What motivates a ninja? An exploration of students' CoderDojo experience

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Declaration

This Dissertation is entirely my own work, and has not been previously submitted to this or any other third-level institution.

Signed: _____ Date: _____

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Abstract

While previous studies have indicated that learning through digital game-play is highly motivating, young people's motivation to create their own digital artefacts has received less attention. In particular, few studies have focused on young people's motivation to learn within community-based informal coding environments such as CoderDojo. This research therefore aimed to explore young people's motivations to attend CoderDojo and perceptions of their experience. Transcripts from three focus groups of CoderDojo students were thematically analysed using a deductive Self-Determination Theory-driven approach. Results suggest that CoderDojo is perceived to be a highly autonomy-supportive learning environment that also fosters students' needs for competence and relatedness. Young coders were intrinsically motivated by the enjoyment found in learning and making digital artefacts, and had a strong desire to learn to code – for a variety of largely autonomously motivated reasons. Only boys expressed gave motivations identified as externally regulated. Main findings are consistent both with assertions made by SDT and with previous research in the area of constructivist game-based learning. Strengths, limitations and potential future studies are addressed.

What motivates a ninja? An exploration of students' CoderDojo experience

1. Introduction

"Computational thinking is a skill needed by everyone to function in modern society." (Wing, 2006, p.7)

Digital technology is integral to contemporary life, as we transform from mere consumers to producers of technology (Kafai & Burke, 2014). The capability to understand code and create technology is increasingly considered to be a vital skill that enables us to engage fully with our progressively digital world (Resnick, Maloney, Monroy-Hernandez, Rusk, Eastmond, Brennan… & Kafai, 2009; Kafai & Burke, 2014), and that addresses a growing shortfall of proficient ICT workers (European Commission, Digital Agenda for Europe, 2015).

The value of learning to think computationally has been recognised since Papert's seminal *Mindstorms* (1980), but has returned to the spotlight due to a recent revival of interest in teaching young people to code (Grover & Pea, 2013; Brown, Sentance, Crick & Humphreys, 2014; Kafai & Burke, 2014). By learning computational thinking via programming and coding, young people are given the opportunity to understand, manipulate and create digital technology (Burke, 2012) and use it constructively (Kafai & Burke, 2014). In an Irish context, the development by the National Council for Curriculum Assessment (NCCA) of optional Junior Cycle courses in digital media literacy and coding illustrates an increasing acknowledgement of its importance (NCCA, 2014).

This resurgence of interest in coding has been led not by formal educators but by grassroots youth initiatives (Kafai & Peppler, 2011) such as CoderDojo – an Irish-initiated, volunteer-led, global network of free coding clubs for young people. Such informal community coding movements have been facilitated by the development of free or inexpensive technological resources, such as MIT App Inventor (Wolber, Abelson, Spertus & Looney, 2011) and Scratch (Resnick et al., 2009), that are easy to use and have been shown to improve learning outcomes (Goadrich, 2014; Gouws,

Bradshaw & Wentworth, 2013; Guzdial, Ericson, Mcklin & Engelman, 2014). These tools give young people the opportunity to become designers and makers of digital games, apps and websites and to explore robotics.

Such authorship of digital technology has been shown to enhance motivation for learning and augment higher-order thinking skills such as problem solving, critical thinking, reflective thinking and creativity, as well as fostering positive attitudes towards failure and nurturing collaboration (Kafai, 1996; Resnick, 2006; Robertson & Howells, 2008; Vos, van der Meijden, & Denessen, 2011; Yang & Chang, 2013; Grover & Pea, 2013; Akcaoglu & Koehler, 2014; Hwang, Hung & Chen, 2014). Children as young as pre-schoolers have been shown to be capable of engaging with, enjoying and learning basic programming concepts (Fessakis, Gouli & Mavroudi, 2013), given the appropriate environment, tools and support.

An increasing number of studies have described many advantages of constructionist digital game, app and website creation and robotics as a motivating way of introducing young people to computational thinking and engaging them in the understanding, creation and manipulation of digital media. The constructionist approach (Papert & Harel, 1991) allows learners to actively build their knowledge by interacting with digital media. Meta-analysis of computing education studies in primary and secondary schools has found game development to be an enjoyable means of learning computational concepts such as abstraction skills, and promoting higher-order thinking, creativity and self-confidence (Grover & Pea, 2013; Garneli, Giannakos & Chorianopoulos, 2015).

Kafai, Peppler and Chapman (2009) assert that informal educational technology settings outside school and college environments are well placed to support students in this ‘maker’ role, being more open and social than formal settings, encouraging collaborative and creative open-ended generation and permitting young people to work at their own pace.

However, despite the abundance of studies indicating that learning through game-play is highly motivating, young people's motivation to create digital artefacts such as games, websites and apps has received less attention. According to Howland, Good, Robertson and Manches (2015), still very little is known about young people's motivation to learn programming. In addition, most research has focused on formal school and college programmes, largely neglecting the proliferation of community-based informal coding initiatives (Kafai & Peppler, 2011). Few studies have addressed students' perceptions of such groups or their motivations to attend them. In particular, motivation of CoderDojo attendees appears to have received no attention in the literature. This research therefore aims to address this gap by exploring young people's motivations to attend CoderDojo and perceptions of their experience. Given the increasing demand for workplace skills in Science, Technology, Engineering and Mathematics (STEM) and the NCCA's introduction of Junior Cycle courses in coding and digital media literacy, an understanding of young people's motivation for learning these skills is highly relevant. The ability to create and manipulate digital content is vital in order to achieve digital literacy and participate in our interactive digital future.

1.1 CoderDojo

CoderDojo is an independent, volunteer-led, global network of free coding clubs for young people. At dojos, young people aged between five and 17 learn from volunteer mentors how to code, develop apps, games, websites and programs, and explore technology in a creative and informal environment. CoderDojo attendees – or ninjas – are encouraged to share what they have learned.

Topics explored in dojos vary according to mentors' expertise, but typically dojos work with Scratch, HTML, CSS and PHP, and many cover JavaScript, Python, Ruby and Node.js. Game development and Minecraft mods are popular, and many students go on to explore hardware and robotics with Arduino, Raspberry Pi and Galileo.

Each dojo is autonomous, having been set up and run by volunteers, and is hosted in a local library, school, university or office, usually after school or at the weekends. As of June 2015 there were 710 verified dojos in 57 countries, reaching more than 30,000 young people.

1.2 Conceptual framework: Self-Determination Theory

Deci and Ryan's (1985, 2000) Self-Determination Theory (SDT) is a meta-theory of motivation that offers an understanding of human behaviour across many domains, and one that has been suggested to provide a robust and rigorously studied framework for the study of motivation in technological learning environments (Tran, Chen, Warschauer, Conley & Dede, 2012). The theory proposes that all individuals have a basic need to feel autonomous (i.e., self-determined) and that motivation of all behaviour lies along a continuum of relative autonomy (i.e., self-determination), (Figure 1). At the most autonomous end of the continuum is intrinsically motivated behaviour, carried out because it is inherently satisfying (i.e., enjoyable, challenging or interesting). At the opposite end of the continuum is amotivation (i.e., lack of motivation). Between these two poles lay extrinsically motivated behaviours, driven by external rewards or to avoid punishment. SDT consists of numerous sub-theories, the two most relevant to this research being Cognitive Evaluation Theory and Organismic Integration Theory.

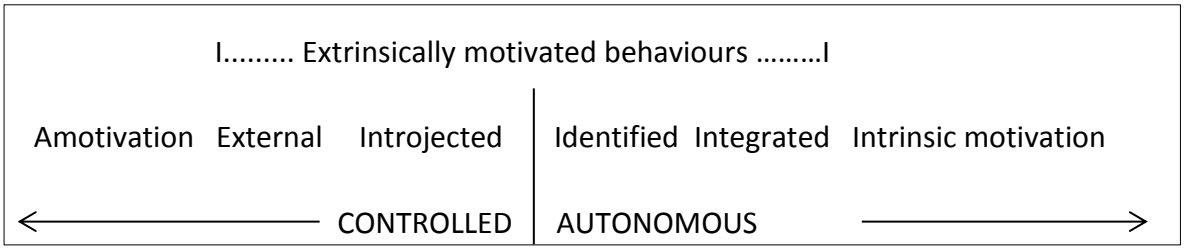

Figure 1: Self-Determination continuum

1.2.1 SDT and intrinsic motivation: Cognitive Evaluation Theory

Cognitive Evaluation Theory posits that individuals experience more autonomous forms of motivation when their needs for autonomy, competence and relatedness are satisfied (Ryan & Deci, 2000).

Autonomy refers to an individual's perception of control over a situation and sense of choice or volition. The need for autonomy is considered to be the most important need, essential for a person to feel intrinsically motivated (Deci & Ryan, 2000). Thus, in an educational setting, the degree of support for students' sense of control over their learning plays a key role in student motivation (Reeve, 2002).

Competence concerns a person's need to be effective. Satisfaction of the need for competence supports an individual to explore environments, adapt to changes and rise to challenges, while lack of satisfaction for this need may result in lack of motivation and feelings of helplessness (Deci & Ryan, 2000). Optimal challenge, acquisition of new skills and receipt of positive feedback promote feelings of competence (Ryan, Rigby & Przybylski, 2006).

Relatedness refers to a need for affiliation with significant others and being part of a group that shares beliefs and practices (Deci, Vallerand, Pelletier & Ryan, 1991) – which, in an educational environment, includes feeling valued, liked and respected by teachers and peers (Niemiec & Ryan, 2009).

According to Deci and Ryan (2012), contexts that are autonomy supportive also satisfy to some extent the needs for competence and relatedness. Research consistently suggests that situations that support these three needs foster intrinsic motivation (Niemiec & Ryan, 2009; Przybylski, Rigby & Ryan, 2010; Przybylski, Weinstein, Murayama, Lynch & Ryan, 2012).

1.2.2 SDT and extrinsic motivation: Organismic Integration Theory

The sub-theory of Organismic Integration (OIT) identifies four types of extrinsically motivated behaviours, defined by the extent to which the regulation of an extrinsically motivated activity has been internalised (Rigby, Deci, Patrick & Ryan, 1992). OIT proposes that the more a person internalises external regulation, the more they will behave and feel as if they were intrinsically motivated. The four forms of extrinsic motivation, from most autonomous to least, are: integrated, identified, introjected and externally regulated.

Integrated regulation refers to the performance of behaviours consistent with a person's needs and that are integral to what the person stands for; identified regulation includes behaviours perceived as valuable to a person's development, but not necessarily enjoyable; introjected behaviours are performed to avoid guilt, anxiety or shame; while externally regulated behaviours are carried out for reward or to avoid punishment. External regulation and introjected regulation are referred to as controlled, while identified regulation, integrated regulation and intrinsic motivation are considered autonomous. Substantial research points to autonomously motivated behaviours being more stable, performed more carefully and associated with more enjoyment (Ryan & Deci, 2000) and interest (Deci, 1992; Grolnick & Ryan, 1987).

1.3 Motivation and learning

A number of studies point to the advantages of autonomous motivation in learning. Intrinsically motivated students tend to perform better academically (Areepattamannil & Freeman, 2008; Niemiec & Ryan, 2009; Gottfried, Marcoulides, Gottfried, Oliver, & Guerin, 2007; Black & Deci, 2000; Taylor, Jungert, Mageau, Schattke, Dedic, Rosenfield & Koestner, 2014), be more inquisitive (Kuhl, 2000), focus on understanding over memory (Deci & Ryan, 2008), use more active learning methods (Black & Deci, 2000) and process information more attentively and

comprehensively. They also tend to be more creative (Ryan & Deci, 2000), show more exploratory behaviour (Martens, Gulikers & Bastiaens, 2004), demonstrate more persistence and engagement, and be less inclined to drop out (Vallerand & Bissonnette, 1992). Individuals high in autonomy orientation tend to self-initiate activities and seek challenging and interesting pursuits (Deci & Ryan, 1985).

Teachers can play a fundamental role in supporting students' autonomy by listening to them, acknowledging their perspective, providing encouragement, answering questions, permitting students to work by themselves and at their own pace, and giving constructive feedback (Reeve, Bolt, & Cai, 1999; Reeve & Jang, 2006). Offering choice (Patall, Cooper & Wynn, 2010; Ryan et al., 2006), tailoring instruction to students' personal interests (Ryan et al., 2006), providing rationale for activities and using non-controlling language (Reeve, 2006) can also support students' sense of autonomy. Pupils of teachers who have a more autonomy-supportive teaching style tend to be more actively involved, more intrinsically motivated and show more positive emotion (Black & Deci, 2000).

1.3.1 Motivation and game-based learning

Digital game-based learning holds considerable potential to increase students' motivation to learn (Gee, 2005; Liu, Toprac & Yuen, 2009; Papastergiou, 2009; Huang, 2011) as well as boosting learning efficacy (Liu & Chu, 2010; Liu, Horton, Olmanson & Toprac, 2011; Yang, 2012). Prensky (2001) suggests that many games possess some or all of the seven factors that, according to Malone and Lepper's taxonomy (1987), connect learning with intrinsic motivation: fantasy, control, curiosity, challenge, competition, cooperation and recognition. In addition, game elements important to motivation include socialising, play, problem solving, voluntary acting and information processing (Liu et al., 2011). Motivation in game-based learning has also been found to positively affect students' problem-solving competencies (Eseryel, Law, Ifenthaler, Ge & Miller, 2014).

Perceived support for autonomy, competence and relatedness has been found to be associated with high intrinsic motivation while gaming (Przybylski et al., 2010), a finding consistent with SDT. In contrast, Farrell and Moffat (2014) found that SDT alone could not account for levels of engagement in a 'serious' game-based learning context, proposing that an extra element such as purpose might need to be considered. However, Farrell and Moffat conceded that their measure of engagement may have been inaccurate.

1.3.2 Motivation and digital game/artefact creation

In comparison to learning through playing games, learning via game creation is a relatively under-researched field – particularly at primary level (Wilson, Hainey & Connolly, 2013).

In a pioneering study, Kafai (1996) showed that making games allows children to have control over their own thinking and learning – a finding echoed by Robertson and Howells (2008) – as well as prompting them to plan and manage the complexities of game development. Gee (2005) suggests that game-making might be more motivating and promote deep learning more effectively than playing a game because it demands more self-regulation and critical thinking. Triantafyllakos, Palaigeorgiou and Tsoukalas (2011) advocate game design as an optimal tool for empowering students and encouraging participation – a view also held by Smeets (2005), who suggests that game-making is potentially a potent learning environment, actively engaging learners – often collaboratively – in rich, authentic activities that can be tailored to their individual needs. Brennan and Resnick (2012) suggest that through designing, programming and building interactive media, young people not only develop computational thinking skills but view computation as a means of self-expression. This proposal is supported by Kafai and Peppler (2011) and Kafai and Vasudevan (2015), who state that learning to code creatively is a key step on the path towards production and expression in interactive digital media. Productive learning tends to take place in collaborative settings where knowledge can be shared

(Kafai & Burke, 2014), such as after-school clubs that encourage open-source use and blending of code – an activity that is prohibited in more formal settings.

Designing and constructing digital artefacts such as games has been found to enhance both motivation to learn and enjoyment in classroom and college settings (Robertson & Howells, 2008; Reynolds & Caperton, 2011; Triantafyllakos et al., 2011; Vos et al., 2011; Hwang et al., 2014), as well as being perceived as relevant (Reynolds & Caperton, 2011). The literature also indicates that game creation in a classroom environment boosts problem-solving abilities (Hwang et al., 2014; Triantafyllakos et al., 2011); improves retention and critical thinking skills (Yang & Chang, 2013); stimulates creativity (Triantafyllakos et al., 2011; Hwang et al., 2014), and is a pleasurable and effective means of learning to program (Wilson & Moffat, 2010; Werner, Campe & Denner, 2012). According to Howland and Good (2015), creating 3D role-playing games also improves computational communication.

Less attention has been paid in the literature to informal game-building initiatives outside the established, structured educational environment. Of the limited number of studies focusing on such communities (e.g., Maloney, Peppler, Kafai, Resnick & Rusk, 2008; Kafai, Fields & Burke, 2012; Sheridan, Clark & Williams, 2013; Smith, Sutcliffe & Sandvik, 2014; Akcaoglu & Koehler, 2014; Fields, Giang & Kafai, 2014;), none explores the motivation of their young members in any depth.

1.4 Current study

Although copious research has identified learning through game-play to be highly motivating, young people's motivation to create their own digital games, websites and apps has received comparatively little attention. Much remains to be discovered about young people's motivation to learn to program (Howland et al., 2015). In addition, previous studies have largely focused on formal college and school settings, tending to overlook the burgeoning informal youth coding initiatives (Kafai & Peppler, 2011). Little attention has been paid to young people's perceptions of such communities or their motivations to attend them. Specifically, motivation of young

people to attend CoderDojo appears to have received no consideration in the literature. Given the increasing demand for STEM skills, and, in an Irish context, the NCCA effort to offer coding and digital media education, a study of such young learners' motivation to create and manipulate digital content is highly pertinent. This study therefore aims to explore the following research question:

RQ: What motivates young people to attend CoderDojo?

2. Method

2.1 Research design

Johnson and Onwuegbuzie (2004) state that qualitative research can provide a richly detailed understanding of people's experiences of phenomena, based on their own categories of meaning, as they are situated in naturalistic local contexts. Therefore this study employed a flexible, exploratory qualitative design, using a semi-structured interview protocol gathering data from three focus groups. Focus groups were chosen for their pragmatism and efficiency in generating a large quantity and range of attitudes, ideas and opinions, expressed in participants' own words. Group dynamics also stimulate reflection, comment and deeper insight (Robson, 2011).

2.2 Participants

Purposive sampling was used to recruit participants via the CoderDojo Foundation. Participants were required to be attendees of CoderDojos in Ireland and aged between 7 and 17 years old (N=20). Participants were not screened for academic ability or learning disability. Demographics can be found in Table 1.

Table 1: Focus group demographics

Focus group	**Average participant age (years)**	**No of boys**	**No of girls**	**No of participants in group**	**Average attendance (months)**
1	11.86	4	3	7	17.3
2	10.50	6	0	6	16.5
3	10.42	2	5	7	16.7
	Mean = 10.95	**Total = 12**	**Total = 8**	**N = 20**	**Mean = 16.8**

2.3 Materials

Materials included parental information and consent sheets, participant information and consent sheets, participant questionnaire, debrief forms and a semi-structured, open-ended focus group question guide (Appendix A). The question guide was informed from previous literature on SDT and by the researcher's own experience gained while volunteering with CoderDojo. A digital Sony voice recorder and iPhone 5 were used in conjunction to record focus group discussions.

2.4 Procedure

2.4.1 Pilot study

According to Robson (2011, p.405), a 'dummy run' should form the initial stage of data gathering in order to overcome potential issues. Therefore a pilot study was run with four CoderDojo students to determine the clarity, coherence and comprehensiveness of the questions and test their effectiveness in eliciting responses of quality and depth. Based on the outcome, minor changes were made to the question wording and order. Data from the pilot was not included in the main study.

2.4.2 Interview procedure

Following the pilot, three focus group discussions were conducted face to face in March 2015 in the respective institutions where the Dojos took place, in adjacent rooms, either during or immediately after the Dojo session. Prior to focus groups commencing, both participants and their parents/guardians were provided with a research information sheet and consent form. Participants also filled out a 4-item questionnaire collecting data on age, gender, length of time attending CoderDojo and their rating of CoderDojo on a scale from 1-10. The researcher initiated each discussion but subsequently followed participants' lead, using the question guide when necessary. Focus groups varied between 32 and 41 minutes' duration.

Discussions were recorded for transcription. All participants were subsequently debriefed. The estimated saturation point was reached after the third focus group, and data was combined for analysis.

2.4.3 Analysis procedure

Thematic analysis "offers an accessible and theoretically flexible approach to analysing qualitative data" (Braun & Clarke, 2006, p.3) and describes data in rich detail. In addition, the realist method reports the reality, experiences and meanings of participants, while the latent thematic approach allows for a theoretical interpretation of identified themes (Braun & Clarke, 2006). Thus, focus group transcripts were thematically analysed using a realist, latent, deductive SDT-driven approach, following Braun and Clarke's (2006) guidelines for rigorous, transparent, replicable, verifiable and systematic process: familiarisation with data by repeatedly listening to the recordings and reading the transcripts; initial code generation; identification of themes; reviewing, defining and labelling themes; and creating a report. Analysis was carried out manually, without use of specialist software, and was continuous throughout the period of data collection.

The audio recordings were transcribed manually, verbatim, by the researcher into Microsoft Word documents. Transcriptions were then checked against original recordings. To gain an initial overview of themes, the transcripts were combined and run through Wordle software (Appendix B).

To address reliability and reduce random error and researcher bias in interpretation, one-third of data was coded independently by a co-researcher with no pre-existing experience of or bias towards CoderDojo. An interrater reliability analysis using the Cohen Kappa statistic was performed on this data to determine consistency among researchers. Interrater reliability was found to be Kappa = 0.79 (Appendix C).

Each researcher independently proposed a set of themes and mediating factors. The researchers then compared and agreed on proposed themes and agreed on a set of coding definitions to operationalise these themes and mediating factors (Appendix

D). The researchers worked together on an iterative process of reviewing codes, and re-examining themes and mediating factors. Several codes were eliminated or merged. Care was also taken to search for negative cases. When prioritising analytic themes, researchers considered frequency, extensiveness, intensity, specificity, internal consistency and participants' perception of the importance of concepts, as described by Krueger and Casey (2015). For example, participants' consistency of response was considered, as well as the number of times a similar response was given by other participants. Several categories were merged. For example, three categories initially named 'supportive mentors', 'supportive peers' and 'supportive environment' were merged to form a single category named 'provision of support'.

Identified themes were then mapped to the different types of motivation proposed by SDT, along a spectrum from amotivation to intrinsic motivation. Data was also examined to investigate whether motivation differed according to age, gender, participation at a particular dojo or level of attendance. A detailed audit trail was maintained throughout, as advised by Elliot and Timulak (2005).

Finally, the primary researcher selected quotes considered most representative to illustrate each theme and mediating factor identified.

2.5 *Ethics*

Permission was granted by the CoderDojo Foundation to carry out the study (Appendix E). Focus group participants and their parents/guardians had the research fully explained to them and the voluntary nature of the study was stressed, before informed consent was sought. Both participants and guardians were informed that, due to the nature of focus groups, confidentiality could not be guaranteed, but that all data gathered would be unidentifiable and anonymity would be adhered to when reporting the results. In the interests of child safety, two parents were requested to be present during each focus group discussion. Prior to each focus group commencing, participants were asked for permission for the audio of the discussion to be recorded. A suspended interview procedure was established, but did not prove necessary. Participants and parents/guardians were provided with the researcher's

contact information in the event that they required further details of the study, to have their data deleted, or to request the research article. The Department of Technology and Psychology Ethics Committee IADT, Dun Laoghaire, Co Dublin, granted ethical approval for this research.

3. Results

3.1 Participants' rating of CoderDojo

The mean rating given to CoderDojo by participants was 9.5.

Table 2: Participants' rating of CoderDojo

Focus group	**Rating (1-10)**
1	8.86
2	9.83
3	8.85
Mean	**9.15**

3.2 Identified themes

Two primary themes relating to student motivation to attend CoderDojo were identified:

1. enjoyment of learning and creating digital games, apps and websites; and

2. desire to learn valuable skills.

The latter was further divided into four sub-themes: desire to create games, apps and websites; desire to meet needs integral to the self; desire to prepare for the workplace; and desire for external reward.

These themes mapped on to 4 corresponding types of motivation as proposed by SDT: intrinsic, integrated, identified and externally regulated motivation.

Additionally, students' enjoyment was found to regulate their desire to learn, while their desire to learn also regulated their enjoyment. No difference in motivation was identified between different focus groups, age or level of participation at CoderDojo. However, gender differences were identified: only boys gave motivations identified as externally regulated.

Table 3: Summary of themes identified and corresponding motivational type

Theme identified from data	**Motivational type according to SDT**
1. Enjoyment of learning and creating digital games, apps and websites	Intrinsic
2. Learning valuable skills (in order to:)	
a) To create games, apps and websites	Identified
b) To meet needs integral to the self	Integrated
c) To prepare for the workplace	Identified
d) To gain an external reward	Externally regulated

Further, students' motivations were identified as mediated by five inter-related characteristics of CoderDojo: 1. provision of support; 2. scope for creativity; 3. freedom of choice; 4. provision of challenge; and 5. friendship (Figure 2). These characteristics were interlinked, reflecting a web of participants' motivations and perceptions. For example, being presented with freedom of choice enabled participants to express their creativity, as well as making learning more enjoyable.

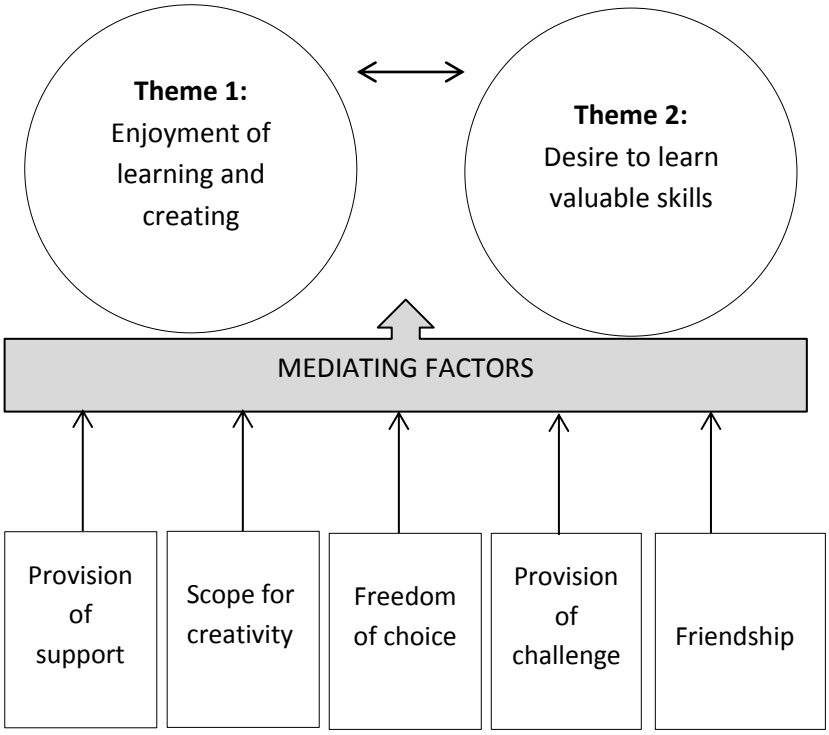

Figure 2: Thematic map: themes and mediating factors

3.2.1 Theme 1: Enjoyment of learning and creating digital games, apps and websites

The majority of participants provided comments that suggested their attendance at CoderDojo was intrinsically motivated, stating that it was inherently satisfying:

"For me, it's the fun. I can't see me in the future using it, but it's fun – and if I need it, I have it" (Focus Group 1, male, 11); "It's great craic" (FG1, male, 12); "It's just really fun and cool making things" (FG3, female, 12); "I come because it's fun, because you can create anything you really want" (FG1, male, 11).

Students took pleasure in learning:

"It's interesting and it's fun and you learn a lot" (FG2, male, 11); "I love new stuff" (FG3, female, 9).

Some enjoyed sharing their knowledge:

"I really enjoy mentoring – and learning. So that's why I come" (FG1, female, 14).

Seeing an idea transform into a tangible creation was a source of wonder to some participants:

> "You kind of learn how to make an idea turn into something you can actually play and look at and marvel over" (FG3, male, 11).

Students particularly enjoyed making their own games, websites and apps:

> "I like the feeling of making something yourself – you know that you've made it and it's not just another game. It's really fun and I like doing it" (FG3, female, 12); "We're making our own kind of app or a website or a game or utility or anything that we can do ourselves, which is really good fun" (FG3, female, 12).

3.2.2 Theme 2: Desire to learn valuable coding skills

3.2.2.1 Sub-theme 1: To create games, apps and websites

Many students explained their attendance in terms of identified motivation, considering that learning to code would help them achieve desired goals, such as being able to create digital games, websites and apps:

> "To learn how to code… so I can make websites and apps and things like that" (FG2, male, 8); "The best thing is that you can make really cool games and the teachers will help you make it more cool" (FG3, female, 9).

Learning to code also allowed participants to manipulate games:

> "In Scratch, if I saw a game I like that I've played or one that I've bought, I can make an easier version in Scratch that has something that I didn't like about the other game. I can change it" (FG1, male, 14).

3.2.2.2 Sub-theme 2: Desire to meet needs integral to the self

Some students described attending CoderDojo in terms of integrated motivation, believing it to be consistent with their values and needs. Many felt it would help them in their chosen career:

> "I want to learn coding. I want to be a games developer" (FG2, male, 10); "I've always wanted to become a computer programmer or game modifier" (FG1, female, 11).

Others wanted to learn to code in order to express what was highly important to them on a personal level:

> "Websites and apps give you an opportunity to voice your opinion and have it seen by lots of different people… and you can use it to do anything with charities and so that's why I'm big into it. My sister is Down syndrome, and I'm planning on using websites to promote helping people with different disabilities" (FG1, female, 14).

3.2.2.3 Sub-theme 3: To prepare for the workplace

Numerous participants commented that coding skills would be needed to get a job, corresponding to identified motivation:

> "There are a lot of jobs at the moment available with computers and computer programming , so I think it would be a valuable skill to have to be able to program" (FG1, male, 14); "It would be very helpful in the near future. Because there will be more jobs in IT and everything" (FG2, male, 11); "All the jobs will be changing over the next few years and by the time we're old enough to get jobs they'll probably be, like, mostly to do with coding" (FG3, female, 12).

3.2.2.4 Sub-theme 4: To gain an external reward

Some participants – all boys – depicted learning to code in terms of external regulation. For example, several spoke of potential financial rewards:

"You can make a lot of money, like if you make one good app and you put it on the app store, it can make you millions" (FG2, male, 12); "You can make good money out of it" (FG3, male, 11).

A small number felt that knowing how to code raised their social standing among peers:

"You also get more popular at school because you know, kind of, things…" (FG2, male, 12); "One good game and everyone knows" (FG2, male, 10).

3.3 Mediating factors

Five characteristics of CoderDojo were identified that were considered to mediate participants' motivation: 1. provision of support; 2. scope for creativity; 3. freedom of choice; 4. provision of challenge; and 5. friendships.

3.3.1 Mediating factor 1: Provision of support

Participants commented extensively about the level of support available from mentors, peers and CoderDojo environment.

The advantages of having access to a number of knowledgeable mentors, and of mentors' teaching style and personal qualities, were strongly articulated by students. Mentors were able to spend time helping individuals:

"You'll have a lot more individual help if you're stuck with something" (FG1, female, 14).

More mentors also equated to a larger pool of knowledge for students to draw on:

"In school you have one teacher, but here we have several mentors to help you. And if one of them doesn't know something, then another one will come along who will most likely know" (FG1, male, 14).

Mentors were able to support students with individual projects:

A school teacher] is teaching an entire class, whereas this mentor is teaching you and you're doing a completely different thing to everyone" (FG2, male, 10).

Students felt that mentors' teaching style was facilitative rather than instructive:

"In school you're getting told what you have to do but in CoderDojo the teachers, the mentors, they're not here telling you what to do, they're here helping you with what you want to do" (FG2, male, 12); "You have the freedom to choose what you want and they'll help you no matter what you're doing" (FG1, male 14).

Learning was seen as largely self-directed, yet supported:

"Teachers tell you how to do it, but here you do it yourself. And then if you get stuck along the way, you get helped" (FG1, female, 11).

Mentors taught multiple methods to solve problems:

"In school, the teacher tells you to do it one way, when you know another way, but the mentors tell you like three different ways to do it" (FG1, male, 11).

Mentors also allowed students to work at their preferred pace:

"You can work at your own speed. You don't have to rush" (FG1, male, 12).

Mentors' focus on students' understanding rather than on memory was also mentioned:

"In school the teacher says, for example, '1+ 1 is 2, you just remember that.' And if someone asks you that question, 'What's 1+1?' you don't know how it works, you just say 2 because you remember it. They [the mentors] actually show you how it works" (FG1, male, 12).

Mentors allowed students to talk to each other:

> "They don't mind if you're talking to the person beside you, yet a teacher will get extremely annoyed if you start talking to the person beside you" (FG3, female, 11).

Peer support was encouraged:

> "Helping each other. In class that's copying. It's a good thing here, helping" (FG1, male, 11); "You can show your friend what you've been working on and compare it and see what they've done" (FG1, male, 11).

Students were encouraged to seek help from each other before asking a mentor:

> "The idea is that we only help if their friends around them can't help them" (FG1, male, 14, who also mentors).

This facilitated friendships:

> "It gets people talking to each other at their table. It helps them be friends and stuff" (FG1, female, 14).

Peer mentoring enabled students to make a positive contribution, as one boy, (11), explained:

> "It's like a two-way system… receiving, you can actually give."

Peer mentoring also boosted students' self-esteem:

> "You feel proud of yourself because you're doing a better thing than just working on something for yourself" (FG2, male, 12).

Learning between mentors and students travelled in both directions:

> "You can teach mentors yourself with your own ideas… so then it's sort of reversed" (FG1, female, 11).

However, some male participants described negative experiences of mentoring their peers:

"It's distressing. You're trying to help them, they're trying to do something else, and you're saying, 'No, no, you're not doing the right thing,' but they keep on going with that" (FG2, male, 10).

In addition, some male participants did not enjoy being mentored by younger peers: "It makes me feel stupid. It makes me feel stupid" (FG2, male, 10); "If they're younger than you, you just feel depressed" (FG2, male, 10).

The friendly, informal, helpful atmosphere at CoderDojo was cited by many participants:

"The best thing I find about CoderDojo is, all the mentors, the teachers and the people that go here, all the kids, are always really friendly and help you out with everything" (FG3, female, 7); "A good atmosphere. Like, everyone… you get the sense that everyone there is enjoying it… and is happy" (FG2, male, 10); "kind of focused but relaxed, so different to in school. Technically focused" (FG1, age 14).

Participants were not required to adhere to a schedule:

"In school everything's done on a time, but with CoderDojo you just do your own thing" (FG3, female, 12); "You can leave whenever you want and it doesn't really matter if you're late or anything" (FG3, male, 11).

3.3.2 Mediating factor 2: Scope for creativity

Participants indicated that CoderDojo enabled them to express their creativity:

"You can get really creative and do stuff you like at the same time… it's really imaginative, so I like it" (FG3, male, 11); "We're actually utilising our creativity to make things" (FG1, male, 14).

Participants also felt that CoderDojo facilitated creative problem-solving:

"Your imagination is the limit, whereas in school you have one thing, you've to answer those questions, and you have to answer it correctly – you can't find

different ways of doing it as much. With code you figure out different ways, or easier, or harder ways to do it" (FG3, female, 12).

Students were encouraged to stretch their imaginations:

"It sort of tests your creativity and the way that your mind works" (FG1, female, 11).

3.3.3 Mediating factor 3: Freedom of choice

Students stated that CoderDojo gave them the opportunity to make their own decisions and therefore have a high degree of control over their own learning.

They attended CoderDojo voluntarily:

"We're here, we're all turning up because we want to do it" (FG1, male, 11).

Attendees were able to choose from a wide selection of topics:

"You can literally learn anything really that has to do with coding" (FG2, male, 12); "If you don't like Scratch, maybe, you can go to App Inventor or HTML or Arduino. And if you don't like what you're doing within Scratch, you can change all that. So I think you've complete freedom over what you're doing" (FG1, male, 14).

Students were able to make choices based on personal interest:

"You have loads of choices. Every mind thinks differently and everyone has different likes, so you'll all have different ideas and different opinions on everything. If you think it, you can probably make it as well, and do like a game or an app or a story or something" (FG3, male, 11); "You can kind of do anything – it's like a blank canvas. It's really personalised by you because you can do whatever you want then that's coding" (FG3, female, 12).

3.3.4 Mediating factor 4: Provision of challenge

Students reported that CoderDojo presented challenging activities:

> "We've recently built a maze for the robots to navigate and you have to work it out completely yourself, we don't have booklets that have the code how to do it" (FG1, male, 14); "…at the end there'll be a challenge where there'll be no instructions and you have to try and do it yourself. I think that's the best way of working" (FG1, female, 14).

Researcher: "What's so good about that part?"

> "Challenge, so if you're finding something easy you can always get to the next level" (FG1, male, 14).

Students perceived challenge to be enjoyable:

> "I think it's great – especially the challenges, where when you complete it you just feel very excited" (FG1, female, 10); "The way that you make a game, it's kind of confusing, but then figuring out how everything works and testing it… You just feel very happy when it's done" (FG3, male, 11); "You kind of think a lot – that's what I like" (FG3, male, 11).

3.3.5 Mediating factor 5: Friendship

Participants viewed CoderDojo as a regular meeting venue for existing friends:

> "It's another place for you to meet your friends on the weekends. It's like, you can arrange a meeting with your friends, but this is a definite meeting that you know they'll be at" (FG1, male, 14).

The opportunity to forge new friendships was also cited:

> "It's really sociable and you make lots of new friends" (FG2, male, 12).

One participant commented that it was enjoyable to meet others who understood the language of code:

> “It’s fun to meet people who actually know what you’re talking about. I like it because people understand what you’re talking about here and there’s nowhere else where people understand what you’re talking about” (FG3, female, 11).

4. Discussion

4.1 Overview

The purpose of this study was to explore young people's motivations to attend CoderDojo and perceptions of their experience. Two primary themes were identified: enjoyment of learning and creating digital games, apps and websites; and the desire to learn valuable skills. Regarding the latter, four sub-themes were identified. Desire to learn valuable skills, in order to: create games, apps and websites; to meet needs integral to the self; to prepare for the workplace; and to gain external reward.

These themes were identified to correspond with four different forms of motivation, as posited by SDT. Enjoyment of learning and creating digital games, apps and websites was mapped to intrinsic motivation; desire to learn in order to create games, apps and websites was mapped to identified regulation; desire to meet needs integral to the self was mapped to integrated regulation; desire to prepare for the workplace was mapped to identified regulation; while desire for external reward was mapped to external regulation.

In addition, five characteristics of CoderDojo were identified that mediated the relationship between identified motivations and attendance at CoderDojo: provision of support; scope for creativity; freedom of choice; provision of challenge; and friendships.

Participants gave CoderDojo a mean rating of 9.14 out of 10, or 91.4%.

4.2 Discussion

Results indicate that participants found both learning to make digital apps, websites and games, and actually making them, to be intrinsically motivating. Participants also voiced a strong desire to learn to code. This desire was tied to the enjoyment coders expressed in learning and creating. Enjoyment increased their desire to learn, while their desire to learn increased their enjoyment. Acquisition of coding skills was highly valued mainly because such abilities enabled young coders to design and make their own creations, but also because these skills empowered them to express what was personally important to them, aided them to move towards coding-related career goals, or simply upskill in preparation for their working lives – all autonomous expressions of motivation. These finding are consistent with the assertions of Self-Determination Theory (Deci & Ryan, 1985, 2000; Ryan et al., 2006), and also with those of previous findings that constructivist game-based learning enhances motivation to learn (Gee, 2005; Liu et al., 2009; Papastergiou, 2009; Huang, 2011; Vos et al., 2011; Reynolds & Caperton, 2011; Triantafyllakos et al., 2011; Hwang et al., 2014). The high rating participants gave to CoderDojo indicates that the young coders felt highly positively towards CoderDojo.

A minority of participants – interestingly, all boys – demonstrated externally regulated expressions of motivation: potential financial reward or improved standing among peers. This might be interpreted as suggesting that young male and female coders have different reasons for attending CoderDojo, but the small number of boys who responded in this way would advise caution in this assumption.

CoderDojo was perceived to offer scope for creativity and self-expression, echoing the findings and assertions of Triantafyllakos et al. (2011), Hwang et al. (2014), Brennan and Resnick (2012), Kafai and Burke (2014) and Kafai and Vasudevan (2015). This scope for creativity aided problem-solving, nurtured participants' enjoyment and was facilitated by having choice in their own learning, by mentors' teaching style, by being challenged, by the easy-going atmosphere and by being able to help each other and compare work.

Students were given the opportunity to make their own choices in what and how they learned, giving them a sense of control over their own learning, satisfying their need for autonomy (Deci & Ryan, 2000) and potentially playing a key role in their motivation (Reeve, 2002; Patall et al., 2010) – a finding consistent with that of Kafai (1996) and Robertson and Howells (2008). Control is also one of the seven factors considered by Malone and Lepper (1987) to connect learning with intrinsic motivation. Being able to make their own choices made learning more enjoyable for students and encouraged their creativity. This freedom of choice was facilitated by the mentors, and by the relaxed environment.

In addition, students perceived CoderDojo to provide challenge, which they found enjoyable. This finding indicates that young coders felt sufficiently competent to rise to these challenges and explore multiple solutions, and is in line with Deci & Ryan's (2000) assertion that satisfaction of the need for competence enables such exploration and response to challenge. It is also consistent with Ryan et al.'s (2006) finding that optimal challenge fosters feelings of competence. Being presented with challenging activities made learning more enjoyable for students, encouraged their creativity, and was enabled by mentors and by the relaxed environment.

Mentors, peers and the friendly CoderDojo ambiance were all seen as helpful and supportive, allowing young coders the freedom, time and space to make their own decisions about their learning, as well as socialise, compare, express their creativity and share their knowledge, ideas and creations with both mentors and peers. Mentors were perceived to be facilitators rather than instructors, actively listening to students, helping them in whatever they chose to do and allowing them to work at their own pace – a teaching style previously found to supports students' autonomy (Williams & Deci, 1996; Reeve et al., 1999; Reeve & Jang, 2006). According to Niemiec and Ryan (2009), feeling valued, liked and respected by teachers in this way fosters feelings of relatedness. Mentors' teaching style and personal qualities were also perceived to facilitate creativity and challenge, make activities more enjoyable, add to the supportive atmosphere and enable both self-directed and

peer-learning. The focused but informal atmosphere was perceived to add to students' enjoyment, support friendships and encourage creativity.

CoderDojo was also perceived to nurture friendships with a group of likeminded peers, which also promotes feelings of relatedness (Deci et al., 1991). That this factor appeared to be of least importance could be interpreted as suggesting that making and meeting friends is seen by these young coders as an added benefit rather than a core reason to attend. In addition, some students might prefer to retain sole 'ownership' of their own creations. Alternatively, it could be the case that CoderDojo attracts young people who prefer to learn alone, or who are introverted, or who find coding so engaging that socialising at CoderDojo is low on their list of priorities. Nevertheless, CoderDojo's social nature was perceived to add to students' enjoyment, enable peer helping behaviour and aid creativity. It was considered to be enabled by the relaxed atmosphere and by the mentors' teaching style and personal qualities.

Results also suggest that CoderDojo incorporates elements from Papert's (1980) constructionist framework, which asserts that young people experience deep learning when they create their own personally relevant games, apps and websites in a collaborative community that allows for exploration and reflection. Immersed in the investigation of coding and programming, CoderDojo is likely to foster computational thinking, encourage investigation of alternative solutions, and nurture positive approaches to failure. In addition, findings align with the assertion that informal settings outside the school environment – being more social, less structured and allowing for individual interests and different paces of learning – are effective in supporting students as 'makers'. As identified by Smeets (2005) and Robertson and Howells (2008), creating games potentially provides students with a powerful, rich, authentic, active and meaningful learning experience.

In sum, findings suggest that CoderDojo attendees perceive CoderDojo to be an autonomy-supportive, relaxed, fun and social learning environment that gives them the opportunity to acquire useful and relevant skills from volunteer experts in an

enjoyable manner, to have control over their own learning, to explore and express their creativity, to be challenged, to create and manipulate technology, to give and receive help, to compare and share what they make, and to nurture friendships with likeminded others. CoderDojo appears to provide a learning context that meets these young coders' needs for autonomy, competence and relatedness, and fosters their intrinsic motivation.

4.3 Research limitations

It is possible that the participant sample, being comprised of those CoderDojo students who volunteered to share their views, were those more highly motivated to learn and enjoy digital artefact creation or were high in autonomy orientation and therefore more likely to seek and initiate challenging and interesting activities (Deci & Ryan, 1985). They may also have been the more confident, outgoing and outspoken CoderDojo attendees.

Participants' questionnaire rating of CoderDojo should also be interpreted with caution, as in hindsight the question asked of participants was somewhat ambiguous.

In addition, this research does not capture variations that exist across CoderDojo locations with regard to depth and breadth of mentors' expertise, topic of choice facilitated, or level of support of young coders. However, participant responses shared common themes that allow some confidence in determining motivational factors.

4.4 Research strengths

This exploration of young people's motivations to attend CoderDojo is believed to be the first of its kind. Despite the limitations expressed above, this study identified motivating factors highly pertinent to CoderDojo students, as well as a series of inter-related characteristics of CoderDojo that influence these young coders'

motivations. This research also provides a rich description of young coders' perceptions of CoderDojo and of their experiences, and adds to the increasing body of research which suggests that constructivist digital game-based learning can be employed as an effective motivational tool that makes learning more enjoyable and empowers students to express their creativity.

These research findings should be of interest to educators, researchers and policy makers as they offer insight into the motivational elements of CoderDojo from the young coders' viewpoint, lay the groundwork for future research into student motivation within increasingly popular informal community coding initiatives such as CoderDojo, and provide a forum for discussion around motivational methods to teach coding within schools. With strong demand for STEM skills and digital literacy in society, understanding young people's motivation to attend groups such as CoderDojo is vital.

From an Irish perspective, as more and more technology companies invest in Ireland, having an appropriately skilled workforce is a primary government objective. If the government is to develop formal coding education beyond the current short course options in the revised Junior Cycle, research such as the above may help inform such an initiative. It will be essential for policy-makers to have an understanding of the pertinent issues from the young person's perspective.

4.5 Future research

The finding that only boys expressed externally regulated motivation – to make money and be admired by their peers – deserves further investigation. A future study could focus specifically on investigating gender differences in young coders' motivation.

Another interesting angle would be to explore whether exceptionally able students or children on the autism spectrum are over-represented at CoderDojo – and if so, why this could be.

Future research could also address the following questions: What role does young coders' motivational orientation play? Would CoderDojo attendees and students who learn coding at school differ in their level of intrinsic and extrinsic motivation in the two learning environments? If so, why? Should coding be taught at school? And if so, should it be mandatory for all school children, or voluntary? What role do mentors play in nurturing young coders' intrinsic motivation? How does mentors' own motivational orientation affect young people's learning experience? And why do some young people choose to stop attending CoderDojo?

4.6 Conclusion

This research aimed to explore young people's motivation to attend CoderDojo and perceptions of their experience. Results suggest that the young coders involved in this study perceived CoderDojo to be a highly autonomy-supportive learning environment that also fosters their needs for competence and relatedness. Young coders were intrinsically motivated by the enjoyment found in learning and making digital artefacts, and had a strong desire to learn to code – for a variety of largely autonomously motivated reasons. Findings are consistent both with assertions made by SDT and with previous research in the area of constructivist game-based learning.

This research adds to the growing number of studies which suggest that educators have much to learn from such environments. It also adds weight to Peppler and Kafai's (2005) assertion that coding is a creative language vital to expression in interactive digital media, and that allowing young people to become producers of such media is an effective means of teaching that language. As Peppler and Kafai (2005) propose, although only a small number of us may become the experts who create the digital technologies in which we are increasingly immersed, an understanding of code can only benefit our ability to understand, interpret and meaningfully engage with our digital future.

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Appendices

A(i): Parental information letter and consent form

Dun Laoghaire Institute of Art, Design and Technology (IADT).
Faculty of Film, Art and Creative Technologies,
Department of Technology and Psychology.
Kill Avenue,
Dun Laoghaire,
Co. Dublin.

Parental information letter

Title of Research Study: What motivates a ninja? An exploration of students' CoderDojo experience.

Dear Parent/Guardian,

This study is part of my Masters in Cyberpsychology second-year research project in the Department of Technology and Psychology, Faculty of Film, Art and Creative Technologies, Dun Laoghaire Institute of Art, Design and Technology (IADT). Your son/daughter is being invited to consider participating in this research study.

Before you decide whether or not you wish your son/daughter to take part, it is important for you to understand why this research is being conducted and what it will involve. Please take the time to read this information carefully and discuss it with friends and relatives if you wish. If you are concerned about any aspect of this study or if something is unclear, you may wish to contact me, Natalie Butler, by email at cikbabi@gmail.com or my supervisor, Cliona Flood, at cliona.flood@iadt.ie.

Purpose of Research: The primary objective of this study is to explore CoderDojo students' experience of CoderDojo and their reasons for attending.

Procedures: In order to gather this information, I would appreciate if you would consent to your son/daughter participating in this research. If both you and your child consent, your son/daughter will be asked to join the researcher and a group of 6-8 students at CoderDojo for an informal discussion about their experience at the Dojo and their reasons for attending. The discussion is expected to last about 30 minutes. The conversation will be recorded for later transcription and analysis. Parents are welcome to be present during the discussion.

Risks: There are no risks associated with this study. No personally identifying data will be collected and your son/daughter will not be identified in reporting of the research.

Benefits: Your son/daughter's participation in this study will help offer insight into the motivational elements of CoderDojo from the students' point of view, contribute to educational debate around the teaching of creative computational thinking in schools and help lay the foundation for further research. This research is not an evaluation of your child's performance at CoderDojo.

Voluntary Participation: Participation in this study is entirely voluntary and you may withdraw your consent at any time. Even if parents/guardians consent to their son/daughter taking part, students can still choose not to participate. If your son/daughter decides to take part, he/she is free to choose not to answer a question and may leave the discussion group at any time without explanation and without negative repercussion.

Confidentiality: Due to the nature of focus groups, confidentiality cannot be guaranteed, but all data gathered will be unidentifiable and anonymity will be adhered to when reporting the results. The researcher will not distribute any identifiable information to any individual or organisation. Information collected during the course of the discussion will not be traceable to any participant. Audio recordings will be transcribed verbatim (written exactly as the information was communicated in the interview) on the researcher's private, secure computer and stored in an encrypted file for one year – after which time it will be destroyed. All participants will be assigned a pseudonym (fictitious name). This will ensure that the transcribed information will not be associated with or linked to any individual participant.

All information in hard-copy form will be stored in a secure location that only the researcher and supervisor will have access to. All information in soft-copy form will be stored in an encrypted file.

If you chose to withdraw your son/daughter from the study, you may do so. Consequently, any information pertaining to their involvement in the research will be destroyed.

The results from this research study will be reported in my dissertation and may be disseminated through professional publications. The final printed report will not include any data that is traceable to your son/daughter or any individual Dojo.

Contact Information

If you have questions regarding this research, please do not hesitate to seek clarification from the researcher or their supervisor. If additional questions or concerns arise at a later date, you can contact the researcher via the information outlined below.

Researcher: Natalie Butler **Tel:** 0876315884 **Email:** cikbabi@gmail.com

IADT Supervisor: Cliona Flood **Email:** cliona.flood@iadt.ie

Thank you for taking the time to read this information sheet

Dun Laoghaire Institute of Art, Design and Technology (IADT),
Faculty of Film, Art and Creative Technologies,
Department of Technology and Psychology.
Kill Avenue,
Dun Laoghaire,
Co. Dublin.

Parent/Guardian Consent Form

Title of Research Study: What motivates a ninja? An exploration of students' CoderDojo experience.

As the informed parent/guardian of this student, I understand that:

- My child's participation is voluntary and they can withdraw from the study at any time without giving any reason.
- I am fully aware of all the procedures involving my child, and of any risks and benefits associated with this study.
- My child's information and results will remain anonymous.
- I consent to the data being used anonymously in report format and published output.

I have read the parental information sheet. I have read and fully understand all of the above, and give my consent to let my son/daughter take part in this study.

Name (BLOCK CAPITALS): _____

Signature: _____

Child's Name (BLOCK CAPITALS): _____

Date: _____

Contact Details:

Researcher: Natalie Butler Email: cikbabi@gmail.com
Supervisor: Cliona Flood Email: cliona.flood@iadt.ie

A(ii): Participant information letter and consent form

Dun Laoghaire Institute of Art, Design and Technology (IADT).
Faculty of Film, Art and Creative Technologies,
Department of Technology and Psychology.
Kill Avenue,
Dun Laoghaire,
Co. Dublin.

Title of Research Study: What motivates a ninja? An exploration of students' experience of CoderDojo

Dear student,

Your parent/guardian has given permission for you to take part in a short group discussion about CoderDojo. I want to find out what it's like to go to CoderDojo, and why students go there.

What you say will be totally anonymous when I write up my research, so no one will know what you said. There aren't any risks involved in taking part, and the study will help me to understand more about CoderDojo and its students. You will find an information sheet below. Please read this and discuss it with one of your parents/guardians and make sure you fully understand what the study involves before deciding whether or not to take part.

It's up to you whether you choose to take part, it's totally voluntary. If you decide you want to do it, you can still choose not to answer a question and are free to leave the discussion group at any time without having to explain why, no problem.

If you want to ask me any questions or would like to have something explained to you, please contact me, Natalie Butler, by phone on 0876315884, by email at cikbabi@gmail.com, or my supervisor Cliona Flood at cliona.flood@iadt.ie.

Thank you.

Purpose of Research: This study aims to explore CoderDojo students' experience of CoderDojo and their reasons for attending.

Procedures: In order to gather this information, I would appreciate if you would agree to take part in this research. If both you and your parent/guardian consent, you will be asked to join me and a small group of 6-8 students at CoderDojo for an informal chat about your experience at the Dojo and reasons for attending. The discussion should last about half an hour. The conversation will be recorded. Your parent/guardian is welcome to be present during the discussion.

Risks: There are no risks associated with this study.

Benefits: By joining the discussion group you will help me to understand more about CoderDojo and why students attend.

Voluntary Participation: It's up to you to decide whether or not to take part. Even if your parents consent, you can still choose not to take part. If you decide to take part, you can choose not to answer a question and may leave the discussion group at any time without saying why.

Confidentiality: I can't stop any student from talking about this research outside the focus group. However, what you say will be totally anonymous when I write up my research, so no one will know what you said. No one can trace your answers back to you.

If you still have questions, please talk to your parents/guardians, myself or my supervisor.

Contact Information

Researcher: Natalie Butler; Email: cikbabi@gmail.com

IADT Supervisor: Cliona Flood; Email: cliona.flood@iadt.ie

If you have been upset by this study in any way, please tell your parent/guardian straight away or contact one of the help organisations below:

Barnardos: http://www.barnardos.ie/resources-advice/young-people/teen-help/finding-help.html Phone: (01) 453 0355 / Callsave: 1850 222 300

Childline: https://www.childline.ie/

Phone: 1800 66 66 66; text TALK to 50101

Thank you for taking the time to read this information sheet

N00133668

Participant Consent Form

Please tick each box.

I confirm that:

1. I have read and understand the Information Letter. ☐
2. I have had enough time to consider whether or not to take part in the study. ☐
3. I have had the opportunity to ask any questions. ☐
4. I know where to get help if I am upset by anything during the discussion group. ☐
5. My participation is voluntary and I can leave the discussion group at any time. ☐

I consent to taking part in this study ☐

Participant (CAPITALS): _____

Participant (Signed): _____

Date: _____

Researcher (Signed): _____

Date: _____

*** Note: The consent form will be stored separately from all other documentation and data in order to maximise confidentiality.**

A(iii): Participant questionnaire

Focus group No:

Student number:

1. Are you a boy or a girl?

2. How old are you?

3. How long have you been coming to CoderDojo (any dojo, including this one)?

4. If you could rate CoderDojo on a scale from 1-10, what number would you give it?

Thank you!

N00133668

A(iv): Participant debrief form

Dun Laoghaire Institute of Art, Design and Technology (IADT).
Faculty of Film, Art and Creative Technologies,
Department of Technology and Psychology.
Kill Avenue,
Dun Laoghaire,
Co. Dublin.

Participant Debrief Form

Thank you very much for helping me with my study on CoderDojo.

Any questions you answered are anonymous, so no one will know what you said and everyone's answers will be grouped together so no one can trace your answers back to you.

If you want to ask me anything or you decide later that you want to have your answers taken out of the study, please email me at cikbabi@gmail.com or call me on 0876315884. If you like, you can email my supervisor instead: Cliona Flood, at cliona.flood@iadt.ie.

If you have been upset by this study in any way, please tell your parent/guardian straight away or contact one of the help organisations below:

Barnardos: http://www.barnardos.ie/resources-advice/young-people/teen-help/finding-help.html Phone: (01) 453 0355 / Callsave: 1850 222 300

Childline: https://www.childline.ie/

Phone: 1800 66 66 66; text TALK to 50101

Thank you once again for helping with my study.

Natalie Butler,

Email: cikbabi@gmail.com

0876315884

A(v): Focus group question guide

Focus Group Question Guide

1. Introduction: Researcher introduces herself, thanks participants for giving the time to take part, briefly explains the purpose of the focus group and that she will be asking some questions about their experience at Bray CoderDojo. Researcher reiterates the voluntary nature and reminds participants that they are free to choose whether or not to answer any question and free to leave at any time. Researcher then suggests each participant briefly introduce his/herself and tell the group how long they have been attending Bray CoderDojo and which group they are currently part of (there are several groups learning different coding languages). Sample questions follow.

Q1. So, WHY do you guys come to CoderDojo?

- WHY are you willing to give up so much of your free time to come here?
- HOW enjoyable is it?
- WHAT is it about CoderDojo that you enjoy so much?
- WHY is it so much fun?
- HOW would you describe CoderDojo?
- WHAT sort of atmosphere is there here? (Fun/exciting/relaxing etc)

Q2. HOW do you feel when you're here?

- WHY do you think you feel like that?
- WHAT do you get out of it?

Q3. WHAT sorts of things are you learning to do here?

- Can you explain to me some of the things you do here?

Q4. WHY do you want to learn this/these skills?

- WHY are they important?
- HOW useful do you think what you're learning here is?

Q5. Who chooses what you learn? How much say do you have in what's taught?

Q6. Now I'd like to hear your thoughts on HOW things are taught in CoderDojo.

- Are you split into groups by age or by what you want to learn, or by ability, or something else? Do you think this is a good thing? If so, why/why not?
- Who decides the time spent on learning each thing?
- What is a mentor? What do they do? Can you describe for me HOW the mentors teach you? What sort of role do they have? Who can be a mentor?
- What's it like being a mentor to other kids?
- How does the way mentors teach compare to the way most school teachers teach?
- What do you think of the way things are taught?
- How is the way things are taught here similar or different to the way lessons are taught in school?

Q7. What do you think about the idea of coding being taught in schools?

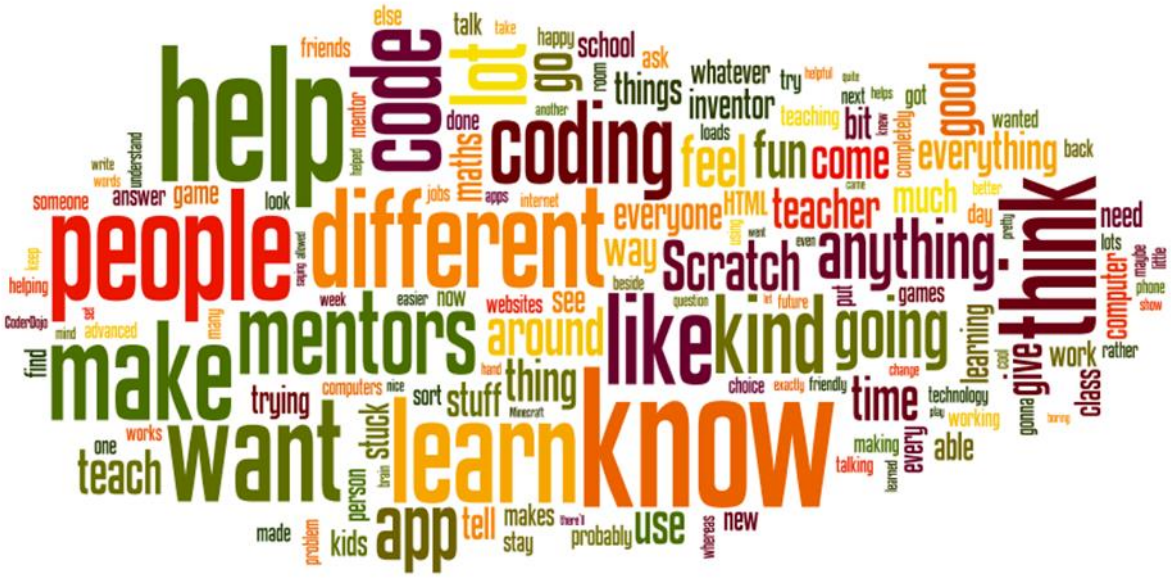
- Would you like to learn coding in school? Why? Why not?

Final Q. Would any of you like to add anything? Have I missed out something important?

Thank you all so much for talking to me and helping me out with my study. If you have any questions you can ask me now, or you can call me on my mobile or email me or my supervisor. I have a sheet here for you with our contact details on it and a little information for yourselves and your parents to read. (Researcher hands out debriefing sheets.)

Researcher then thanks the mentor(s)/parent(s) present during the focus group.

Appendix B: Wordle illustrating frequency, by text size, of words in combined focus group transcripts



Appendix C: Cohen's Kappa calculation

	Theme 1 Enjoyment	Theme 2 Desire to learn	Row Totals
Theme 1 Enjoyment	11 (ef=7.15)	-	11
Theme 2 Desire to learn	2	7 (ef=3.15)	9
Column Totals	13	7	N = 20

$\sum a = 18$

$\sum ef = 7.15 + 3.15 = 10.3$

$$K = \frac{\sum a - \sum ef}{N - \sum ef} = \frac{18 - 10.3}{20 - 10.3} = 0.79$$

D: Code book

Appendix D: Code Book

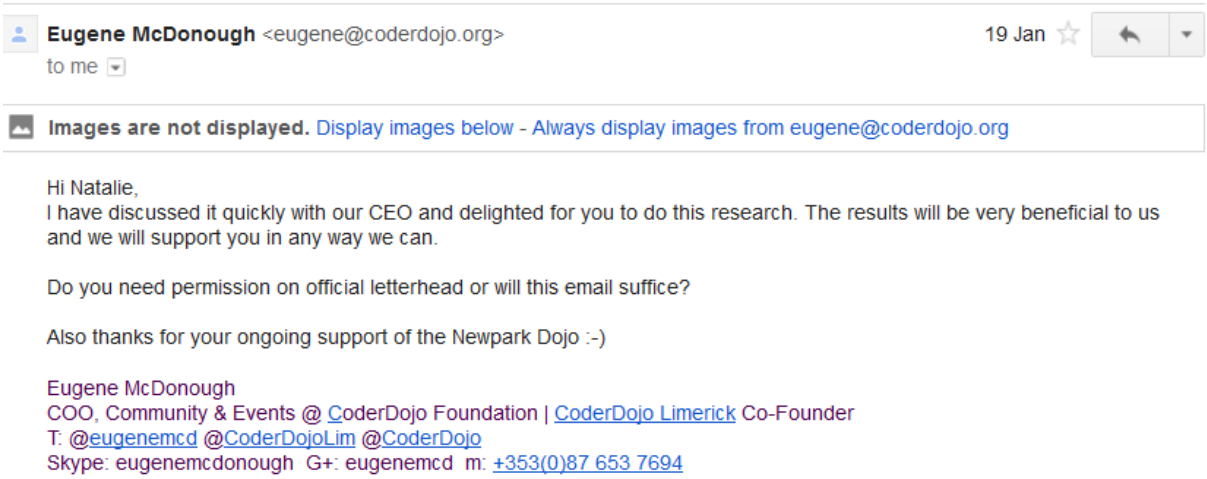
Theme	Code name	Definition	Example quote from transcripts
1: Enjoyment of learning and creating apps, games and websites	CoderDojo is fun	CoderDojo is inherently satisfying	*For me, it's the fun. I can't see me in the future using it, but it's fun*
	Pleasure in learning	Learning is enjoyable	*I love new stuff*
	Pleasure in sharing knowledge	Sharing knowledge is enjoyable	*I really enjoy mentoring… So that's why I come*
	Pleasure in making ideas come to life	Turning an idea into a tangible object is enjoyable	*You kind of learn how to make an idea turn into something you can actually play and look at and marvel over*
	Pleasure in making own games, apps, sites	Making your own digital games, app or website in enjoyable	*I like the feeling of making something yourself – you know that you've made it and it's not just another game. It's really fun and I like doing it*
2: Desire to learn valuable coding skills			
Sub-theme 1: To create games, apps and websites	Learning to code enables game, app and website creation	Learning to code in order to create games, apps and sites	*To learn how to code… so I can make websites and apps and things like that*
	Learning to code enables manipulation of digital artefacts	Learning to code in order to manipulate digital artefacts	*In Scratch, if I saw a game I like that I've played or one that I've bought, I can make an easier version in Scratch that has something that I didn't like about the other game. I can change it*
Sub-theme 2: Desire to meet needs integral to the self	Learning to code enables progress towards a specific career	Learning to code in order to prepare for a specific career	*I want to learn coding. I want to be a games developer*
	Learning to code enables expression of personally important values	Learning to code in order to express something highly important to participant on a personal level	*Websites and apps give you an opportunity to voice your opinion and have it seen by lots of different people… and you can use it to do anything with charities and so that's why I'm big into it. My sister is Down*

			syndrome, and I'm planning on using websites to promote helping people with different disabilities
Sub-theme 3: To prepare for the workplace	Learning to code enables acquisition of skills needed in the workplace	Learning to code in order to gain skills needed in the workplace	*All the jobs will be changing over the next few years and by the time we're old enough to get jobs they'll probably be, like, mostly to do with coding*
Sub-theme 4: To gain an external reward	Learning to code leads to financial reward	Learning to code in order to gain financial reward	*You can make a lot of money, like if you make one good app and you put it on the app store, it can make you millions*
	Learning to code leads to increased standing among peers	Learning to code in order to gain increased standing among peers	*You can make a lot of money, like if you make one good app and you put it on the app store, it can make you millions*
Mediating factor 1: Provision of support	Mentors can give individual students time	Students get a lot of individual help	*You'll have a lot more individual help if you're stuck with something*
	More mentors means more knowledge	Students can draw on large pool of mentor knowledge	*In school you have one teacher, but here we have several mentors to help you. And if one of them doesn't know something, then another one will come along who will most likely know*
	More Mentors means students can work on individual projects	Students can work on individual projects	*A school teacher] is teaching an entire class, whereas this mentor is teaching you and you're doing a completely different thing to everyone*
	Mentor teaching style	Mentors facilitate rather than instruct	*In school you're getting told what you have to do but in CoderDojo the teachers, the mentors, they're not here telling you what to do, they're here helping you with what you want to do*
	Self-directed learning	Students direct own learning	*Teachers tell you how to do it, but here you do it yourself. And then if you get stuck along the way, you get helped*
	Multiple solutions to problems	Students learn multiple methods of problem solving	*In school, the teacher tells you to do it one way, when you know another way, but the mentors tell you like three different ways to do it*
	Student-led pace	Students work at own pace	*You can work at your own speed. You don't have to rush*
	Mentor focus on understanding over memory	Student understanding is more important than memorising	*In school the teacher says, for example, '1+ 1 is 2, you just remember that.' And if someone asks you that question, 'What's 1+1?' you don't*

			know how it works, you just say 2 because you remember it. They [the mentors] actually show you how it works
	Mentors permit talking	Students can talk to each other	*They don't mind if you're talking to the person beside you*
	Peer support	Peer support is encouraged	*Helping each other. In class that's copying. It's a good thing here, helping*
	Peer support before mentor support	Students ask each other for help before asking a mentor	*The idea is that we only help if their friends around them can't help them*
	Peer support aids friendships	Asking for peer help facilitates friendships	*It gets people talking to each other at their table. It helps them be friends and stuff*
	Giving back	Students can give back by teaching peers	*It's like a two-way system… receiving, you can actually give*
	Self esteem	Peer mentoring boosts self esteem	*You feel proud of yourself because you're doing a better thing than just working on something for yourself*
	Two-way learning	Students teach mentors	*You can teach mentors yourself with your own ideas… so then it's sort of reversed*
	Negative experience of peer mentoring	Peer mentoring can be distressing	*It's distressing. You're trying to help them, they're trying to do something else, and you're saying, 'No, no, you're not doing the right thing,' but they keep on going with that*
	Negative experience of being mentored by younger peers	Being mentored by younger peers is not enjoyable	*It makes me feel stupid. It makes me feel stupid*
	CoderDojo atmosphere	Atmosphere is supportive	*The best thing I find about CoderDojo is, all the mentors, the teachers and the people that go here, all the kids, are always really friendly and help you out with everything*
	No timetable	Students do not have to adhere to a time schedule	*In school everything's done on a time, but with CoderDojo you just do your own thing*
Mediating factor 2: Scope for creativity	Expression of creativity	CoderDojo enables students to express their creativity	*We're actually utilising our creativity to make things*
	Creative problem solving	CoderDojo facilitates creative problem-solving	*Your imagination is the limit, whereas in school you have one thing, you've to answer those questions, and you have to answer it correctly – you can't find different ways of doing it as much*
	Stretching creativity	Students are encouraged to stretch	*It sort of tests your creativity and the way that your mind works*

		their imaginations	
Mediating factor 3: Freedom of choice	Voluntary attendance	Students choose to attend	*We're here, we're all turning up because we want to do it*
	Many topics	Students can choose from a wide selection of topics	*You can literally learn anything really that has to do with coding*
	Choice based on personal interest	Students can choose according to their own interests	*You can kind of do anything – it's like a blank canvas. It's really personalised by you because you can do whatever you want then that's coding*
Mediating factor 4: Provision of challenge	Challenge	CoderDojo presents challenging activities	*At the end there'll be a challenge where there'll be no instructions and you have to try and do it yourself. I think that's the best way of working*
	Challenge is enjoyable	Students enjoy being challenged	*I think it's great – especially the challenges, where when you complete it you just feel very excited*
Mediating factor 5: Friendship	Regular meeting place for friends	CoderDojo is a meeting venue for existing friends	*It's another place for you to meet your friends on the weekends. It's like, you can arrange a meeting with your friends, but this is a definite meeting that you know they'll be at*
	Make new friends	CoderDojo is a place to make new friends	*It's really sociable and you make lots of new friends*
	Be understood	CoderDojo students speak the same 'language' of code	*It's fun to meet people who actually know what you're talking about. I like it because people understand what you're talking about here and there's nowhere else where people understand what you're talking about*

E: CoderDojo permission email



Eugene McDonough <eugene@coderdojo.org> 19 Jan

to me

Images are not displayed. Display images below - Always display images from eugene@coderdojo.org

Hi Natalie,
I have discussed it quickly with our CEO and delighted for you to do this research. The results will be very beneficial to us and we will support you in any way we can.

Do you need permission on official letterhead or will this email suffice?

Also thanks for your ongoing support of the Newpark Dojo :-)

Eugene McDonough
COO, Community & Events @ CoderDojo Foundation | CoderDojo Limerick Co-Founder
T: @eugenemcd @CoderDojoLim @CoderDojo
Skype: eugenemcdonough G+: eugenemcd m: +353(0)87 653 7694

N00133668

Journal chosen for publication: Computers in human behavior

http://www.journals.elsevier.com/computers-in-human-behavior/

Impact factor: 2.694. © Thomson Reuters Journal Citation Reports 2015.

Relevance: This is an academic journal that examines the impact of human-computer interaction from a psychological viewpoint, including its effect on behaviour, learning, personality, development, social communication and cognition – in society, in groups and individual people. It is a respected resource for cyberpsychologists and has a creditable impact factor. Article types considered for publication include research reports, as well as literature reviews and theoretical papers.

Readership: Most articles focus on human behaviour, seeing the computer only as the vehicle that influences and enables our behaviour. Thus, readers of this journal tend to be professionals who are interested in the psychology of human computer use but are not necessarily computer experts. Its audience consists largely of psychologists, educational psychologists and cognitive scientists.

Formatting requirements: There are no strict formatting requirements, but all manuscripts must contain essential elements such as Abstract, Introduction, Methods, Results, Discussion and Conclusion. The article should be divided into clearly defined and numbered sub-sections: 1.1, 1.1.1., 1.1.2 and so on. The abstract is not included in the section numbering.

Word count: No minimum or maximum stipulated.