

SOCIAL LEARNING AND PROJECT-BASED LEARNING AT UNIVERSITY

COMPLEXITY AND NONLINEAR-APPROACHES TO COGNITIVE DIVERSITY AND DIVERSE LEVELS OF PHYSICS LEARNERS

Manuel A. B. Bache^{a,b}

Presenting Author: Manuel A.B. Bache (mbejarano@us.es)

^aDepartment of Biomechanics, "Fco. Maldonado" University College, University of Sevilla, Osuna, Sevilla,41640, Spain

^bHUM-962, University of Sevilla, Sevilla, 41013, Spain

KEYWORDS: PALS, Physics Curricula, Cellular Automata Learning, Complexity and Non Linear-Approaches in Education, Diversity in Higher Education

Since Piaget's proposals about cognitive learning and constructivism (Piaget, 1976), active methodologies were proposed (Johnson et al., 1984) with two main trends appearing: participative systems in learning and education (Moench, 1986), and cooperative structures (Johnson et al., 1984; Kagan, 1989). At the time, a counteractive theory of motivation appeared, emerging an organismic theory called Theory of Autodetermination (TAD), which proposed that students and learners strive for self-regulated learning and self-determination in their goals and learning-process (Deci & Ryan, 1985).

Currently, active methodologies and teamwork are frequently used in science education (de Los Rios et al., 2010; Jo, 2011; Lipson et al., 2007; Torio, 2019), as well as cooperative learning (Lipson et al., 2007; Torio, 2019). However, in this case, our context was a highly diverse classroom, in cognitive styles, and also in levels of prior knowledge in the subject-matter, with some students on the spectrum of high functioning neurodiversity (Grandin, & Duffy, 2008). 67 students participated in a participatory-action-research (PAR), where the teacher was a conductor towards task-oriented, self-regulated and cooperative-collaborative PALS (peer-assisted) learning.

Social learning and cooperative learning was mainly implemented for practical-technical classes, and for the completion of a project-based learning (PBL) long term project (full-term), but it was also subsequently implemented into theory classes, forming a complex system consisting of two systems, one multi-nodal of small groups PBL and Kagan's structures, and one one-node complex system. Being a mixed system, the outcomes were expected to be nonlinear enriched learning, and a wider scope of application of the information, which was mainly generated by the students, with the teacher as a lecturer (at first), becoming *a leader* for a while; and a challenger and a promoter finally (and all the time for some students). The behavior of the system(s) was interesting from a qualitative point of view. But the outcomes exceeded the expectations.

REFERENCES

- de Los Rios, I., Cazorla, A., Díaz-Puente, J. M., & Yagüe, J. L. (2010). Project-based learning in engineering higher education: two decades of teaching competences in real environments. *Procedia-Social and Behavioral Sciences*, 2(2), 1368-1378.
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior*. New York: Plenum Press.
- Grandin, T., & Duffy, K. (2008). *Developing talents: Careers for individuals with Asperger syndrome and high-functioning autism*, AAPC Publishing, Shawnee Mission, Kansas.
- Jo, I. H. (2011). Effects of role division, interaction, and shared mental model on team performance in project-based learning environment. *Asia Pacific Education Review*, 12(2), 301-310.
- Johnson, D., Johnson, R., Holubec, E., & Roy, P. (1984). *Circles of Learning*, ASCD, Washington, DC.
- Kagan, S. (1989). The structural approach to cooperative learning. *Educational Leadership*, 47(4), 12-15.
- Lipson, A., Epstein, A. W., Bras, R., & Hodges, K. (2007). Students' perceptions of Terrascope, a project-based freshman learning community. *Journal of Science Education and Technology*, 16(4), 349-364.
- Moench, T. T. (1986). The Participative Learning System. *Journal of College Science Teaching*, 15(5), 437-439.
- Piaget, J. (1976). Piaget's Theory. In: Inhelder, B., Chipman, H.H. and Zwingmann, C., Eds., *Piaget and His School*, Springer Study Edition, Springer, Berlin, Heidelberg.
- Torio, H. (2019). Teaching as coaching: Experiences with a video-based flipped classroom combined with project-based approach in technology and physics higher education. *Journal of Technology and Science Education*, 9(3), 404-419.

Proceedings of the IUPAP International Conference on Physics Education, ICPE 2022 5-9 December 2022, page 54, ISBN: 978-1-74210-532-1.