

ANALYSIS OF ACTIVITY AT STATISTICAL LITERACY: CONTRIBUTIONS OF THE ACTIVITY THEORY

Aida Carvalho Vita¹, Eurivalda Santana¹, Irene Cazorla¹ and Silvana Oliveira²

¹State University of Santa Cruz, Brazil

²State School Eduardo Catalão, Ilhéus, Bahia, Brazil

aida_vita@hotmail.com

This paper analyzes the actions, whilst activities concern Statistical Literacy were applied. The analysis was based on the Activity Theory using the Engeström's complex model of an activity system. It was considered teaching as activity system and it was carried through the activity "Vitruvian Man". This activity took place in a Virtual Environment Supported by Statistical Literacy-AVALE and involved 34 teachers. By using the Engeström's model, we characterized subject, community, objects, tools, rules and division of labor all together. We also investigated the classroom interactions and tensions, characterizing the microanalysis Subjects' actions had been observed, filmed and audio-recorded. The analysis pointed out that activity contributes to develop: subject's criticizes dimension, the scientific discovery, and social practices.

INTRODUCTION

The formalization of the teaching of Probability and Statistics in Basic Education (Campos, Silva & Cazorla, 2008) made it possible to work on the school's subjects in both the interdisciplinary and transdisciplinary forms, surpassing the barriers of the disciplines and the school's walls, thereby adding to the teaching and learning aspects of ethics, esthetics and so on.

This is possible because instruments of Statistics ease the process of scientific research, especially those areas where we work with empirical evidence, where the formulation of hypotheses must be confronted with sample data to assess its plausibility.

However, there are few materials that assist teachers in their task of teaching statistics. In this context, a group of statistics educators in Brazil is developing the project "Virtual Environment to Support Statistical Literacy-AVALE" which aims to provide activities to teach in the Basic Education Statistics. The project is funded by the Foundation for Research of the State of Bahia-FAPESB. This paper shows the validation process of the activity "The Vitruvian Man", in the AVALE, based on the Engeström's complex model System of Activity, implemented by teachers.

REFERENCE RESEARCH

The model of Engeström (2002) sees teaching as a System of learning Activity oriented by the intentional actions of those who teach therefore we use it in our analysis. The activities were designed to apply the interaction among individuals mediated by the concept's statistics, negotiating meanings and collectively aiming to solve the problems posed.

According to the author, participatory learning in communities of practice is effective when participants have ample access to different parts of the activity; in other words, it occurs when there are horizontal interactions between participants and when the technologies and structures of communities of practice are transparent. In this case six internal mechanisms are available for inspection by the learner. To investigate the multiple relations of construction and renegotiation between the subjects Engeström (1987) introduced the model described in Figure 1.

The elements present in the Engeström model are defined as follows: The *subject* is the individual or *group* whose action is chosen as the point of view in the analysis; the *object* refers to the raw material or problem space in which the activity is directed and which is molded and transformed into the result with the help of physical and symbolic, internal and/or external *instruments* of mediation including tools and signs; the *community* comprises multiple individuals and/or subgroups who share the same general goal and which are constructed separate from other communities; the *rules* are the regulations, standards and conventions (explicit and implicit) that limit actions and interactions within the activity system; the *division of labor* refers to both the horizontal division of tasks between the members of the community and the vertical division of power and status. According to Engeström (1987), contradictions or tensions that constantly renew

themselves arise from all productive human activity by the struggle between individual actions and the general activity of the system.

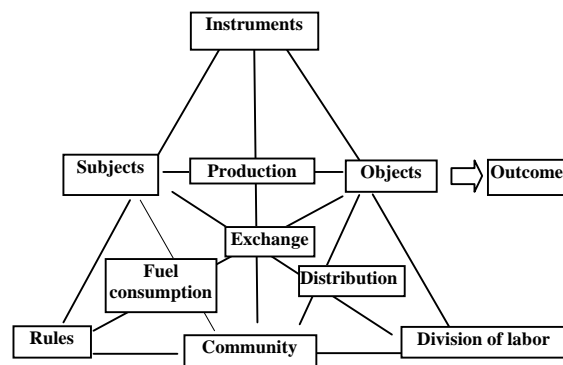


Figure 1. Complex model of activity

METHOLOGICAL PROCEEDINGS

The activity “Vitruvian Man” was created from the perspective of Statistical Literacy, designed to prepare teachers and students for the exercise of citizenship and the development of the scientific spirit. Starting the relationships between different parts of the body, postulated by Leonardo Da Vinci, the activity questions the validity of such relationships and suggests taking data to check its plausibility. The activity provides the use contextualized of measures of central tendency, dispersion and correlation, the dotplot, scatter plot, box plot, allowing an interdisciplinary approach.

The activity was conducted by three researchers of the AVALE and had four observers at two sessions of four hours each class, one in the physical-experimental environment and the other in the virtual environment. 34 teachers in Math and Science for Basic Education, who were on a course of specialization, participated on the project. All teachers had attended at least one discipline of Statistics in their undergraduate courses; however, they were not offered any statistic discipline in their specialization courses. Furthermore, some teachers were teaching statistics topics in their basic schools.

The activity was implemented in a learning environment characterized as an environment that allows the development of contexts: critical, of discovery and social practice. Those contexts, according to Engeström (2002) present cognitive, social and motivational forces that are different among them:

The context of criticism emphasizes the power to resist, challenge, contradict and debate. The context of discovery emphasizes the power of experience, modeling, symbolization and generalization. The context of social practice emphasizes the power of social relevance and applicability of knowledge, community involvement and guided practice. (p. 193)

Featuring the system according to the Engeström model, it was used as instruments all the teaching tools, necessary teaching methods and strategic schemes. The community was formed by the group of teachers and researches, presenting or not cooperative links; the division of labor was produced by the power of decision in each task; the rules regulated the use of time and how to evaluate the results. The Figure 2 presents one of the analyses of the teachers’ action using this model.

For this article we select and discuss some moments of the actions of teachers which reveal the constituents of a learning environment.

ANALYSIS OF RESULTS

The teachers, in the physical-experimental environment, discussed in groups various measures of the human body and the relationships postulated in the activity. They formulated hypotheses and among them stated that the height could not be the same as the length of a man’s outspread arms. Subsequently they chose variables and relationships between them and to confront

their hypothesis they took measurements of their own bodies. The measurements of height and the length of a man’s outspread arms were relatively easy because the researchers had set a tape on the wall. However, measurement of the width of the shoulders presented much difficulty and inaccuracies because they were made by several teachers, until one teacher took on the responsibility to make the measurement affirming that she was a tailor. The group at that moment agreed that it would provide more accurate results for the measurements. Thus, the actions of the subjects were forming a learning space, a context of social practice in which individual participation was effective, allowing for expression of personal characteristics and enhancement of interactions among them.

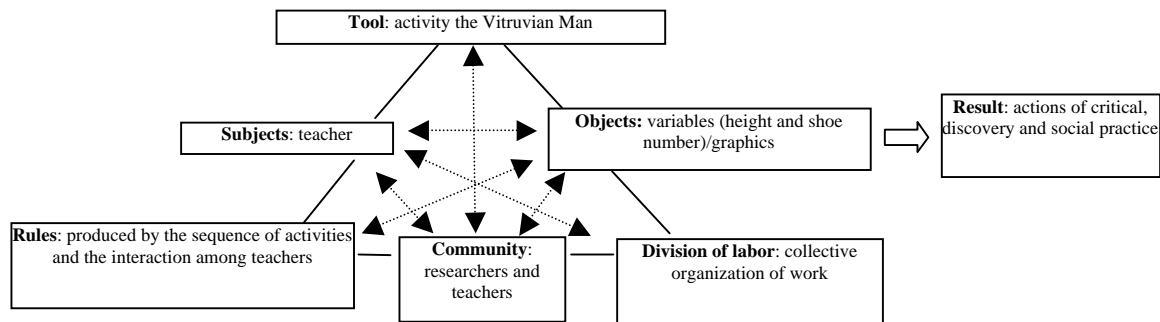


Figure 2. Activity system the “Vitruvian Man”: actions of teachers

Initially the measurements were recorded in a table on a large paper and fixed on the wall. Following the teachers should organize their heights graphically (continuous variable) and shoe size (discrete variable) using their bodies. However, there were many difficulties as there was no command, no explicit rules, such as: removing or not the shoe; from highest to lowest how the people with the same measures would be presented. Several attempts of organization were made. One teacher volunteered, holding the colleagues’ arms one by one, lining them up from smallest to tallest against one of the classrooms wall trying to form a “human dotplot”. However, they didn’t fit against the wall so they formed rows of five in five inches tall, forming a “human histogram”. Thus, they orally described the set of data from the bimodal configuration, since in general the women were shorter and the men taller, with some exceptions. This action indicates a context of discovery due to the transformation of the object (measures) in creating a mathematical model (graphics).

For the shoe size, inspired by the previous activity, the teachers organized themselves quickly creating another “dotplot human”, which was simpler because it is a discrete variable that takes a few values. Decision-making led to infer the presence of a context of criticism and, therefore, a learning environment. On the learning environment the teachers demonstrated control of their actions previously disorganized and hectic; and in practice they found an alternative way to perform the work. They demonstrated the creation of an action mobilized and motivated to the discovery of a principle of solving problems. And above all, they showed the ability to transfer the model to similar problems.

Next in groups, the teachers should draw the “human” graphs on graph paper, which didn’t present difficulties, including using different colors for each gender. These graphs allowed to observe the presence of bimodal configuration, as well as the need to analyze data by gender, as both the average and median were not the measures that best represented this data set.

The groups also should choose one hypothesis relating two variables and with the data demonstrate its validity or not. The teachers used the scatter plot, bars, points or histograms isolates, all of them calculated some measure of central tendency (mean, median and mode), a few them used measures of dispersion (total range and standard deviation) and none of them used measure of correlation. Some groups have calculated the ratio between the two measures and have relied on low variability of the results to validate their hypotheses.

From the results, some teachers have revised their hypotheses on noticing that the average height tends to be comparable with the average length of their outspread’s arms. This step allowed the teachers to work on concepts from statistical measurements. Also the free choice of the groups

members and their organization in the space of the room allowed for exchange of information among them. They discussed the difference between social conventions and instruments, for example, the number of shoes and foot size. Graphical representations of data were developed from the organization of work in a collective perspective and the groups exchanged information between them and the researchers.

Analyzing the discussions held among three teachers of a group on the construction of the graphs showed that the difficulties lied on the selection of the scales, on the appointment of axes and the choice of the chart depending on the nature of the variables. In this episode we see the presence of the context of social practice, organization of collective action and participation jointly developed, despite tensions and constant rules changing among the three teachers.

The validation of the learning was held in a collective form when all the groups presented their results and defended their hypothesis. The participants' actions signaled the presence of a context of social practice, contemplating the effective participation of everyone involved, the exchange of learning and the socialization of graphic presentations. Other than that, we highlight the interaction between the groups. According to Engeström learners need to have the opportunity to critically and systematically analyze their practical activity and its internal findings and be given the opportunity to develop and implement a practical alternative route, a new model to make work.

In the virtual computing environment the participants handled the measures in different types of graphs, comparing them with graphs produced in the classroom. Moment of approximation, contextual discussion and analysis were also present in that step. The perception of concepts of value such as minimum and maximum, as well as fashion and distinction by gender were immediate.

However, this environment encouraged less interaction between the participants, since their attention was focused specifically on information contained in the virtual environment. We observed a lower instance of learning in the context of social practice and greater intensity of the context of critic and discovery. The teachers were very motivated to use the virtual environment, and even gave their opinions about changes on some graphics appearance.

FINAL CONSIDERATIONS

This activity, unlike traditional education, involved several challenges, forced the subject to act intentionally in pursuit of learning, signaled the change of object and finally the creation of a model or general problem-solving. These actions marked the context of discovery.

These results indicated that the activity provided a zone of proximal development for the class as a whole, in which personal knowledge can be built through shared activities between the researchers and the participants. A collective organization of work arose naturally, in which tasks were distributed without prior planning but emerged naturally from skills and abilities of those involved.

The analysis carried out from observations on the inter-relationships established between individuals and the community, the negotiations of rules, the division of labor, the respect for each other's opinion and the emergence of leadership provided by the developed activity signaled learning in context of social practice, criticism and discovery.

Finally, the proposed activities helped the individuals to achieve potential development of their personalities. They discovered the reasons for their actions, made analysis in search for solutions, transformed and understood situations in all aspects, which inspired the emergence of creativity.

REFERENCES

- Campos, T. M. M, Silva, C. B. Da, & Cazorla, I. M. (2008). *Statistical Literacy in Brazil in High and Middle School: An Analysis of Official Documents*. In C. Batanero, G. Burrill, C. Reading & A. Rossman (Eds.), *Proceedings of the ICMI Study 18 and IASE 2008 Round Table Conference*. Monterrey, México, 2008.
- Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Helsinki: Orienta- Konsultit.
- Engeström, Y. (2002). Non scolae sed vitae discimus. Como superar a encapsulação da aprendizagem escolar. In H. Daniels (Org). *Uma introdução a Vygotsky*. São Paulo: Loyola.