Teaching within the CoderDojo Movement: An Exploration of Mentors' Teaching Practices

Abeer Alsheaibi, Meriel Huggard and Glenn Strong
School of Computer Science and Statistics
Trinity College Dublin
Dublin, Ireland
{alsheaia, Meriel.Huggard, Glenn.Strong}@tcd.ie

Abstract—This work in progress reports on the initial findings of a significant study that aims to explore the evolution of programming teaching practice in non-formal, volunteer-led clubs where young people are learning to code. Working together, the mentors and their students create a non-formal learning environment that differs significantly from traditional classroom settings. The specific coding club environment under consideration is that of the CoderDojo Foundation. The study aims to capture the mentors' teaching practices within the CoderDojo Movement and how this, and other external factors, informs and influences their practice. This paper reports on preliminary analysis of qualitative data gathered through semi-structured interviews with mentors drawn from different programming clubs across the Irish CoderDojo network.

Keywords—Non-formal learning, Teaching practice, Programming, Programming clubs

I. INTRODUCTION

Much attention has been focused on a perceived deficit in young people's technological competences and skills [1] [2] [3], as well as on the challenges that young people face in acquiring those skills [4] [5] [6]. Despite this worldwide interest in developing young peoples' competences and skills in technology, computing education has been largely absent from, or is a relatively recent addition to, the K-12 curriculum [7]; and even where it has been offered there is some criticism of the curriculum choices that have been made [2]. For example, in the authors' home country, Ireland, the National Council for Curriculum and Assessment (NCCA) is currently exploring the introduction of coding at primary level (i.e. kindergarten to sixth grade) but no national policy is yet in place [8]; while formalised teaching of computer science at second level (i.e. seventh to twelfth grade) has only begun in the past two years. Such patterns are replicated worldwide [7].

The very slow pace of the development of initiatives to introduce computer science within the formal school curriculum, contributed to the creation of socially driven initiatives to fill the perceived "gap in the market"; for example, the CoderDojo Movement [9], Girls Who Code [10], and Code Club [11]. This led to a rapid expansion in the numbers of young people who are acquiring programming skills in non-formal learning environments [12] [13] [14].

One notable feature of these clubs is that they often rely on volunteer mentors to help guide participants through both formal and informal learning activities. These mentors are often drawn from the ranks of interested parents, undergraduate students and computing professionals whose qualifications and experience of teaching is limited in scope. Clubs use a wide variety of programming languages; for example, Scratch, Python, Java. While some use Arduinos and Lego Mindstorms in order to provide students with a more physically concrete entry point to the world of computer programming [15] [16] [17].

The CoderDojo Movement was established in Ireland almost a decade ago and participants in the study detailed in this paper were drawn from Irish CoderDojo clubs (known as Dojos). However, there is almost no empirical research on teaching practices within the CoderDojo context. Thus, the learning setting of a Dojo where young people are learning in a non-formal context about computer programming guided by mentors who have no formal training as educators provides a unique and novel environment for a deep exploration of how the teaching practices of mentors evolve to suit the needs of the students (known as Ninjas).

Recent work has focused on the student experience within the CoderDojo learning environment; for example, student motivations for participating in CoderDojo's were been explored in [18], while [19] considered the effect of the learning environment on student emotions. [20] explored the knowledge and understanding that students acquire through participation in CoderDojo. By contrast, there has been little independent research on teaching practices within CoderDojo programming clubs.

This paper presents some preliminary findings on a comprehensive research study that focuses on one specific form of programming club, namely those run under the auspices of the CoderDojo Movement [9]. In particular, it aims to capture the mentors' understanding of teaching within the CoderDojo Movement and how this informs their practice within the non-formal learning environment. This work in progress reports on the motivation for the conduct of this study, the underpinning research questions, the methods being used to answer these questions, and presents some preliminary findings.

The main study that underpins the work presented in this paper will draw on qualitative data including semi-structured interviews with mentors and observational data of how Dojos are realised on the ground. It is anticipated that the outcomes will not only be of interest to all those engaged in mentoring

within the CoderDojo movement but it will also provide informative insights for those seeking to engage young people with computing and programming in both non-formal and formal learning contexts.

II. THE CODERDOJO MOVEMENT

CoderDojo is an international network of volunteer-led, free, independent, community-based computer programming clubs for young people [21]. CoderDojo aims to give young people the opportunity to learn to code in a social and safe environment [9], [22]. In these programming clubs (called Dojos) young people (called Ninjas), between seven and seventeen years of age, learn coding, develop websites, create games, construct mobile applications, and explore technology in a social and innovative environment [9], [22]. The CoderDojo ethos is a set of values and principles that lay the foundations of any Dojo session [9].

The first Dojo was established in Cork, Ireland in 2011. Since then, the movement has expanded enormously, with over 2000 verified Dojos reaching over 60,000 young people in more than 110 countries worldwide by 2018, and it is continuing to grow [23]. The CoderDojo Foundation was founded in 2013 in Dublin, Ireland in order to support existing Dojos and to assist in establishing new ones with resources and community development initiatives. The team working in the CoderDojo Foundation also aims to assist in creating global awareness among young people of technology and the importance of programming [9].

Dojos are usually organised and delivered by volunteer mentors who might be computing professionals, university computing students, teachers or previous Ninjas [21]. According to the CoderDojo Foundation, mentors are *"Volunteers who provide support, guidance, and encouragement to the Ninjas in completing their projects and developing their skills"* [9]. The Foundation emphasises that mentors are different from teachers, as they are encouraged to foster self-directed learning rather than directly delivering solutions to their Ninjas. The ethos of the CoderDojo Movement is reflected in their expectations of the mentors practice; to be specific, mentors are assumed to be committed to encouraging collaboration, peer to peer learning and project-based learning between young people in a social and fun environment [9].

III. RESEARCH QUESTIONS

The main objective of the broader research study underpinning the results presented in this paper is to explore current teaching practices underpinning current mentoring within Dojos in Ireland, and the relationship between these and the CoderDojo ethos and the expectations of the CoderDojo foundation. Thus, the research questions guiding the main study are as follows:

1) What teaching practices underpin current mentoring within Dojos in Ireland?
2) To what extent is the CoderDojo ethos reflected within Dojos?

3) To what extent do mentors' teaching practices align with the expectations of the CoderDojo foundation?

This paper does not aim to answer these questions, rather it presents the framework and methodology through which we hope to answer these questions along with the analysis of some of the preliminary data gathered through semi-structured interviews with CoderDojo mentors.

IV. RESEARCH FRAMEWORK AND METHODS

The primary focus of this research is to investigate the teaching practices that underpin current mentoring within Dojos and to explore their relationship with the CoderDojo ethos and the expectations of the CoderDojo Foundation. This research utilises an interpretivist social constructivism framework in order to answer the stated research questions. The epistemological position of social constructivism assumes that *"understanding is gained by an active process of construction rather than by a passive assimilation of information or rote memorization"* [24]. This framework lies in the interpretivist paradigm, which often aims to construct the meaning carried within social contexts by conducting interviews and observing participants.

A qualitative research approach is usually chosen when the aim of a study is to understand a phenomena in its context. Such an approach is rooted in a *"system of concepts, assumptions, expectations, beliefs, and theories that supports and informs the research"* [25]. The key philosophical assumption of qualitative research views reality as being constructed by individuals interacting with their social worlds. Thus, the qualitative method is considered to be an appropriate method for use in this research.

A. Triangulation

Creswell and Miller define triangulation as *"a validity procedure where researchers look for convergence among multiple and different sources of information to form themes or categories in a study"* [26]. The main study utilises three data collection techniques which are: semi-structured interviews with mentors, the observation of mentors' practice and an analysis of the relevant documentation provided to mentors by the CoderDojo movement. In this research the primary data are the semi-structured interviews and observations while the data collected through the reviewing of existing documents are secondary data. This paper reports on a preliminary analysis of data gathered through semi-structured interviews; in future work this will be triangulated with data gathered from the secondary data sources.

B. Semi-structured Interviews

The research interview has been defined by Kvale and Brinkmann as *"an interchange of views between two persons conversing about a theme of mutual interest"* [27]. Creswell also suggests that the interview is an evolving conversation between two persons talking about common themes of interest [28]. A semi-structured interview is a form of the interview which Kvale and Brinkmann defined as having the purpose

of obtaining descriptions of the experience of the interviewee in order to interpret the meaning of the described phenomena [27]. In this type of interview, the researcher usually has a list of themes and questions and asks the participant to respond to these specific open-ended questions [29].

Thus, to gain in-depth insights into the participants' teaching practices when mentoring in Dojos, a group of mentors from different Dojos around Ireland have been interviewed. Each mentor was interviewed on two occasions and each interview focused on different themes related to their mentoring practice like their planning for the sessions, their mentoring strategies, and parents' influence on the learning process etc. (see Table I).

TABLE I
SAMPLE OF SOME OF THE INTERVIEW QUESTIONS

Background	Tell me a little bit about yourself. What was your motivation to become a mentor?
Mentoring Practice	Describe to me a regular Dojo class from start to end.
Session Planning	Do you usually plan your class ahead? What outcomes do you expect of your teaching?
Mentoring strategies	Any strategies to ensure the active participation of all ninjas in your Dojo? Any strategies to ensure the social development of your ninjas?
CoderDojo Movement	What do you think it means to be a CoderDojo mentor? What do you think are the characteristics of a good CoderDojo mentor?
Parents/guardians	What influence parents/guardians have on the learning process? How is their involvement in the learning process

To recruit participants for the interviews, an invitation was published on the CoderDojo community webpage, CoderDojo newsletters, and on different social media platforms (Facebook, Twitter, and Slack) asking mentors to voluntarily participate in this research. Dates and times of the interviews was scheduled based on the participant and researcher availability. Prior to conducting the interviews, the study was approved by the ethics committee at the authors' home institution.

C. Observation

Participant observation is a method where the researcher takes part in some field activities and/or events to learn about what people can articulate and tacit aspects of their life and their culture [30]. The aim of carrying out observations is to get insights into what is actually happening in the field. In this research, participants' observations involved the researcher attending Dojos while a session is taking place and keeping contemporaneous notes of what is happening on the ground. While observational data is not reported on in this paper, it forms a part of the main study and will be used in future work for triangulation with the semi-structured interview data.

V. PRELIMINARY DATA ANALYSIS

Thematic analysis is an independent qualitative descriptive approach that is *"a method for identifying, analysing and reporting patterns (themes) within data"* [31]. According to Guest et al. [32], thematic analysis is the most commonly used method of analysis in qualitative research analysis. The thematic analysis identifies common threads and allows for an extended interview or set of interviews [33]. Given the

chosen data collection methods and since interviews are the main source of data in this research, thematic analysis was chosen. Data analysis was done in line with Braun and Clarke's [31] six step approach to thematic analysis (see Fig. 1).
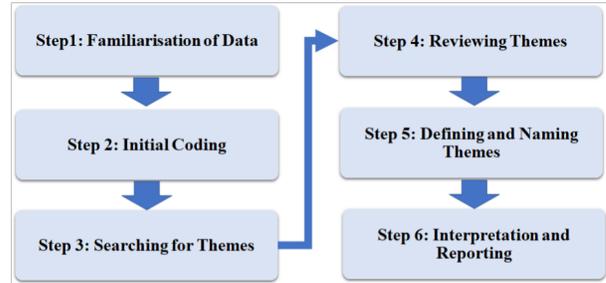

Fig. 1. Thematic Analysis Six-step Approach. Adapted from [31]

VI. PRELIMINARY FINDINGS

In this section we present some key preliminary findings that emerged from the analysis of the semi-structured interview data. In this preliminary study N=11 mentors from eight different Dojos around Ireland were interviewed on two different occasions. The gender balance was Male=5 and Female=6. The participants were drawn from a wide different educational backgrounds (see Fig. 2). Nine participants were computing professionals, six of whom were also parents of participants attending the same Dojo, and two undergraduate students registered in computing related disciplines.
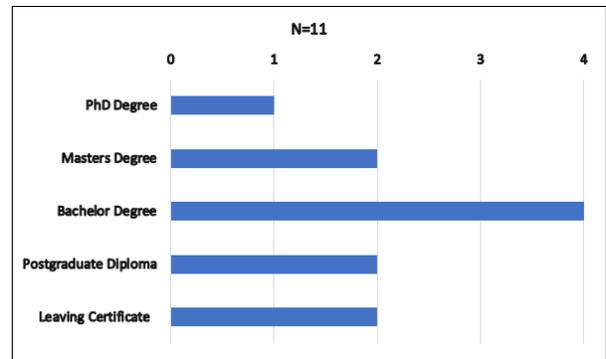

Fig. 2. Participants' Level of Educational Attainment

Four key, over-arching themes emerged from the thematic analysis of the interview data:

A. Self-led learning

This was an emerging theme among all participants. According to the CoderDojo handbook, mentors should get involved only if the attendees can't solve a problem by using a search engine or by asking their peers. All mentors view self-lead learning as an important skill for ninjas to develop, as evidenced by the quotations given below. It should be noted that these quotations are drawn from three different mentors.

"Free session is something I'm trying to get more of this year which is kind of to say 'Ok, this week I'm not

going to show you anything, it's just make something yourself and I'll help you do it.'"

"What we wanted was people that have kids that can learn to learn, that they are able to talk, and present, and grow, and be confident about what (they)'re doing."

"For me personally, I teach them this stuff, but I generally want to tell them 'Oh, you don't need me to do this, I'm here to help you and after I'm gone you can build on it yourself'."

It is interesting to note that many of the mentors expressed a desire to promote self-directed learning, but they acknowledge that it is something they aspire to rather than achieve within their Dojo.

B. Project-based learning

According to CoderDojo Foundation *"Learning through project work is a different approach to following a curriculum. Ninjas are guided to learn the basics and then encouraged to work on their own projects."* [9]. When describing pre-class planning, most participants adopt a project-based learning approach as a fundamental part of their classes:

"I have some tricks about that in my pockets and touch points along the way to the end result usually just enables them to come up with a project which is interesting to them. The goal of that perspective is that it's going to lead to a project where they can go and do something in which they are confident and proud about it. Like it's their voice that's been heard."

The following quotes refers to Sushi cards, which are double-sided laminated cards that are used within CoderDojos to communicate programming concepts.

"So we kind of just let them work on their own, so they either pick (a) kind of a project off their heads so they just started making something and you support them and give them ideas, or sometimes they use like the sushi cards and we recommend the sushi cards to the people who kind of are there for the first time."

"We have the basics like boat race, brain game, the sushi cards that we always kind of do with the beginners, but that's kind of evolved with the older kids and we let them choose their projects and explore what they want to do themselves."

The quotations above are drawn from three different mentors who participated in the study.

C. Creative learning environment

Almost all participants show a desire to create a creative learning environment for ninjas attending their Dojos:

"What we try to do is we mix technology with arts and crafts. So you kind of take the current things in paper

and say something attached to that, so all we're trying to do is avoid being dry on the subject."

"If I can capture the child's imagination, that's really where I want to be."

"Now what they would like to do is when we had a project we would always kind of point out where they could tweak it and play with it you know, just something a little bit different so that everyone was kind of keen on trying that as you do this and then they get different results."

D. Lack of collaboration

It should be noted that many mentors expressed views on collaboration amongst ninjas that do not align with those of CoderDojo ethos; to be specific, while encouraging collaboration is essential element of the CoderDojo ethos most mentors did not actively promote collaboration among young people in their classes and indicated that the participants often resisted attempts to encourage collaboration:

"We very rarely have a group project."

"Ninjas mostly prefer to work on their own."

"I do think collaboration is something that we could do better on."

The four key themes reported on above were common across almost all those interviewed. As part of the main study being undertaken, further interview data is being collected and analysis is ongoing process. It is anticipated that further themes will emerge during the course of the main study when the whole six step approach to thematic analysis is completed and triangulation is carried out with the secondary data sources described above.

VII. CONCLUSION AND FUTURE WORK

This paper sets out the qualitative approach that is being adopted in order to provide a rich descriptive insight into the teaching practices mentors employ in working in Dojos. It also aims to explore their relationship with the CoderDojo movement ethos and with the expectations of the CoderDojo Foundation. This paper has outlined the theoretical framework and methods that will be used to answer these research questions. This main study is continuing and more interview data is being gathered and analysed. This will then be triangulated with the observational and with secondary data that is being gathered. Preliminary analysis of the semi-structured interview data showed four key emerging themes: self-led learning, project-based learning, creative learning environment, and lack of collaboration. It was interesting to note that for many mentors self-led and collaborative learning were often viewed as aspirational goals for the learning environments they seek to create.

REFERENCES

[1] A. Balanskat and K. Engelhardt, "Computing our future: Computer programming and coding - priorities, school curricula and initiatives across europe," http://www.eun.org/documents/411753/817341/Computing+our+future_final_2015.pdf, October 2015.

[2] N. Bresnihan, R. Millwood, E. Oldham, G. Strong, and D. Wilson, "A critique of the current trend to implement computing in schools," *Pedagogika*, vol. 65, no. 3, pp. 292–300, 2015.

[3] CS for All, https://www.csforall.org/, Accessed: 2020-05-01.

[4] R. Vivian, K. Falkner, and C. Szabo, "Can Everybody Learn to Code? Computer Science Community Perceptions about Learning the Fundamentals of Programming," in *Proceedings of the 14th Koli Calling International Conference on Computing Education Research*, ser. Koli Calling '14. New York, NY, USA: Association for Computing Machinery, 2014, p. 41–50. [Online]. Available: https://doi.org/10.1145/2674683.2674695

[5] J. A. Bellanca, *21st century skills: Rethinking how students learn*. Solution Tree Press, 2010.

[6] M. Huggard, "Programming trauma: can it be avoided," *Proceedings of the BCS Grand Challenges in Computing: Education*, pp. 50–51, 2004.

[7] K. Falkner, S. Sentance, R. Vivian, S. Barksdale, L. Busuttil, E. Cole, C. Liebe, F. Maiorana, M. M. McGill, and K. Quille, "An international comparison of k-12 computer science education intended and enacted curricula," in *Proceedings of the 19th Koli Calling International Conference on Computing Education Research*, ser. Koli Calling '19. New York, NY, USA: Association for Computing Machinery, 2019. [Online]. Available: https://doi.org/10.1145/3364510.3364517

[8] National Council for Curriculum and Assessment (Ireland), "Coding in Primary Schools," https://ncca.ie/en/primary/primary-developments/coding-in-primary-schools, Accessed: 2020-05-01.

[9] The CoderDojo Movement, https://coderdojo.com/movement/, Accessed: 2020-05-01.

[10] Girls Who Code, https://girlswhocode.com/, Accessed: 2020-05-01.

[11] C. Club, "Code Club," https://www.codeclubworld.org/, Accessed: 2020-05-01.

[12] A. Begel and A. J. Ko, "Learning outside the classroom," in *The Cambridge Handbook of Computing Education Research*, S. A. Fincher A.V. Robins, Ed. Cambridge University Press, 2019, pp. 749–772.

[13] M. Huggard and C. McGoldrick, "Incentivising students to pursue computer science programmes," in *36th Annual Frontiers In Education Conference (FIE)*, Oct 2006, pp. 3–8.

[14] G. Strong, C. Higgins, N. Bresnihan, and R. Millwood, "A Survey of the Prior Programming Experience of Undergraduate Computing and Engineering Students in Ireland," in *IFIP World Conference on Computers in Education*. Springer, 2017, pp. 473–483.

[15] E. Aivaloglou and F. Hermans, "How is Programming Taught in Code Clubs? Exploring the Experiences and Gender Perceptions of Code Club Teachers," in *Proceedings of the 19th Koli Calling International Conference on Computing Education Research*, ser. Koli Calling '19. New York, NY, USA: Association for Computing Machinery, 2019. [Online]. Available: https://doi.org/10.1145/3364510.3364514

[16] C. M. Goldrick and M. Huggard, "Peer learning with Lego Mindstorms," in *34th Annual Frontiers in Education (FIE)*, Oct 2004, pp. S2F–24–9 Vol. 3.

[17] I. Stamouli, E. Doyle, and M. Huggard, "Establishing structured support for programming students," in *34th Annual Frontiers In Education Conference (FIE), 2004.*, Oct 2004, pp. F2G–5–9 Vol. 2.

[18] N. Butler, C. Flood, and A. Power, "What Motivates a Ninja?: An exploration of students' CoderDojo experience," in *Cyberpsychology and Society*. Routledge, 2018, pp. 47–62.

[19] N. McKelvey and P. Cowan, "Valence at CoderDojos: An Exploration," *Literacy Information and Computer Education Journal*, vol. 8, pp. 2525–2533, 03 2017.

[20] I. Sheridan, D. Goggin, and L. O'Sullivan, "Exploration of Learning Gained through CoderDojo Coding Activities," in *INTED 10th International Technology, Education and Development Conference*, 2016.

[21] A. Alsheaibi, G. Strong, and R. Millwood, "The Need for a Learning Model in Coderdojo Mentoring Practice," in *Proceedings of the 13th Workshop in Primary and Secondary Computing Education*, ser. WiPSCE '18. New York, NY, USA: Association for Computing Machinery, 2018. [Online]. Available: https://doi.org/10.1145/3265757.3265785

[22] N. McKelvey and P. Cowan, "An Investigation into Tenacity Levels at CoderDojos," *International Journal of Innovation in the Digital Economy (IJIDE)*, vol. 8, no. 3, pp. 35–48, 2017.

[23] CoderDojo, "CoderDojo Foundation Report Q4 2018," https://coderdojo.com/2019/04/16/coderdojo-foundation-report-q4-2018/, Accessed: 2020-05-01.

[24] J. G. Greeno, A. M. Collins, L. B. Resnick *et al.*, "Cognition and learning," *Handbook of educational psychology*, vol. 77, pp. 15–46, 1996.

[25] J. A. Maxwell, *Qualitative research design: An interactive approach*. Sage publications, 2012, vol. 41.

[26] J. W. Creswell and D. L. Miller, "Determining validity in qualitative inquiry," *Theory into practice*, vol. 39, no. 3, pp. 124–130, 2000.

[27] S. Kvale and S. Brinkmann, *Interviews: Learning the craft of qualitative research interviewing*. Sage, 2009.

[28] J. W. Creswell and J. D. Creswell, *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications, 2017.

[29] M. Saunders, P. Lewis, and A. Thornhill, "Research methods for business students (sixth edition.)," 2012.

[30] K. Musante and B. R. DeWalt, *Participant observation: A guide for fieldworkers*. Rowman Altamira, 2010.

[31] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative research in psychology*, vol. 3, no. 2, pp. 77–101, 2006.

[32] G. Guest, K. M. MacQueen, and E. E. Namey, *Applied thematic analysis*. Sage Publications, 2011.

[33] L. DeSantis and D. N. Ugarriza, "The concept of theme as used in qualitative nursing research," *Western Journal of Nursing Research*, vol. 22, no. 3, pp. 351–372, 2000.