WeThinkCode_: Case study of a tuition-free coding academy

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ABSTRACT

WeThinkCode_ is a tuition-free coding academy in Johannesburg that uses peer-to-peer learning methods. Launched in 2015, it positioned itself as a tertiary learning environment for anyone aged 17-35 looking to acquire digital skills. In South Africa, socio-economic circumstances for the majority of the population mean that their access to fees-based graduate training opportunities is limited. This is despite a significant undersupply of skilled software developers and many companies citing a lack of such skills as a strategic challenge. This mixed methods case study uses elementary statistical methods and thematic analysis to review elements of WeThinkCode_. Three transitions in the student journey are used as a high level framework to elicit insights about how the school works; (1) *Applicant to Participant*, (2) *Participant to Learner* and (3) *Learner to Contributor*.

Applicant to Participant: The school attracts large numbers of economically disadvantaged individuals, filters them for programming affinity and inducts a manageable sized cohort into campus life. *Participant to Learner*: There is a well structured and continuously improving framework including life skills as well as core and elective modules over two years which facilitates the individual and collective learning process with strict performance measures. *Learner to Contributor*: Four month internship programmes in each year of study help students prepare for the workplace and build relationships with the corporates who sponsored their studies. The 2016 cohort has progressed through this student journey at WeThinkCode_ to become the first batch of workplace-ready programmers. Further work is also proposed including a socio-economic study of the contribution of the 2016 cohort and a comparison with relevant traditional tertiary education institutions covering costs, sustainability and student performance.

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CCS CONCEPTS

• **Computers and Education** → Computers and Information Science Education – *Computer science education*

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Education, software development, agile learning

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1 INTRODUCTION

WeThinkCode_ is a peer-to-peer coding academy that accepted its first intake of students in 2016. It has no classrooms or teachers, uses gamified learning processes and derives its content from the curriculum of Ecole 42 in Paris, France [1]. Importantly for its socio-economic context in a developing country such as South Africa, its course is tuition-free for students who can also apply to receive a stipend during the two years of the programme. A 2013 study of 141 students at three universities of technology in South Africa found that 69% “bemoaned a lack of income as the most common impediment towards realizing their career choices” [2]. During each of the two years of study at WeThinkCode_, students also complete a four month internship at sponsoring organisations. The funding model for the school relies entirely on corporate clients who sponsor the students at a cost of R150,000 each and host them during their internships. The sponsored students are allocated to job openings at these companies once their studies are completed.

There is 27% unemployment in South Africa [3] and a severe shortage of computer programmers [4]. WeThinkCode_ aims to address both these issues, not only in South Africa but also through a future network of satellite campuses across the African continent. The premise of the school is that people who have an affinity for a career in software programming may lack the financial resources to gain the necessary qualifications in existing tertiary institutions. Three online tests must be completed once a person registers on the website after which they can participate in a bootcamp at the campus. The first cohort of students in 2016 were 118 successful applicants out of nearly 30,000 who originally

registered. 82 of these students have since graduated and found employment, having overcome the obstacles that previously kept them from formal training and finding employment.

Many industries are increasingly focused on digitisation and new business models are causing disruption to traditional companies. WeThinkCode_ claim to “work closely with leaders in the tech industry to ensure our students learn what is relevant and current” [5]. Students regularly participate in hackathons such as the FNB Codefest [6] and some have already launched software products such as MiBRAND which was nominated for the 2016 MTN App of the Year award [7]. The three co-founding sponsors; FNB, Derivco and BBD provided seed funding and share the vision of digital skills creation. They have also been actively involved partners and provide ongoing support through coaching, events, public relations and networks. FNB has created a digital ecosystem of banking products, services, value-adds and competitive relationship banking. WeThinkCode_ supports this ecosystem by supplementing existing sources of digital skills; FNB have sponsored over thirty students since the school’s inception. Derivco provide online gaming solutions and were also looking to add to their sources of developers. They took twenty WeThinkCode_ students as interns in February 2017 and director of HR Kelly Gordon notes the benefit it provided, “WeThinkCode_ helps us find undiscovered talent in a very different way” [8].

1.1 The recent rise of coding training

The importance of computers in the information age cannot be overstated but the recent rise of coding as a popular skill seems to have surprised mainstream education. Peter Gow mulls this in his 2015 article “A new culture of coding” [9] which he subtitled “Teaching Computer Programming is Back. Why Now?” The simple answer seems to be the problem solving nature of software and its core language; the lines of code in which it is written. Five decades ago, these problems were well removed from every day life, today software runs many aspects of our lives and coding ability has thus become more important. In May 2014 The New York Times compared the importance of coding to reading, writing and arithmetic as “less like an extracurricular activity and more like a basic life skill” [10]. This following a period during which interest in software programming had noticeably declined. Gow correlates this decline with the collapse of many internet companies at the turn of the century and the move of thousands of these jobs off-shore [11]. According to Gow’s article, the number of students taking the AP Computer Science exams fell to an all-time low of 16,600 in 2009 but recently surged to more than double that in 2013.

Since 2013, demand for coding skills has remained strong and “technology employment opportunities are expected to increase by 12% by 2024” [12]. This has also resulted in new and innovative supply models, partly because the traditional classroom approach is limited by teaching skills and student-teacher ratios. Coding bootcamps offer a short format, startup approach for people looking to enter the software industry. Kyle Thayer interviewed twenty-six students in eight different bootcamps in his research [13] on new models of software development training. His main

focus was to understand the barriers that these students face entering the industry. His study concluded that such bootcamps do provide viable alternatives and in many cases can also be a second chance for those who missed earlier computing education opportunities, especially women. The barriers to entry ranged across personal obstacles (intensity, time, location, family support), formal boundaries (admissions, payment, graduation) and informal boundaries (gender). Importantly for this case study, bootcamps are paid for: “In the US and Canada in 2016, bootcamps had an average tuition of \$11,541 and length of 13 weeks” [13].

Graduates of coding bootcamps who participated in the above study also came from diverse backgrounds; 54% had previous full-time employment and 40% had never programmed before. All of them wanted full-time jobs in the software industry which also required being successful at job interviews. There were mixed views about how much a coding bootcamp qualification actually improved the job application prospects, “several of our participants felt that bootcamp certificates were looked down on by employers.” Another key factor was getting relevant work experience such as internships and contracting work, while maintaining an updated online profile was deemed critical. Coding bootcamp students also highlighted the importance of networking in the industry, as well as attending tech meetups and hackathons as ways of meeting recruiters. Other students felt that good interviewing skills were useful as well as “whiteboarding” and knowledge of data structures and algorithms [13].

Another software innovation centre called the Tshimologong Digital Innovation Precinct [14] also opened in the Johannesburg city centre in 2016. It houses the IBM Research Lab Africa [15], one of only twelve such IBM labs globally. Although Wits University also offers well respected computer science and other IT-focused degrees, the need was identified for a more accessible hub-like environment where learning is combined with practical and commercial application of software development skills. Its flexible, open plan co-working space combined with the research emphasis is hoped to “inspire new talent, create jobs and lead to an economic renaissance” according to Barry Dwolatzky, Wits Emeritus Professor of Software Engineering [16]. Other coding and entrepreneurial hubs have also started up in Johannesburg such as Jozihub at 44 Stanley [17].

1.2 Self-directed learning

Adult learning specialist Malcolm Knowles developed the concept of self-directed learning (SDL) in the 1970s [18]. He defined it as, “a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies and evaluating learning outcomes.” Also known more recently as “agile learners” they generally have a profile of flexibility, adaptability and a high degree of being proactive about acquiring new skills [19].

SDLs also prefer organisations with new and flexible learning methods. Many industries are undergoing disruptive change and an agile learning workforce could be an advantage when

operating models and traditional jobs have to change. Many jobs are also being automated and human workers will need to get better at roles that require creativity [20] – this means that workers will need to “pivot” and do new and different things to create value. A 2016 article in Forbes [21] also describes a shift in workplace roles from “knowledge workers” to “learning workers”. The article claims, “A learning worker is far more valuable to an organisation because he or she can adapt with a changing workplace environment”. A thematic study found that, “computing students’ motivations for self-directed learning falls into four general themes: projects, social and peer interactions, joy of learning and fear” [22]. Project and social motivations were most significant in this study; students were most proactive in adapting their skills to meet these needs. This adaptability is a clear requirement for success at WeThinkCode_ which offers learners, “no classes, no teachers and no tuition. You will learn how to use coding ... in a peer-to-peer environment” [5].

2 CASE DESCRIPTION AND APPROACH

WeThinkCode_ intends to complement existing skills pipelines to the workplace and train developers from under-privileged backgrounds. Its impact on both these environments is important to understand, especially in how it continues to play an evolutionary and co-existing role in both of these. This case study makes observations about selected elements of the initial three year phase of incubation of the school which can help inform the next stage of growth.

Figure 1: The WeThinkCode_ programme

Figure 1 shows the design of the school and how the key elements sequence and combine to form the overall programme. Data for the case study was sourced primarily from the following areas of the programme;

- Sourcing – external digital marketing report
- Online assessments – applicant performance
- Life skills – external audit, student surveys
- Core curriculum – student performance
- Internships – employer feedback, student monologues

Figure 2: The WeThinkCode_ student journey

The case is analysed and presented through a student journey narrative as depicted in Figure 2 above. The context and insights in the study are developed through this lens which shows a collective and individual progression of students from one stage to the next. This is a very loose construct, simply intended to group analysis in a logical sequence. The school creates value in the life of the student through their journey in the campus environment. This is achieved with a structured curriculum and student support processes but the contribution to society is in the individual journey as they travel from becoming aware of the school through stages of belonging and growing to becoming an employed software developer.

The school is a highly fluid environment, the focus is constantly on growth and change; not only in the life of its students but also in how it is managed. Transitions also see periods of regress; students sometimes drop out or fall behind and the focus of the school is to help them catch up and be successful. Additionally, the milestones of growth often overlap or happen together, thus the research is oriented around the fluid nature of the school and the movement of students in their journey of development (forwards or backwards). Related to each transition are high level themes that are explored and research questions that are investigated using mixed methods. These questions and themes support the broad research objectives of the case study as given below. Each of the transitions in Figure 2 highlight key areas of interest and research questions (RQs).

2.1 From “Aware Applicant” to “Belonging Participant”;

A prospective student finds out about WeThinkCode_, goes through the online assessments and bootcamps and becomes part of a 2016 or 2017 cohort.

- How does WeThinkCode_ position itself to attract applicants? How many applicants register and where do they come from?
- How do the online assessments and bootcamps work in the application process and are they effective in pre-selecting successful students?
- What is the correlation between prior learning and successfully becoming a student?

2.2 From “Belonging Participant” to “Growing Learner”;

A registered student at WeThinkCode_ identifies within a cohort of students and establishes patterns of growing and learning.

- How are incoming students inducted and supported and do these methods effectively integrate student life and curriculum performance?
- How is student performance assessed in the context of self-directed learning and how did the 2016 and 2017 cohorts perform?
- What are the students’ perceptions of life at WeThinkCode_ and its contribution to their development?

2.3 From “Growing Learner” to “Earning Contributor”;

Students attend internships, carry the WeThinkCode_ brand into various workplaces and eventually graduate into a position of employment.

- What is the experience of internships and the contribution of this programme to workplace readiness?
- How else are students prepared for a career in computer programming?
- What are the prospective employers' perceptions of their interns and by extension, WeThinkCode_?

This case study uses mixed methods; quantitative and qualitative analysis is performed on a variety of data to objectively assess the school and how it works. Mixed methods are particularly suitable for analysing case studies [23]. In this case study there are various sources of data which will be analyzed to create a blend of insights that are inter-connected and which create a deeper understanding of the case than would otherwise be possible. WeThinkCode_ made available quantitative data on applicant sourcing and student performance while extensive qualitative data is publicly available on their Youtube channel [24]. These interviews were analysed using narrative or thematic analysis and the applicant sourcing data was analysed using elementary statistical methods. Orienting the study and sources of data around the student journey helps describe their journey from job-seeker to job-doer.

3 RESULTS

3.1 Applicant to Participant

WeThinkCode_ market extensively on social media and through networks of stakeholders established through a public relations campaign [25]. They maintain a very active presence on most major social media platforms and also use their students to create content such as blogs and videos. The Facebook page has over 23,000 likes and a 4.8 star rating from 209 reviews. Their Instagram page has 2392 followers at the time of writing and actively promotes the hashtags #BornToCode and #ReCodeYourFuture which convey a clear and consistent message about the centrality of coding in everything they do.

The WeThinkCode_ website is the only channel through which an interested person can register and apply to the school. The target audience of all potential "aware applicants" are thus people who are aware of the site and take action to visit it. Digital marketing statistics from Google Analytics provides insights about these visitors to the website and their behaviour. (RQ2.1a)

- In May 2018 there were nearly 11,000 visits, consisting of over 8,000 unique visitors who spent an average of eight minutes on the site looking at eight pages.
- Top eight referring sites of all time, in order of the number of backlinks: Telkom.co.za, ambafrance.org, techcentral.co.za, studynoteswiki.com, switchup.org, tech4africa.com, alphacode.club, coursereport.com
- Google's taxonomy of audience interests shows two main categories of people that visit the website:
 - Internet and Telecom > Social Network
 - Career and Education > Jobs and Employment

The above insights cover everyone who visits the school's website, but a smaller group of people also register on the site which only requires an email address after which the three online assessments can be attempted. These tests are online games designed to evaluate for programming affinity and a problem solving aptitude. There are no rules given and applicants must work out what to do to make progress in each game. The instructions given prior to the test are part of the game and applicants must read them carefully. Test 1 is time based; an applicant has ten minutes to get to the highest level possible, Test 2 and 3 are puzzles and in a total of three hours for both, an applicant must also get to the highest level possible. No other assessment criteria are used and these three tests are proprietary to WeThinkCode_ as made available by 42.

Figure 3: Online test 1

Figure 4: Online test 2

Figure 5: Online test 3

Figures 3-5 show the user interfaces for the three different online tests. The first test is a memory game with each level showing successively more blocks with demonstrated sequences that the applicant must repeat. At the launch of WeThinkCode_ in 2015 a number of IT industry stakeholders were challenged to play online test number 1 at the evening event. The intention was to provide some insight into the structure and approach for the online assessments and see if traditionally educated IT leaders could complete them. Most of the players from that night, including this author, did not get very far in the allotted ten minutes. Despite the fun aspect, this highlighted the vast difference in traditional IT skills compared to lateral logical thinking and problem solving as tested by these online assessments.

The second test is a puzzle in which applicants must re-arrange the shapes on the left to look like the 42 logo on the right hand side. The third test is the most similar to programming logic where the applicant must complete some navigational steps using functions and controls. This test was also played with all the participants at one of the FNB Codefests [26] in 2015 when this author also had an opportunity to attempt it. Again, it proved surprisingly difficult for this author and other traditionally educated IT thinkers. From the data for student assessments it is clear that Test 2 proved to be the most challenging of the three.

One objective of this case study is to gain insights about how much correlation there is between prior qualifications and success at WeThinkCode_. Table 1 below shows the first batch of applicants in 2016 who successfully completed the online assessments. Prior qualifications were assigned a numeric scale as shown in the last column.

Table 1: 2016 validated applicants

Highest level of qualification	Number of applicants	Numeric scale
doctorate_degree	2	10
masters_degree	4	9
honours_degree	18	8
bachelors_degree	80	7
Diploma	140	6
Matric	844	5
None	77	4

As shown in Table 2 below, a negligible correlation coefficient was calculated between success in any of the tests and the level of prior qualifications. This means that a higher qualification was not a predictor of greater success in the online assessments. (RQ2.1c)

Table 2: Correlation between prior qualifications and online assessments

Online Assessment	Correlation Coefficient
Test 1 (Figure 3)	-0,03
Test 2 (Figure 4)	-0,03
Test 3 (Figure 5)	-0,03

The premise of WeThinkCode_ is that you don't need any qualifications to be a successful coder and the above results show that qualifications are not required to complete the online assessments. People who complete the online assessments are then requested to meet with WeThinkCode_ leadership on campus when more information is gathered and they are "validated" to attend the bootcamps which is the next phase of the application process.

Once the online tests are completed and a student is fully validated, they are invited to participate in one of three "selection bootcamps". These take place at the campus over four weeks and are run like a hackathon when students have to continually produce software products in a limited time period. The WeThinkCode_ website describes the selection bootcamp as:

"the final stage in the application process that we use to evaluate candidates. We only select the top performers. Think of it as a month long job interview." [5]

New projects are handed out every day and prospective students have to work quickly, delegate within teams and ensure that they don't incur a backlog of unfinished work if they don't plan effectively. This intense period also assesses their capability for deadline-based team work which is very much a precursor of the way they will learn during full time study at WeThinkCode_. Elements of communication, discipline and planning are also assessed during these very intense periods, which often require working through the night. The ability to work under pressure and quickly co-ordinate within a newly formed development team are seen as key skills for digital problem solvers in the workplace.

Of the 29,539 people who originally registered on the website from October 2015 when WeThinkCode_ began (RQ2.1a), only 754 passed the online assessments. Of these only 341 candidates signed up to participate in the selection bootcamps. This "month long job interview" further reduced this number to just 118 *belonging participants*. This represents less than a 0,5% success rate in the first transition of the student journey. (RQ2.1b)

3.2 Participant to Learner

All new participants in a given cohort are introduced to the "Coding You For Success" (CYFS) framework which is a comprehensive guide to campus life at WeThinkCode_. (RQ2.2a) It is intended to create structure and rounded learning opportunities so that students move from entering and participating in the school to becoming a productive team member and individual learner. It explains how all of the main elements of the programme work and what students need to do to be successful. It includes;

- Values and behaviours – grit, learning, connection and responsibility
- Key dates – induction, semesters, corporate interviews, bootcamps and graduation ceremony
- Staff roles – campus manager, internship manager, house representatives
- Student body and campus life – houses, teams, lines of communication, robotics club

- Performance – internship prerequisites, gamification through leader boards and “kudos” points
- 42 curriculum – project retry process, peer-to-peer and individual performance criteria

The first version of CYFS was reviewed by external consultants who concluded that it wasn’t achieving its purpose mainly because students did not identify with it as a crucial path to self-development. Interviews were held with students and sponsors which led to a range of findings and recommendations. These included the need for more structure as well as regular and real time interventions that would position the program more effectively and help prepare the students to get more value. Recommendations included;

- Monday morning status meetings for projects
- Group project leaders should be assigned randomly
- Weekly / monthly rhythms such as skills development days and daily rituals
- Interview practice sessions prior to internships
- Remove the once off talks that introduce life skills
- Review attendance flexibility (rather introduce core hours such as 10h00 – 15h00)

Based on these recommendations, CYFS 2.0 has been introduced with a key difference being the addition of the life skills curriculum which includes;

- Communication (written and oral)
- Self-awareness
- Research skills
- Time management
- Financial literacy

Communication is the only mandatory module in the above but students also have to complete a set number of life skills workshops in each semester. Students are also exposed to prominent leaders from industry who often reinforce the importance of these life skills when they give talks on campus. This highlights the importance of an integrated campus experience so that students are work-ready when they complete their two years of training.

The software development curriculum is licensed from the 42 school in Paris and student performance at WeThinkCode_ is evaluated based on projects that students must complete on campus. Learning objectives are achieved through a set of modules in each year, and a certain number of projects must be submitted and achieve a certain score within each module. The peer-to-peer process of reviewing projects relies on students making time available to correct eachothers work. There are five scenarios in the peer-to-peer process:

- Individual correcting an individual
- Group correcting an individual
- Group correcting a group
- Staff correction
- Project pitch to a “jury”

Each year of the two year programme is divided into 2 semesters, within which the modules are made available for students to work on. Students must “validate” at least one module within each semester which requires them to complete certain software development projects. There are also exams at certain times throughout the year to test core learning. Failure to complete a required number of exams, modules or projects in any given semester can result in dismissal.

Table 2: WeThinkCode_ two year programme

Year 1	
Semester 1	<ul style="list-style-type: none"> • 3 modules available • 12 weeks to validate 1 module
Semester 2	<ul style="list-style-type: none"> • 3 modules available • 11 weeks to validate 1 module
<i>Students attend a 4 month internship</i>	
Year 2	
Semester 3	<ul style="list-style-type: none"> • 3-4 modules available • 11 weeks to validate 1 module
Semester 4	<ul style="list-style-type: none"> • Several modules available • 11 weeks to validate 1 module
<i>Students attend a 4 month internship</i>	

Table 2 shows the two years of the programme including four semesters, modules and two internships. The first module that students work on is the programming language C, and then PHP is introduced after which the student can choose which languages to learn however they must be able to justify their choice. Another module is Algorithms in which search and sort methods are learned as well as heuristics and path finding. Web development is another module and includes a PHP bootcamp which counts as a project. There are two modules on graphics; initially students learn about 3D objects in a 2 D context and then they extend this into three dimensional problem solving and object manipulation. In all modules there are minimum required scores per project and students can achieve higher than 100% if they do extra features that were not explicitly required. (RQ2.2b)

The school is currently conducting its third cohort but first year student performance is only available for the first two cohorts (2016 and 2017). The table below gives a summary of overall performance of both cohorts for the core learning modules. There were 118 first year students in 2016 and 199 first year students in 2017; the numbers of students which successfully validated modules are shown. This is a key measure of individual student performance; students must complete at least one module in each of the two semesters per year. Table 3 below shows this data for the first year of each cohort.

Table 3: Number of students that completed modules

Number of modules	2016 Cohort	2017 Cohort
0	23	53
1	19	66
2	59	69

Number of modules	2016 Cohort	2017 Cohort
3	8	7
4	2	4
5	4	0
6	2	0
7	1	0
8	0	0

Key observations:

- No student in the first year of the 2017 cohort managed to validate more than 4 modules although only 6% of the 2016 cohort achieved this.
- This decline in performance from 2016 to 2017 could be because both cohorts were on campus at the same time during 2017. This placed greater demands on campus staff, which had not increased in number since the previous year when only the 2016 cohort were on campus, completing their first year.
- More than 85% of students in both years validated only two or less modules.
- Of the 42 students who completed less than two modules in the 2016 cohort, some were allowed to count a successfully completed internship as a module, thereby avoiding dismissal.

The module assessment process is binary; a student either “validates” or not based on marks for submitted projects. Students also need to respond well in the self-directed learning environment, if they don’t plan sufficiently they will struggle with the volume of work they must complete. Analysing project scores within modules provides another view of student performance within a cohort and across multiple cohorts. An important change was made in 2017 that was not in place in 2016. In the 2017 cohort, students were allowed to retry projects after submission to consolidate learning and improve scores.

Table 4: Average score of marked projects per module per cohort

Module	2016	2017
Unix / C	63%	90%
Algorithms	64%	94%
Graphics 1	74%	101%
Web	81%	93%
Graphics 2	106%	115%

Key observations:

- The second graphics module is optional and was attempted by the least number of students. However the average of individual scores for projects in this module is also the highest for both cohorts as shown in Table 4
- The overall averages of all scored projects in the first year of the 2016 and 2017 cohorts are 78% and 99% respectively (RQ2.2b). This increase is possibly due to the introduction of the retry process which allowed students a second chance to improve project scores.

A student survey was run to gauge students’ perceptions of WeThinkCode_. The question “What do you like about the WeThinkCode_ learning environment” elicited a range of responses; (RQ2.2b)

- “the way it is structured, it provides more information and flexible learning where you grow in solving problems, social skills, entrepreneurship and innovation”
- “The French 42 system and peer to peer learning environment is really the backbone ... a well thought out, high quality curriculum with peers available to help”
- “the environment is very inviting and conducive for studying. It encourages hard work, creativity, leadership skills as well as having fun in the various clubs”
- “The WeThinkCode_ way is best, not only does one learn new stuff but one also learns how to learn”

Of the 118 students who entered WeThinkCode_ as the 2016 cohort (*applicant to participant*), 93 were still active in the programme two years later. There are various reasons for this reduction:

- Two postponed their studies to 2017 due to visa or financial issues
- Seven became employed during the programme such as Johan Meiring who joined SPARK Schools through the FNB Business Innovation Awards [27]. Other students were hired onto WeThinkCode_ staff either full time or as interns and another two have moved to Cape Town to help launch the new campus.
- Five were terminated and thirteen dropped out

The overall reduction of the 2016 cohort for various reasons from an original 118 students to 93 active students is a 77% success rate in the second transition from *participant* to *learner*.

3.3 Learner to Earner

Progressing from learning to earning re-orientates the student from the campus to the workplace. The iterative, recursive nature of this approach is inherent in the internship programme which takes place during both years of study. All students attend a four month internship at their allocated corporate sponsor where they are allocated meaningful work on projects that give them relevant exposure and experience. This is aimed at giving them some workplace experience and starts building a relationship with a future employer.

Returning back to the campus learning environment after the internship helps students make sense of their student journey with a broader, workplace perspective. Their peer-to-peer interaction and self-directed learning is now more geared towards workplace preparedness as students have seen firsthand the practical issues of where they will need to apply their skills. A number of video monologues on the WeThinkCode_ Youtube channel featured student’s insights on their internships. These transcripts were analysed for common themes to understand how they viewed the internship experience and what impact is had on their training.

Student “X” did his internship at FNB Online where he spent time in the digital banking development teams contributing to projects and learning more about how the bank works. Key phrases offer insights from his self-recorded video monologue [28]: (RQ2.3a)

- *“some good and some bad experiences”*
- *“learnt about banking architectures and working with people as well”*
- *“lack of understanding on my part about their systems”*
- *“learning the way corporates work really helped”*
- *“learnt a lot about working with people in big teams”*
- *“learnt about different code styles”*
- *“gave me a different perspective on my future as a dev”*

The most recurring theme in his narrative was that of learning and how the environment of the internship opened up his learning opportunities significantly. While he mentions “good and bad” experiences a couple of times he does not elaborate any further.

Student “Y” did his internship at RMB in the Foundry division, which is a relatively new research department. He worked directly with the head of engineering and was involved with four projects; virtual assistant, digital NDA, eConcierge and eRecruiter. His interview [29] took place at RMB Foundry and offered some valuable insights about his experience and its impact on his learning journey. (RQ2.3a)

- *“lot of machine learning and artificial intelligence ... they have been the backbone of our projects since I started here”*
- *“the idea of being not just a developer or a programmer, but also an innovator”*
- *“understand the business environment, how investment banking works”*

Student Y’s interview was more self-reflective than Student X’s, possibly because it happened after the internship and back at the WeThinkCode_ campus. Sizwe’s transition from learner to earner also benefitted from a trip to Cape Town [30] that he was awarded for achieving the highest marks in his selection bootcamp. He was joined by another student, Stephen Asiedu, and they visited start-up companies such as Nichestream, Wigroup, Codex, Experience71 and BitX. They talked to the owners of these businesses and saw firsthand how they operate; “such valuable insights right at the beginning of their working lives will help them chart a course for career success” [30].

Employers were also given an opportunity to share their feedback on the internships. Managers and team leaders completed a survey about each intern including a 1-5 scale rating of core capabilities including attitude, quality of work, ability to learn, initiative, discipline, technical skills and likelihood they would employ them. There is some threat to the validity of this data because employers are also sponsors of the programme and there may have been some bias in the feedback. Questions also requested feedback on the overall internship programme and specifics of how and when it should run in future. Employers were also even asked if they would like the same intern back the next time. Crucially a 1-5 scale question asked “how likely are you to offer permanent employment to your intern at the end of their

studies?” Through the lens of the student journey this is probably the most important question. All other questions provide useful data points for student and campus, however to transition from *learner to earner* requires the commitment from an employer that they will make the student an employee.

This all-important feedback informs the rest of the internship employer feedback data; of the 97 WeThinkCode_ students for which there is feedback from potential employers, eight achieved the lowest rating for this score (1). Notably however, only two of these students scored less than 3,5 as an average for their core capabilities. Potential employers did not necessarily rate these eight students as having weak capabilities, they just did not want to hire them. This is a common dilemma; candidates for a job might be rated above average but this does not mean they will get the job. However, comparing average scores of all 97 students with their likelihood to be employed showed a positive correlation coefficient of 0,62. This is considered to be a strong correlation, ie that employers in general do associate strength of capabilities with suitability for employment. (RQ2.3a)

For the eight students that achieved the lowest score for likelihood to be employed, the free text feedback data provides some useful – although somewhat contradictory – observations from employers about WeThinkCode_ students; (RQ2.3c)

- *“the interns brought fresh ideas ... eager to learn and grasped the processes easily”*
- *“provide the interns with job specific training before they get here”*
- *“Not a logical thinker”*
- *“Strong work ethic”, “willingness to learn”*
- *“He also put extra thought into the required task”*
- *“the interns brought fresh ideas to the space”*
- *“more focus [required] on understanding the building blocks of developing software”*

Thirty students achieved a five rating for likelihood to be employed (highest possible score) while the average for the capability ratings of these same students were all four or above. Eleven students scored a perfect five for their capability scores as well as a perfect five for their likelihood to be employed. A selection of the free text feedback for *only these students* offers further insights about these top performing students in the eyes of potential employers.

What did you like about the WTC internship?

- *“passion and desire to learn and to code”, “hand-on approach; can-do attitude!”, “person that fits in with our culture”*
- *“they think for themselves”, “ability to work on his own”, “[student name] was very hands on and willing to jump in and do things rather than wait for me”*

Any other comments you would like to share with us?

- *“[student name] has excelled ... very hard to believe she only started coding a year ago”*

- “[student name] was a pleasure to work with ... humble, hard-working, intelligent and switched-on”
- “[student name] is an excellent individual ... he does however lack some fundamental knowledge”

For one of these top performing students, there was a benefit of pre-selection, (“person that fits”); WeThinkCode_ management used their knowledge of the workplace environment and employer culture to best match students for their success. However in another case the pairing of student to employer, “seemed like a bit of a lottery”. A different observation is that in one example of the eleven, “fundamental knowledge” was not necessarily an inhibitor to demonstrating perfect capabilities as well as maximum likelihood to be employed. It is also clear that prospective employers place a very high value on proactive interns; they want new employers to be self-starters and not require much direction, “dive right in from the start”. It is possible that students who get into WeThinkCode_ are already self-starters but the self-directed learning approach at WeThinkCode_ reinforces this mindset and according to the above data positions them well for the workplace.

4 DISCUSSION

The observations in each of the three transitions above provide selective insights about WeThinkCode_ and its efforts to prove a new and innovative alternative for post school coding training. Some credibility has been achieved with sponsors and prospective employers who have had firsthand experience of the first batch of trainee software developers when they completed internships. The WeThinkCode_ student journey has thus produced a throughput but it relies on strong facilitation of the self-directed and peer-to-peer learning approach. WeThinkCode_ recognize that while the tuition-free model creates a wide pool of applicants it also requires very structured facilitation of the curriculum to ensure that students perform.

Summary observations for each of the three transitions in the student journey;

From “Aware Applicant” to “Belonging Participant”;

- Social media marketing and PR achieves widespread awareness to generate a large pool of interested applicants. (RQ2.1a)
- The tuition-free model bridges the affordability gap for many who otherwise couldn’t study even though they may have an affinity for coding. (RQ2.1a)
- The online assessments and bootcamps filter down the large number of applicants to a manageable sized cohort. (RQ2.1b)

From “Belonging Participant” to “Growing Learner”;

- Version 2.0 of the CYFS framework was an extensive revamp of the inaugural attempt and was based on

internal and external feedback that was formalised in an audit report. (RQ2.2a)

- A license agreement for the Ecole 42 curriculum meant that WeThinkCode_ does not have to develop its own. However it was able to calibrate how this curriculum was consumed and assessed through a blend of agility, self-directed and peer to peer learning.
- Student performance relies heavily on self-directed work to complete a number of projects for each of the modules per year. (2.2b)
 - The number of students “validating” more than four modules declined from the 2016 cohort to the 2017 cohort.
 - However, the average scores of completed projects increased from the 2016 cohort to the 2017 cohort.

From “Growing Learner” to “Earning Contributor”;

- The sponsorship model funds the running of the school and it locks in prospective employers who host students at four month internships in each year of study.
- The internships help the students transition from the campus to the workplace because they experience the reality of projects and working conditions. This experience can reinforce the subsequent learning process in the second year if students approach the curriculum with the workplace context they have been exposed to. (RQ2.3a)
- Students are also given opportunities to join hackathons, conferences and product launches. Taking advantage of these opportunities can help build their business acumen for life after graduation. (RQ2.3b)

The student journey is a useful narrative for understanding how the school works but it is also a funnel for producing workplace-ready computer programmers. The overall throughput in this funnel for the 2016 cohort is shown in Figure 6, which is adapted from Figure 3 and showing the numbers in each transition.

Figure 6: 2016 cohort numbers in the student journey

At the time of writing, 82 of the 93 students had been offered employment as shown in the bottom right of Figure 6. This number is expected to increase as further opportunities are

actively being sourced for the remaining thirteen. Assuming another eight employment offers are made, the overall throughput for this cohort is 0,3% (90 job offers / 29,539 registered applicants). As future cohorts pass through the school, their student journey numbers will be insightful to understand how the throughput is changing.

5 CONCLUSIONS

WeThinkCode_ has been reviewed as a new and affordable model for learning software coding and observations have been made in the context of a student journey. Data that was reviewed included digital marketing, student applications, online assessments, the CYFS framework, publicly available student interviews and internship feedback. Three loosely defined transitions in the student journey were used as a narrative within which this data was analysed and selective observations were made. The school is in its third year of operation, the inaugural cohort of 2016 have successfully completed the curriculum as well as internships and are entering the workplace this year. WeThinkCode_ positions itself as a disruptive model but is currently one established campus with a newly formed second campus currently starting up. Like any commercial business, its ability to scale and expand into an established, multi-site operation will require localization and replication of successful elements to future locations. This case study provides some early observations which could inform the next phase of the WeThinkCode_ expansion.

Future work could review data on graduates working at their employers to assess how well they perform in full time employment. The 2018 and 2019 cohorts will also provide additional data for online assessments and student performance, this will help understand correlation and trends across four years, broadening the case study beyond the current two years of comparison. The curriculum and how it integrates with the CYFS framework could also benefit from more in-depth analysis. As a new learning model it would also be useful to compare data with established tertiary institutions, possibly establishing a control group of students in each and tracking them through a longitudinal study. A more direct comparative study could also be made that includes costs, sustainability and student performance. The student journey describes a process that ends in contributing, which is simply defined in this study as working and earning a salary. A socio-economic study of students in the context of their lives before or without WeThinkCode_ would also help assess the exact nature of this contribution in society.

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