a comprehensive study to show the usage of large amounts of data available in Massive Open Online Courses (MOOCs). Such data is effectively analysed qualitatively to investigate the attrition, retention, time distribution among resources, usage of resources and the usage of resources for problem solving.

Cluster analysis conducted in Rienties et al. (2015) identified four learning design patterns, namely: constructivist, assessment-driven, balanced-variety and social constructivist modules. The study provided crucial insights on learning design and how it impacts academic performance. Pilli and Admiraal (2017) formulated a series of suggestions that will be beneficial in designing MOOCs. The suggestions include increasing student participation, providing clear and structured assessments, facilitating learner-centred communities and many more. The Open University Learning Analytics Dataset (OULAD) is a learning analytics dataset which can be used for benchmarking in the learning analytics domain (Alhakbani and Alnassar, 2022). Such datasets provide ways to assess the students in Virtual Learning Environments (VLEs).

### **1.8 The open learning platform of the University of Moratuwa**

The open learning platform of the University of Moratuwa currently provides free and open access to the Trainee Full Stack Developer (TFSD) programme (Nanayakkara et al., 2022). The programme consists of six courses related to Python Programming, Web Development and Professional Practice in Software Development. The participants can follow the courses in a self-paced, asynchronous manner. This study uses data collected from the platform which records all the activities of the participants on the platform. The dataset is ever-growing and can be utilised to analyse user behaviours on the platform. No restrictions have been imposed on who can join the platform. Anyone having access to the internet can register on the platform and get started with the courses.

## **2. Problem statement**

The open learning platform of the University of Moratuwa keeps receiving registrants on a daily basis with the total number nearing 200,000. However, at the time of this statement, the total number of overall completions of the TFSD programme is 141. To fully complete the TFSD programme, a participant should complete six courses in total. The percentage of overall completion is lower than the expectations set forth at the initiation of the platform. The low completion rate may be due to multiple factors, considering that the courses are offered in an asynchronous mode and there are no restrictions on who can register and do the courses. All courses are self-paced. Compared to a traditional mode of learning, it is difficult to keep track of the students' behavioural patterns. Hence this study focuses on identifying the factors that may affect the completion rate of the programme.

Fig1. graphically illustrates the completion behaviour of the participants. The low completion rate is observed especially at the later stages of the programme.

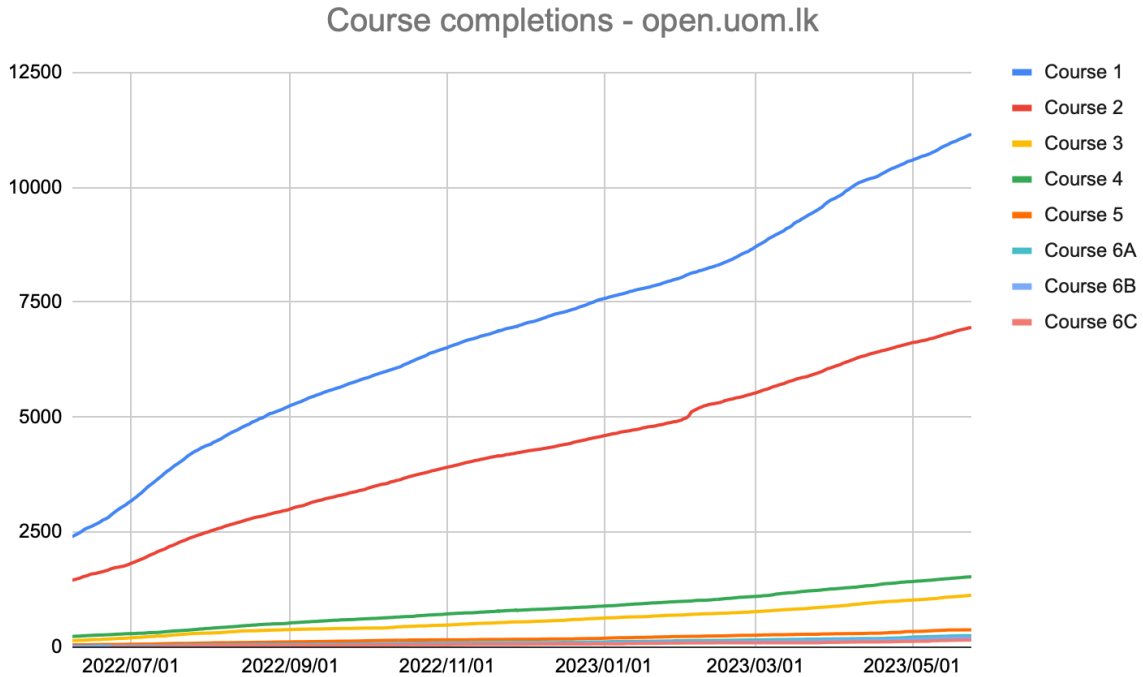


Figure 1: Course completions - Trainee Full Stack Developer Programme on open.uom.lk

### 3. Methods and Data

#### 3.1 Introduction to the online learning platform of the University of Moratuwa

The online learning platform of the University of Moratuwa Sri Lanka has been in operation for over 15 months. The platform generates massive amounts of data on a daily basis. The platform offers six courses related to information and communication technologies (ICT) which leads to the Trainee Full Stack Developer certification issued by the University of Moratuwa.

Each course in the platform consists of a line-up of activities including video lessons, text-based tutorials and assessments. All activities are recorded on the platform and the extracted data can be used to perform analytics related to teaching and learning activities.

#### 3.2 Assessing the experience of the participants who completed the full programme

An overview of the survey is given in Table 1.

Table 1: Overview of the survey conducted on participants who completed the TFSD programme.

Question(s)	Aspects covered
1 - 5	Demographic information
6	Level of education
7	Level of English proficiency
8	Programming skills before completing TFSD
9 - 10	Web development skills before and after completing TFSD
11	Most challenging course in the programme
12	Whether or not currently employed in the ICT domain

Question(s)	Aspects covered
13	Whether TFSD programme was helpful in getting into ICT domain
14	Applicability of the knowledge gained in the TFSD programme
15	Rating of courses in the TFSD programme
16	Suggestions for improvement
17	Whether or not they will recommend the TFSD programme to others

### 3.3 The source of data and the method of collecting data

The method of data collection was two-fold. The records from the online learning platform were available immediately and were extracted at different time intervals. On top of that a survey was conducted targeting the participants who completed all six courses currently available on the platform. Out of the 141 participants who have completed the programme as of now, 63 responded to the survey.

### 3.4 Overview of the dataset

The new registrants on the platform are provided access to Course 1 and Course 2. The participants can start those courses and continue learning in parallel. Since the courses are self-paced it is entirely up to the participants to decide which course to complete first and how much time to spend in each course. Once they complete Course 1 and Course 2, they are provided access to Course 3 and Course 4. There onwards, the courses access is provided in a sequential manner as and when the participants complete the courses. Course 6 consists of three parts. When a participant completes all courses, they are considered to have completed the full TFSD programme.

Apart from the usage data collected from the platform, a survey was designed and conducted to gather information from the participants who completed all six courses on the platform. The objective of this survey was to analyse the experience and the behaviour of those participants who completed the full programme.

## 4. Results and Discussion

### 4.1 Overview of course completion statistics

**Table 2: TFSD - Course registration and completion statistics**

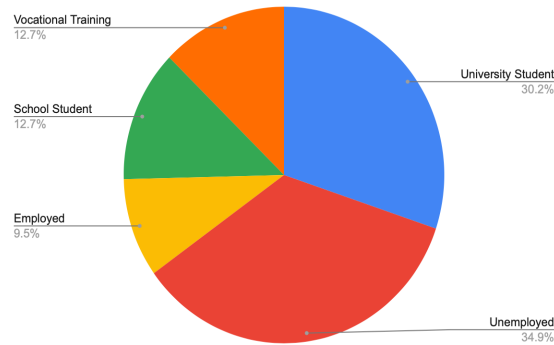
Course	Registered Users	Completions	Completion percentage (%)
Python for Beginners [Course 1]	128047	11151	8.71
Web Design for Beginners [Course 2]	128049	6943	5.42
Python Programming [Course 3]	11137	1118	0.87
Front-End Web Development [Course 4]	6915	1518	1.19
Server-side Web Programming [Course 5]	1520	363	0.28
Soft Skills [Course 6A]	322	237	0.18
Technical Skills [Course 6B]	235	198	0.15
Capstone Project [Course 6C]	198	141	0.11

The course completion statistics of the TFSD programme is given in Table 2. Course 1 has the highest percentage of completion while the other courses have declining completion rates. It should also be noted that the difficulty of the courses increase as the programme progresses.

It is encouraging to see the number of completions of Courses 1 and 2, which has surpassed 18,000. In a short duration of time, the programme has produced individuals who can write programs in Python and develop basic web applications.

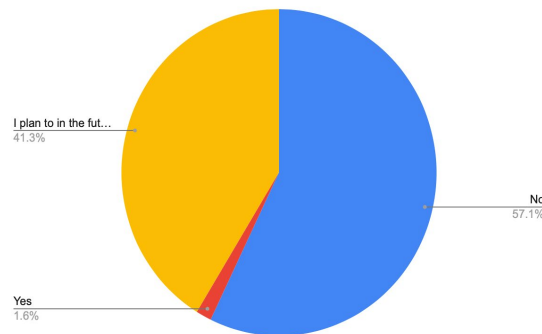
#### 4.2 Analysis of the participants who completed the TFSD programme

Figure 2 provides the breakdown of the employment status of the participants who completed the TFSD programme. Interestingly it was noted that the majority (34%) of the participants were unemployed. 30.4% of the participants were active university students while 9.6% were employed. With 12.7%, a considerable portion of the participants were school goers.



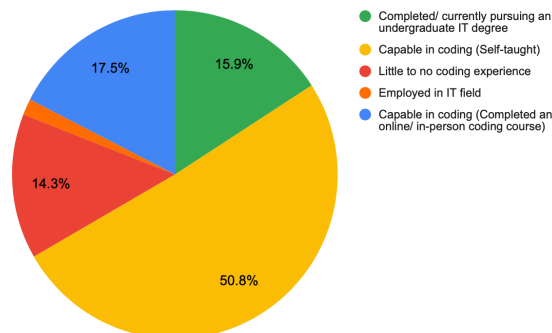
**Figure 2: Employment status of the participants who completed the TFSD.**

A separate question in the survey asked for the employment status in the ICT domain. The results are given in Figure 3.



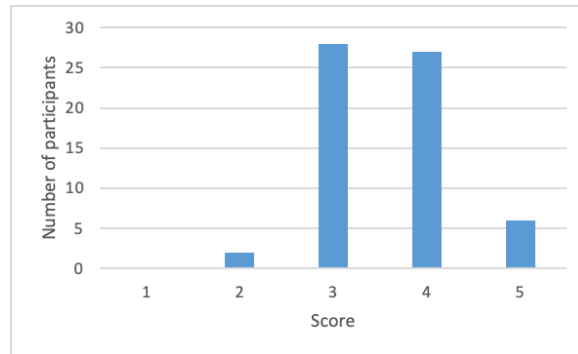
**Figure 3: Employment status in the ICT domain.**

Observations in Figure 3 indicate that only 1.6% of the total population of participants were employed in the ICT domain. As expected, a vast majority of the participants said No to this question. It was interesting to note that 41.3% of the respondents are interested in joining the ICT industry in the future.



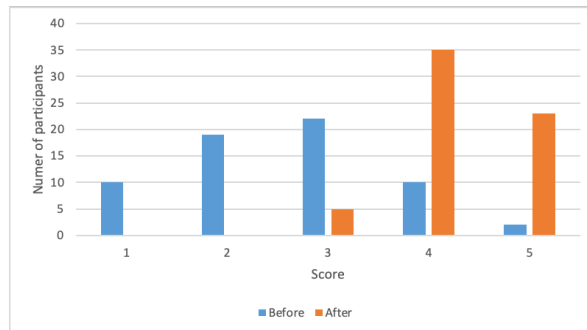
**Figure 4: The programming skills of the participants when starting the TFSD programme.**

Over 50% of the participants were capable of coding at the beginning of the programme. Observations in Figure 4 show that only 14.3% of the participants had little or no coding experience.



**Figure 5: English proficiency scores of the participants on a scale from 1-5**

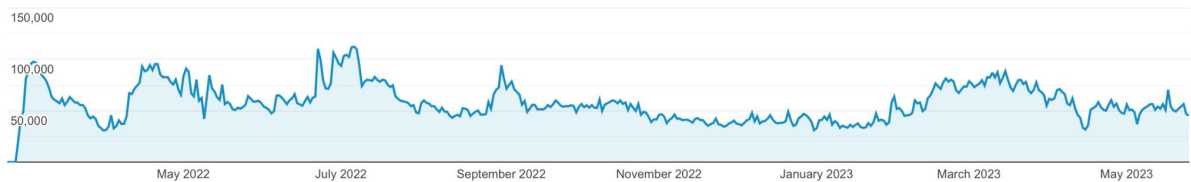
Majority of the participants assessed themselves as having English language proficiency of 3 or above on a scale from 1 - 5. Figure 5 represents the English proficiency scores recorded.



**Figure 6: Programming and web development proficiency score before and after completing the TFSD programme.**

The medium of instruction of the programme is English, and majority of the participants are non-native English speakers. The self-assessment of English proficiency of the participants, shows that in order to perform better in the programme, language proficiency is important. Identifying this relationship, the courses in the programme provide translations of the lecture scripts into two local languages, Sinhala and Tamil.

Figure 6 leads to an interesting observation where it shows the effect of the TFSD programme on the programming and web development skills of the participants. The programme has clearly facilitated in improving those skills. This is important from the perspective of the TFSD programme which targets to produce industry-ready trainee full stack developers.



**Figure 7: Page views on <https://open.uom.lk> for the period Feb 2022 - May 2023**

Page view data collected from the Google Analytics platform reveal that the user presence on the platform has been steady from the launch of the programme. This can be linked to the active user engagement in the courses of the programme. Active user engagement is highlighted to be one of the major factors for successful completion of the programme.

## 5. Conclusion

Based on the illustrations and analysis conducted on the survey data we can identify several factors that may affect the successful completion of online learning programmes. The employment status, the level of education, the proficiency level of the medium of instruction and the level of student engagement are likely to affect the successful completion of an online learning programme. It should also be noted that, with the availability of massive amounts of data in such online platforms, vital information about the user behaviour may be inferred by using analysis of data.

The effectiveness of the TFSD programme in providing knowledge and skills related in ICT domain is clearly identified. Vast majority of the participants who have completed the programme have indicated that their programming and web development skills improved as a result of successful completion of the TFSD programme. Hence the impact made by the programme is highlighted.

In the case of asynchronous, self-paced online learning approaches, student engagement is vitally important. If the engagement levels are low, the likelihood of successful completion may decrease. Those who design asynchronous online learning programmes should pay special attention to the student engagement aspect.

## 6. Future Work

A predictive model based on the factors affecting successful completion of the online learning programme is proposed as future work. The model will be helpful in determining the probability of completion, given the behaviour of the students in the online learning environment. Especially with the availability of large amounts of data on the platform, it would be possible to develop such a model with reasonable accuracy and robustness.

## References

- Alhakbani, H.A. and Alnassar, F.M. (2022). Open Learning Analytics: A systematic review of benchmark studies using Open University Learning Analytics Dataset (OULAD), Proc. ICMLT2022, 81-86.
- Arnold, K.E. and Pistilli, M.D. (2012). Course Signals at Purdue: Using Learning Analytics to Increase Student Success, Proc. LAK'15, 1-4.
- Ayres, P., & Sweller, J. (2014). The split-attention principle in multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed; pp. 206-226). New York: Cambridge University Press.
- Azevedo, R. & Aleven, V. (Eds.). (2013). *International handbook of metacognition and learning technologies*. New York: Springer.
- Benson, B. (2022). Procrastination is a key indicator of success or failure in some online business courses, Proc. LAK'22, 1-6.
- Brunken, R., Seufert, T., & Paas, F. (2010). Measuring cognitive load. In J. L. Plass, R. Moreno, & R. Brunken (Eds.), *Cognitive load theory* (pp. 181-202). New York: Cambridge University Press.
- Clark, R. C., & Mayer, R. E. (2016). *e-Learning and the science of instruction* (4th ed). Hoboken, NJ: Wiley.
- Mayer, R.E., 2019. Thirty years of research on online learning. *Applied Cognitive Psychology*, 33(2), pp.152-159.
- Nanayakkara, V., Karunaratne, B., Ranasinghe, M., Perera, S., Yaggahavita, H., Wickramanayake, S. and Amarasinghe, G. (2022). A sustainable approach to address the human resource requirement of the information technology industry in Sri Lanka. In *Proceedings of the 40th National Information Technology Conference* (pp. 21-27). The Computer Society of Sri Lanka.
- Nanayakkara, V., Karunaratne, B., Ranasinghe, M., Perera, S., Yaggahavita, H., Ahangama, S. and Mahadewa, K. (2022). open.uom.lk: A sophisticated open online learning platform. In *Proceedings of the 40th National Information Technology Conference* (pp. 28-33). The Computer Society of Sri Lanka.
- Nanayakkara, V., Karunaratne, B., Ranasinghe, M., Perera, S., Amarasinghe, G., Wickramanayake, S., Ahangama, S., Mahadewa, K., Hettiarachchi, C. and Yaggahavita, H. (2022). open.uom.lk: A Free Online Knowledge Sharing Platform. In *Proceedings of the 21st European Conference on e-Learning, ECEL 2022*. Academic Conferences International, 2022.
- Pilli, O. and Admiraal, W. (2017). Students' Learning Outcomes in Massive Open Online Courses (MOOCs): Some suggestions for course design, *Yuksekogretim Dergisi*, 7(1), 46-71.
- Rienties, B., Toetenel, L. and Bryan A. (2015). "Scale up" learning design: impact of learning design activities on LMS behavior and performance, Proc. LAK'15, 315-319.
- Seaton, D. T., Bergner, Y., Chuang, I., Mitros, P. and Pritchard, D.E. (2014). Who does what in a Massive Open Online Course?, *Communication of the ACM*, 57(4), 58-65.