Article

Communities of Practice as Systems: The Case of TEALEAF

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Abstract:

This work provides an update to the Erasmus Plus TEALEAF project The outcomes of a week-long EU-funded / Irish Government-recognized teacher course in July 2016 is described within the context of a qualitative small scale study investigating teachers' progress in the course. The explicit aim of the teacher course was to equip a diverse group of teachers with the initial tools to work to produce simple digital apps for learning about biodiversity in their respective domains. A community of practice seeks to establish a new concept of the pre-existing generalised collective conscience through triangulated conversation between the generalised and particularised collective and individual consciences. In particular to revise the generalised collective conscience that teachers can program apps for learning about biodiversity. A number of features of teaching and learning were selected in general and their relationship to constructivism delineated. The teachers were prompted for their responses to each day of the course through a self evaluation tool and the responses were ranked according the the rubric. The data was analyzed using multidimensional scaling - ASCAL procedure - in SPSS 23™ and within the repertory grid domain according to the RepSocio tool in Rep 5™. The plots show a gradual development throughout the week in terms of specific features becoming 'stronger' or exerting more influence towards the middle of the course and fragmenting after that. Analyses were able to show which participants correlated most closely with the hypothetical IDEAL within the community of practice. Concerning this community of practice, the interrelationships within the community are determined using a social mapping exercise moving from the individual consciences to a particularised collective conscience.

Keywords: communities of learning; systems; apps; teacher education; TEALEAF

1. Introduction

This work provides an update to the Erasmus Plus TEALEAF project which in turn is a continuation of that part of the SOPHIA project which specifically addressed serious games in learning about ecology [1-3]. The outcomes of a

week-long EU-funded / Irish Government-recognized teacher course in July 2016 is described within the context of a qualitative small scale study investigating teachers' progress in the course.   The teacher course cemented the careful development of a community of practice [4] among sub-groups of teachers from five countries from different domains of education.   The explicit aim of the teacher course was to equip a diverse group of teachers with the initial tools to work to produce simple digital apps for learning about biodiversity in their respective domains. The picture was complicated further by the fact that almost all of the participants were not 'digital natives'[5], and some were self-confessed 'digital avoiders'.   The everyday perception is that teachers might facilitate coding or app development in a passive supervisory role, but that they would be ill-equipped to produce an app themselves, this is substantiated by the preliminary background research which suggested at least a deficit in confidence to do so [6].   Thus this project is couched within the wider question of the role of the teacher within a constructivist model of learning with technology [7]. The term 'constructivist' is value-laden; and as one of the cornerstones of radical constructivism is skepticism of the match between knowledge and an external objective reality, it becomes difficult therefore to think coherently of a single type or definition of constructivist learning environment [8].   The starting point of the SOPHIA project was the notion that a constructivist teacher is one who wishes to constantly improve their practice and who seeks to involve the students in the construction of knowledge aided *inter alia* by meaningful dialogue. In the TEALEAF project, an apparent 'squaring-the-circle' was advanced, whereby the project was tasked with the mission of teaching and evaluating something that they had little confidence in and rather than 'do a course' to remediate any perceived deficit, teachers were encouraged to 'grow together' into a shared space with national sub-spaces. Such spaces are akin to 'communities of learning' which follows the principles of knowledge management within the community of practice which in paraphrased form are:

- *an evolving design* whereby the participants could provide input that would be incorporated;
- *open dialogue* between participants and organizers;
- *different levels of participation* respecting real world commitments;
- *community spaces* at the local - home - and wider levels - international;
- *a focus on values* which goes beyond procedural knowledge;
- *combining familiarity and new experiences* so as not to fatigue nor overwhelm participants;
- *creating a rhythm* that helps participants know where they stand.

Module 1. Directly teaching teachers the fundamentals of biodiversity.

Module 2. Evaluating existing computer apps for learning about biodiversity: trialling in the classroom.

Module 3. Review of biodiversity content, direct instruction in Scratch™ and Stencyl™, game design.

Module 4. Evaluating new designed computer apps for learning about biodiversity: trialling in the classroom.

The TEALEAF project sought to determine whether teachers thought to improve their practice through taking on a new way of teaching and learning. In our previous work, we found that for some, a more traditional-type lesson could stimulate a constructivist approach in some, whereas a novel, ICT-based lesson might stimulate the opposite response in others. The ability to reflect critically was very variable and the idea that the teacher could be constructivist as opposed to a technician delivering a constructivist lesson was not clear cut. Constructivism is thought by many teachers to be a methodology only, and equated with 'active learning' or a 'hands-on approach'.

Shulman's classic work [9] on pedagogical content knowledge, PCK, has been adapted by [10] and [11], the former who describes technological PCK - TPCK; and the latter who specifically address information and communications technology, ICT-based PCK, i.e., ICT-TPCK.

In this work, complexity is made explicit - having been assumed to be implicit - in the community of teachers participating in the project. Would the complexity advance or diminish as the community developed and adapted to the tasks given to them? In a sense, the project modelled the creation of an adaptive system within an 'artificial' community through bringing together teachers of different nationalities, cultures, values, school level, socio-economic background, and language ability. Allied with these background variables there were the tasks presented to the groups or 'families' within the 'community'. The tasks - development of apps appropriate to a specific targetted age of child and focussed in the area of biodiversity were seen as a two-pronged intellectual challenge since, anecdotally, teachers with a biodiversity background tended not to be au fait with coding apps whilst those who were proficient in app development neither knew nor understood much about biodiversity. There were those who both knew little or nothing about biodiversity nor app development. Add to this how to teach some

point about biodiversity to children and develop an app in order to do so, and to some the task ahead seemed insurmountable. Thus, we see that there were pedagogical content knowledge limitations comprising content knowledge deficits; pedagogical practice lacunae, and how to employ technology in order to address the same lack in children's constructed experience.

The research question for the project overall is to determine whether a community of practice can be established to produce apps to further understanding of biodiversity. The baseline research demonstrated that the two attributes of 'biodiversity' and 'app development' appeared to be mutually exclusive domains. Thus the project needed to forge ahead with a way to disrupt this systemic barrier.

The research question for this part of the project was whether in establishing a community of practice brought about an opportunity to stabilise the system in flux as a result of the perturbation visited upon the community by the difficult task given to it.

2. Method

Teachers of five different nationalities[1] from different domains of education hold particularised collective consciences in conversation with the individual conscience of each participant in the project. A community of practice seeks to establish a new concept of the pre-existing generalised collective conscience through triangulated conversation between the generalised and particularised collective and individual consciences. In particular to revise the generalised collective conscience that teachers can program apps for learning about biodiversity. How this was achieved was by the making explicit of the conversations between consciences using a reflective evaluation instrument which recorded daily reflections of the participants in terms of the systematic development as participants in the community of learning. The responses to the reflective evaluation instrument were codified by applying integers to answers which signified a psychological strength within a conceptual space. The integers were then arranged in a matrix which was then subjected to principal components analysis producing components which are plotted in Cartesian planes.

The self-evaluation questions which were presented to each participant on each of the five days of the course were as follows.

1. What new knowledge did I encounter today?
2. What new skills were encouraged today?
3. What did I find difficult today, and how would I address that?

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[1]Czech Republic, Ireland, France, Slovenia, Spain

4. How will I change my practice based on what I learned today?
5. How does what I learned today change my understanding or attitude towards teaching biodiversity?

A rubric needed to be developed in order to rank responses. In previous work [12], the responses were mapped against three main criteria based on the quality of the reflection carried out by the teacher based on the theory that a constructivist teacher would be someone who is constantly checking the new experience against their constructed value system.

1. 'reflection for action'; i.e., the participant reflects on what has taken place, and some action is considered for the future, even if it is to return to the status quo - rank of 3.

2. 'reflection-on-action'; i.e., the participant reflects on what is taking place and some change is considered - rank of 2.

3. 'reflection-in-action'; i.e., the participant reflects on what is taking place and expresses some view that they adapted to the teaching experience as it unfolded - rank of 1.

In this work, a slightly different approach is taken, whereby rather than focussing on a single attribute of the constructivist paradigm, a number of features of teaching and learning were selected in general and their relationship to constructivism delineated, and this is represented in Table 1.

Table 1. Generalised rubric summarizing the detailed version in the Appendix

Features of T&L	least constructivist rank of 1	transitional rank of 2	most constructivist rank of 3
1. New Knowledge	factual	theoretical	integrative
2. New Skills	skill = knowing	lower order	higher order
3. New Difficulty	completion	general background	theoretical / model
4. Change in Practice	nothing	adopt some ideas	integrate new ideas
5. Attitudinal Change	closed	opening	reflective

Clearly, an ideal candidate will score 3 on all five dimensions, therefore we can construct a theoretical ideal; however, given that we assume that the participants of the summer course were less than ideal at the start of the week, and it is hoped that they would move towards the ideal as the week progressed, it would be meaningless to enter the ideal in each day of the week - one entry overall will suffice and this will involve a rank of 3 in all five features.

The teachers were prompted for their responses to each day of the course through a self evaluation tool and the responses were ranked according the rubric in Table 1. The data was analyzed using multidimensional scaling - ASCAL procedure - in SPSS 23™ and within the repertory grid domain according to the RepSocio tool in Rep 5™ [13]. Also included was the hypothetical 'IDEAL' based on previous work in using such a construct [14] which in this case was constructed by assuming low ranks for day 1 and building up to 3 on day 3. Following this, a problem arises; should one naturally expect a teacher on a course to remain at this level of rank since all novelty is encountered by the middle of the course and thereafter, consolidation is paramount, thus the ranks drop again?

5. Results and Discussion

Figure 1. symbolises the conceptual distance between teachers based on the various input parameters, however it still is best for mapping the individual consciences as they become explicit. Only by becoming explicit can they be addressed. With the particular form of the hypothetical construct 'IDEAL' - MM, MH and PJ begin the week closest to the IDEAL. All three do move away, with MM and PJ following the same tradjectory towards quadrant 3. MH, however, moves in a different direction; thus the divergence from the IDEAL is based on a differing conception of the course. It was also notable that MMC remained within the same quadrant not moving from their original conception, and we might therefore conclude that little impact was made on MMC. Although MM, MH and PJ began by diverging from each other and the IDEAL, this picture changed and there was a movement to the ideal later in the week.
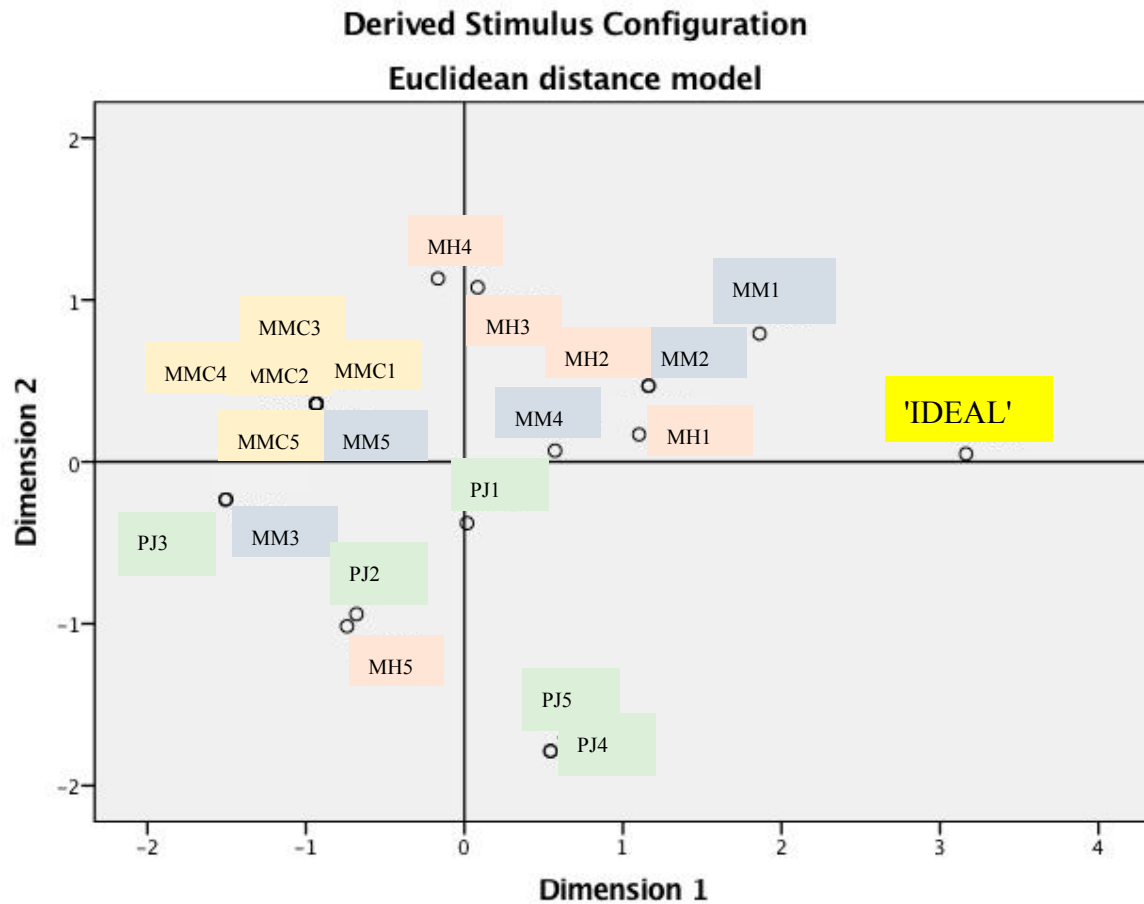
Figure 1. Derived stimulus configuration employing an Euclidean distance model calculating two dimensions. Stress = 0.1099;   RSQ = 0.95326 .   The letters codify the participants: MM, MMC, MH, PJ.   The numbers 1 - 5 denote the day of the course.

However, concerning a community of practice, one might seek to determine the interrelationships within the community, so some type of social mapping exercise would be necessary, thus we move from the individual consciences to a particularised collective conscience. The tool chosen for this was the RepSocio protocol within the Rep 5 program, Figure 2.   According to Figure 2, the strongest link or connection between persons within the community of practice is taken to be denoted by the score on the line between persons, and once again the IDEAL construct plays a role.   The strongest links are between PJ and MMC, and between MM and MH, next PJ and MM , and then MMC and MM, followed by PJ and MH. To some degree, the IDEAL is an outlier drawing links from only two people, and then only at the 75% level, thus there is a nested structure to this 'system'.
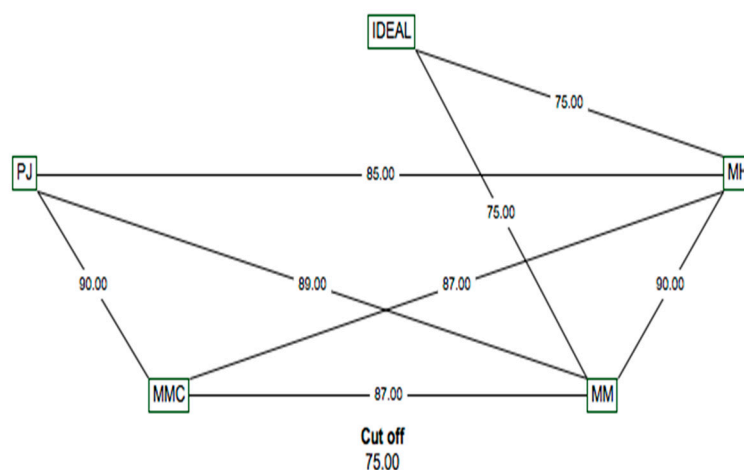
Figure 2. Socionet drawn by Rep 5 'RepSocio' tool. It is drawn at the 75% overall similarity, and linkages at or higher than 75% are drawn.

5. Conclusions

It has to be recognised that conceiving of an IDEAL construct raises almost as many problems as it tries to alleviate. When the methods outlined in this work are extrapolated to the wider cohort of participants a better picture will emerge as to where the scores should be following the middle of the course. MDS is an important method since all the data points are included in the calculation so that the IDEAL is not merely a point dropped into the plot, and therefore the dimensions calculated actually do reflect a total interactivity within the community of learning. What is required now is to continue this work to investigate how the whole cohort operated to calibrate the IDEAL. The work presented here does provide a snapshot of the complexity of the sub-system whereas the Repertory Grid method provides a snapshot of the complexity - described as 'orderliness' - of the individual's thinking which when entered into the Socionet protocol, such as in Figure 2, a picture of the complexity of the sub-system is also presented, such as the relationships between individuals, who stands out as the common link, or partial outlier.

It might be construed that given the small number in this study, the state of the community might be obvious from a cursory observation, however, it is proposed that this would in future be a 'realtime' assessment of where the participants are within the community of practice. It might also be said that knowing how teachers will act is somewhat moot since teachers' perceptions cannot be controlled. Notwithstanding the actual manipulation of teachers' perceptions, a researcher practitioner can adapt their course to suit participants if one knows ahead of time what the state of play is. Ideally, each day of interaction with teachers would be assessed and the following day adapted in response to teachers' remarks. In this way the community of practice in this work can be viewed as a system since it adheres to a common set of rules which brings about the structuralisations whether as role constructs as individuals or clusters.

Whereas groups of teachers may appear to move, adapt or develop within a given system, and fluctuations in complexity occur, the net level of complexity appears to remain constant. Adaptation within the overall system is non-linear and based on the 'procession' of the Irish teachers to the IDEAL. The teachers appear to approach the IDEAL in the first days of the course but then move away because the criteria assume a linearity, however the analyses can detect fluctuations within the system which point to adaptation, and typically, they are not predictable. The instrument needs to be adapted to allow for dampening effects resulting from perceptions of difficulty peaking and diminishing, and the task requiring less novel information to proceed.

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