UNIVERSITY OF LONDON
CENTRE FOR ONLINE & DISTANCE EDUCATION

Teaching and Research Awards Scheme: *Final Report*

Project Title:

Exploring video streaming solutions for tutor-facilitated synchronous social learning sessions in the online environment

Project team:

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Dr Edward Anstead, Lecturer in Computer Science, Goldsmiths University of London.
Chipp Jansen, Post-doctoral research, Textile Circularity Centre, Royal College of Art.

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1. **Activities and achievements: What were the major achievements of the project? In what way(s) was your project innovative?**

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During this project we have developed and deployed a new platform for online synchronous teaching at scale. As part of complying with Data Protection requirements we formed a new legal entity - Handl Education Ltd. This work has resulted in follow up usage by Ada College, University of London - Worldwide and Sussex University. During the project we engaged over 485 students through the platform, 213 of whom participated in real time learning activities and got feedback from 118 students. We developed three prototypes of our platform to test a range of approaches including providing differentiation through multi-stream classes, managing student workflow through automated activities, driving attendance through viral loops.

2. **Were the objectives you set out to achieve met?**

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We started out with three project aims:

1. Iteratively develop, test and evaluate a software platform for tutor-facilitated online synchronous social learning sessions.
2. Enhance online student experience through tutor-facilitated synchronous social learning sessions using video streaming technologies.
3. Establish a metrical framework for evaluating the success with which software enables social learning in online tutor-facilitated synchronous sessions.

Our first objective was arguably achieved. As discussed previously we developed a functional platform and iterated the design to test and evaluate multiple approaches to mitigating issues in synchronous whole class online teaching.

Our student feedback demonstrates that our intervention had a positive effect on our test cohort of students from University of London Online BSc in Computer Science.

As the project progressed it became clear that deriving a metrical framework was not an appropriate target. Instead we focussed our research around experimental work on engagement and logistics of whole class online teaching.

3. **What obstacles have you encountered in your project (particularly those that might be of value to current and future CODE award holders)**

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Testing a new whole class teaching platform with a large student body presented numerous challenges in terms of compliance and risk management, software development and design, and integration with existing systems:

Aside from ethical compliance, legislation such as GDPR and meeting institutional security requirements was extremely challenging. Neither of the principle investigators had prior experience of developing software to these standards and so it was a steep learning curve. A further barrier was that our host institution Goldsmiths deemed that the project to be too high risk to fall under their own responsibility and so this required setting up a new legal entity Handl Education Ltd which could be registered with the ICO and act as a data controller. University of London's ITS has been particularly helpful in providing clear guidance on the set of documentation and policies that needed to be developed. This work also came with significant expense for the running of the company (eg. annual accounts, ICO membership, data protection insurance). There is certainly scope for CODE to provide a better framework for others wishing to perform in the field research with cloud-based platforms in the future. We would be happy to consult on this.

Another challenge was integrating with the Coursera platform. This was necessary to authenticate students from the platform. It was done using an LTI plugin. However, the Coursera platform was not fully compliant with this standard and so it took multiple chains of communication to get this feature working.

Solving serving logistics and selecting appropriate third party tools took considerable time and effort. Various factors had to be taken into account such as unit cost, compliance and location, and ease of integration into the existing codebase. Much of this was a steep learning curve for the researchers.

The software development and design presented numerous challenges itself. Although they were accomplished computer programmers, neither of the researchers had prior experience of developing software to the standards required by the context. Such platforms are normally developed by larger teams. Key considerations were the accessibility and security of the platform.

In terms of experimental design we faced a number of contextual challenges. We did not have the possibility of a control group as we could only work with a single cohort of students who all needed to be given equal opportunity to engage with the experiment. The researchers also needed to facilitate the sessions themselves as the researchers were also convenors for the module. A further challenge was engaging sufficient students to participate in the teaching sessions as synchronous sessions had traditionally had low turnout. This aspect eventually became incorporated into the research.

4. Project results:

a. What educational issues did the project address and which students or other groups benefited from the project?

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Social learning allows learners to form enriching connections with their peers and co-construct knowledge and meaning together (Kytle, 1978). In the contemporary classroom such activity is encouraged and facilitated by the instructor, who monitors peer learning groups making timely interventions where necessary. However, facilitation of social learning in the online context at scale is more challenging. Conventional text-based discussion boards suffer from asynchronicity

and a paucity of connection with peers and instructors. On the other hand synchronous chat platforms such as Slack (2020) present issues in terms of instructor monitoring and intervention. Students report that "Online learning can feel isolating and lonely when it lacks in-person social or human interactions" (Marguire, 2020) and so there is an urgent need to solve these issues.

We worked with a single cohort of students studying on the Introduction to Programming module as part of UoL Online Bsc in Computer Science. This is an open access module which students need to pass in order to continue with their studies on the rest of the degree. As a result it has extremely large cohorts of up to 1000 students in one sitting and a wide diversity of abilities and backgrounds. The course has a median age range of 25-34 with 79% students identifying as male. Location data shows a globally distributed student population with the large groupings in Asia, Europe and North America. 64% of students are full time employed and 26% hold a bachelor's degree or higher. This particular cohort was made up of 785 students. Aside from the researchers a further 8 teaching staff were involved in the course. All of these already worked as online tutors on the module.

b. How has the project built upon current work in the field of online and distance education?

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Our work has built upon existing research in two ways. Firstly, we have tested in-the-field solutions to providing better social learning circumstances and engagement for online learners. Secondly we have evaluated these techniques through analysing user data and collecting feedback from participants.

c. Theoretical background

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The growth of online degrees and more informal courses such as MOOCs improves access for learners from a variety of backgrounds including those in low participation and disadvantaged groups. However, students learning in these contexts suffer from increased social isolation and significantly poorer retention rates than landed education in a campus setting. Online courses have a 10% to 20% lower retention rate than traditional classroom environments (Bawa, 2016), whilst MOOCs had an average retention rate of 3.13% in 2017-2018 (Lederman, 2019). Facilitating the delivery of collaborative learning in this context offers significant benefits for learners and will help online learning better deliver on its promises of widening participation.

Through improving the delivery of social learning by creating Handl, this research has an essential role to play in improving retention rates for students from D & E socioeconomic groups and those who have some form of disability. These segments are more likely to drop out of their courses. Successful social learning experiences through Handl and similar platforms could be instrumental in building student resilience and reducing the feel of isolation, alongside students' social learning opportunities. These approaches have already been shown to improve retention (*Student Resilience: Unite Students Insight Report*, 2016). The academic

advantages of Handl could also benefit those in minority ethnic groups who, in the UK 2015/16, achieved 15.6% fewer 2:1/first class honours than their white counterparts (*Degree Attainment Gaps*, n.d.). Disadvantaged students are also less likely to find employment after graduation and so will benefit from increased confidence and teamwork skills that Handl offers.

Numerous papers problematise social learning within Online and Higher Education. Roberts and McInnerney (2007) summarize numerous issues affecting collaborative work in online environments including group selection, lack of group-work skills, free-riders, unequal student abilities, and assessment. Research by Bakir et al (2020) demonstrates that such issues also affect face to face participants. Hilliard et al (2020) highlight how working with other students online has the potential to cause anxiety for learners, particularly when that work is being assessed.

Further work has shown the applicability and success of utilising machine learning models within platforms such as Handl to facilitate improved outcomes from social learning. For modelling degrees of group collaboration, Chejara et al. (2020) have used features such as log data using traditional machine learning models, whilst Praharaj et al. (2018) have generated collaborative learning analytics through a mixture of audiovisual features and more tabular data. While our initial findings with Handl, facilitated by this grant, don't include exploration of this area. Machine learning approaches suggest a fruitful avenue for future research with the platform.

For relating group formation factors to success, Woolley et al. (2015) looked at group composition and group interaction, finding that high 'group intelligence' results in better performance on complex tasks. Klug and Bagrow (2014) found that diverse groups are more likely to succeed. Saqr et al. (2020) took a social network analysis approach, finding that certain social variables are indicators of if a group is likely to perform well.

For algorithmic group formation, Alberola et al (2016) used Belbin's role theory (Belbin, 2010) to identify role categories and subsequently applied Bayesian learning to estimate the role of each learner within a group. Through maximising the number of roles for a given group they found that they were able to improve cooperation. In a similar fashion Joseph et al. (2017) used learner analytics alongside communication metrics to cluster learners for group formation. The resultant algorithmically generated groups out performed teacher selected ones in terms of learner satisfaction.

d. Results

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We developed a browser-based application for the purposes of instructor-lead synchronous learning with a focus on the increasing opportunities for and engagement with social learning. The resultant design afforded three types of activity: Raised hands, Study groups, and Micro sessions.

Raised hands are initiated by learners and directed at instructors. Learners complete a tweet length description of their query which might be a question, a request for feedback on their work, or a conversation starter that extends beyond the content of the session. The posted hands appear on all learners' activity feeds so that others who find them relevant or interesting can follow them. The instructor responds by video callback which goes to the originator and any followers.

Study groups are for learner to learner activity and can be initiated by learners or instructors. Like the raised hands they have a tweet length subject and appear on the activity stream. Learners can join and leave study groups freely although there are maximum limits for the number of learners in a group at one time. One useful feature is that study groups can be set to replicate themselves as learners join. In this way an instructor can allow learners to self-organise into study groups according to some criteria or preference.

Micro sessions are solely initiated by instructors and directed at larger groups. Like the other activities they have a tweet length description, can be followed and appear on the learner activity feed. Cameras and microphones are switched off by default as the focus here is on conventional instruction. One useful feature is that micro sessions can be set to compulsory, so that when the instructor launches them all learners are brought from their current activity into the call. This is particularly helpful in gathering learners after a period of distributed activity for a plenary session.

Using the tool which we developed we ran a total of six sessions testing three iterations of the app. Out of the 785 students on the course 213 learners actively participated in at least one Handl session. The average attendance for a single session was 55 learners.

The first iteration tested the base application as described above. The session interspersed more passive delivery using microsessions with social learning activities delivered mostly via study groups. The 'Getting to know you' exercise made use of self-replicating study groups to allow learners to split themselves into groups according to their motivations for studying programming, by choosing between titles such as 'I love programming for programming's sake' , 'I just want to make games', 'I'm interested in the intersection between art and technology.' A second exercise 'Dungeon of Zoooom' used the same study groups to present the students with simple collaborative coding task using a 3rd party collaborative coding tool. The third part of the session, 'Sleuth and Game Project Clinic' invited students to use the 'raised hands' feature to ask and follow individual questions about their ongoing assignments. Running alongside this was a series of optional Micro Sessions covering a range of topics at different levels. The parallel nature of the various activities allowed a significant amount of choice for learners meaning that they could self-differentiate according to their needs.

Our second set of sessions focussed more heavily on activities in study groups and less in Micro sessions. For this we introduced a new feature called 'Tasks'. These

combined a pre-programmed todo list with a countdown timer. The aim was to give students a target completion time but also allowed them to check off tasks as and when they completed them for self-paced learning. On the instructor side of the interface 'Tasks' afforded the possibility of pre-programming step by step tasks through an interface and then passively monitoring the study groups as they progressed through each stage.

The third iteration attempted to improve session attendance by creating social media inspired engagement loops. It did this by firstly emailing existing learners who had used the platform and inviting them to select avatars. A few days later learners were asked to choose friends on the platform with suggestions based on previous interactions. Drawing on the resultant social graph. We created student groupings and invited students to a 'pre-session-social' in small study groups before formal session. The aim was that the chance to encounter a few familiar faces within a small group setting would entice students into repeat attendance. Students were then emailed with an invitation which featured the avatars and names of the other students in the group. A further innovation allowed students to post and follow raised hands in advance of the class. These were to be reviewed and approved by module tutors in advance of the session start. For each event students received an email notification with the aim of increasing their commitment to attend the session.

e. Are there any general implications from your project results, which could benefit other programme teams, working in different disciplines?

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In subsequent attempts to spread the use of Handl beyond the scope of this project we have encountered issues with institutional and instructor uptake. It seems that a whole class synchronous approach whilst popular with a sizeable portion of the online cohort might nevertheless be a poor fit for engaging the full cohort. With this in mind we've subsequently been pursuing and testing alternative ideas for creating opportunities for synchronous peer to peer engagement outside of whole class settings.

5. How did you evaluate the project?

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Evaluation has happened through a combination of ascertaining student behaviours through review of application data, post session student surveys which combined qualitative and quantitative feedback, and qualitative feedback from individual instructors.

Following the initial sessions, 56 students filled in the post-session survey, following the second set of sessions 19 filled in the survey, 43 students filled in the survey after the final session.

Regarding the use of study groups, the results were broadly positive. Following the first sessions 52% of students felt that they had learnt by listening and conversing with other students and a further 30% had listened and conversed with others. The 'Getting to know you' exercise had an average rating of 4.18 (SD: 1.0019). It appeared that our approach of affording a small amount of agency in choosing study groups had engendered improved interaction between learners in breakout rooms. This assertion was borne out in individual instructor feedback from after the session. 'Dungeon of Zoooom' received slightly weaker feedback with an average rating of 3.79 (STD: 1.01). One recurrent comment in the qualitative feedback which might account for this disparity is that the coding exercises felt somewhat rushed in relation to the other materials. Interestingly the second session which gave more time to coding exercises within study groups scored slightly lower regarding peer to peer interaction with 46.7% of learners reporting that they had learnt by listening and conversing with other students.

The raised hands featured, explored via the 'Game Project and Sleuth Clinic' in each session also fared less well scoring an average of 3.625 (STD: 1.03). Here there were a large number of neutral scores. This reflects a relatively low level of engagement with this feature. Whilst Handl recorded 135 study group engagements across the first two sessions, there were just 40 engagements for raised hands. This pattern of lower engagement with raised hands has been borne out across all of the sessions. Raised hands was rated the least popular feature with 7.1% of students rating it as their favourite feature in the final survey. Interestingly the feedback on the final set of sessions where learners could submit questions in advance indicated that the feature was rated most strongly by learners out of all of the social media inspired features with a mean rating of 4.04 (std: 1.07).

Despite the mixed response to raised hands. We believe that the combination of raised hands and study groups significantly increased the amount of peer to peer interaction and peer to instructor interaction. For example, in the first survey 73% of students had a small group or 1:1 conversation with a course instructor.

The most popular feature of the platform by far was Micro-sessions. This had the highest number of learner engagements (partially a result of some compulsory sessions), but also the highest rating in the initial learner survey with a rating of 4.55 (std: 0.71). In the final survey 69% selected Micro sessions as their favourite session type. In many ways this is surprising as it's the least innovative feature of the Handl. Once inside a micro-session there is little to distinguish between it and a regular Zoom call. Would students for example have been as enthusiastic about the sessions if Micro sessions were the only feature ? One possibility is that these more passive sessions are necessary points of cohesion for students to then subsequently engage in more self-directed learning.

The social media inspired features did not significantly improve attendance for the final two sessions which had 46 and 53 learners respectively against an average attendance of 55 learners. Nevertheless the response in the survey towards these features was positive. The friends feature scored an average rating of 3.84 (std:

1.13) and the pre-session socials feature scored a rating of 3.67 (std: 1.21) .The implementation of these features was a knowingly naive experiment. It is understood that building up social viral loops takes considerable effort and repeated cycles of engagement.

Overall Handl proved to be popular as a platform with students. After the initial session 60.7% of students said they would attend Handl sessions weekly and 19.6% every two weeks. 85.7% of students said that they preferred Handl sessions to Zoom sessions. There was also plenty of enthusiastic feedback from the students who engaged.

We recognise the limitations of this research. A large degree of the time and effort of the project went into the technical implementation of the platform and meeting compliance requirements. For more robust validation much of this work would need to be repeated with multiple cohorts in a variety of pedagogical settings.

6. How have you disseminated the results of the project throughout University of London Worldwide, the University of London and more widely? Please add all dissemination activities.

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During the development of Handl, Medium blog posts were used to disseminate our findings to the general public in a non-academic format. These can be found here:

https://medium.com/@kimonsatan/launching-handl-9e59c1afc64b
https://medium.com/@kimonsatan/could-viral-marketing-solve-student-absenteeism-93cccf7e598e

Handl regularly disseminates news about its research through its mailing list, linked in and twitter accounts.

The platform has also been trialled at Ada National College for Digital Skills, on the PGCert at Sussex University, and on other modules within the University of London Computer Science BSc. As part of the ongoing research into the commercial viability of a platform such as Handl we have presented our research to senior staff at University of London - Worldwide, University of York, Queen Mary University of London, University of Sunderland, Sussex University, Coursera, Higher Ed Partners, and Goldsmiths.

Beyond this we have presented the platform at Silicon Roundabout Ventures who awarded us a scholarship to participate in the Founder Institute Accelerator programme and UCL Ed Tech Labs.

We will also be presenting our work at the forthcoming RIDE conference.

7. A non-technical summary (this represents a brief overview of the project that will also be used on the CODE website and Centre publications for dissemination of the project outcomes.

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Social learning is well-established as beneficial within pedagogical literature. However, issues around fairness, coordination, scalability, and group efficacy hinder its incorporation into adult education both in online and physical settings.

Handl was our response to this situation. It evolved through experimentation and iteration with Goldsmiths Computing students during the pandemic into a browser-based platform which combines video-conferencing and social network mechanics to create dynamic multi-stream sessions. In these, instructors are able to move fluidly between different streams of activity, whilst learners self-organise according to their interests and needs.

Between April and September 2021 we trialled our platform with a cohort of 785 students on an introductory module for University of London's online BSc Computer Science. Over 6 sessions we experimented with a range of features including multi-stream sessions, topic based selection for breakout rooms, structured and automated collaborative assignments, video callbacks for questions, and using social-media inspired features to create viral loops.

8. Support from CODE.

a. Comments on the usefulness of contacts within CODE

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We are grateful for CODE and particularly support in connecting us with partners for testing at Sussex University.

b. How might the Centre further support award holders?

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The technical challenges of developing prototype software for research with students were significant. This burden was a drain on resources and distracted somewhat from other aspects of the research. We're not sure how often research like ours occurs but significant gains could be made through pooling expertise in this area via CODE. We would be happy to work with CODE in the future towards this aim.

9. A signature and declaration section (the report must be signed by all principal researchers, and by the relevant department head and/or administrative authority at the award-holding institution).

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Dr Edward Anstead

Head/Deputy Head of Department
Dr Golnaz Badkobeh

Acknowledgement:

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Appendices

Post session survey results:
Survey 1:
https://docs.google.com/document/d/1-lel1npvMyGmqoWdboNnKgI_bQW0RxWhUwZ8nH-lM0c/edit?usp=sharing

Survey 2:

https://docs.google.com/document/d/1KrNz2a2Fv-jPbvvMRMeqvgVoDBllbGh0_zKmt4z7PLg/edit?usp=sharing

Survey 3:
https://docs.google.com/document/d/12h9QMz4QXC-zGtWo4VXV3JAAdfd9WFVoIM3nUDfZGtI/edit?usp=sharing

Teaching plans:
Session 1: https://docs.google.com/document/d/1WgXOgBWQaFGA7cYro9LLvCYnykQdkPtl2otS-MhZS8w/edit?usp=sharing

Session 2:
https://docs.google.com/document/d/1yYgD8kH-d-eZ3qW7tMJuC7oiyPdNrIGZvtpnoN_eJ1U/edit?usp=sharing

Session 3:
https://docs.google.com/document/d/1Ad5z2TV_HTjrDqSh9W2XYtL9iTyzQDSTIQNZ_sU2qo0/edit?usp=sharing

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Promoting collaboration and knowledge-sharing in distance education, the Centre for Online and Distance Education (CODE) is a University of London Worldwide initiative to support the development of expertise in this field at University of London College level. The CODE supports a community of practice and provides a focus for the development of high-quality teaching and research in distance education throughout the federal University.

See http://www.cde.london.ac.uk/ for further information.

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