A Qualitative Method to Analyze Collaborative Patterns of Virtual Groups

Consuelo García

Universidad Internacional de la Rioja, (UNIR University), Avda. de la Paz, 137. 26002, Logroño (La Rioja), Spain

Keywords: Collaboration, Qualitative Method, Virtual Groups, Knowledge Construction.

Abstract: This study aims to describe a qualitative method to analyze different patterns of organization that students show during their interaction in a virtual group. Literature review has shown that collaborative patterns have a relationship with knowledge construction. This method involves the analysis of the messages exchanged within the virtual group and the application of five indicators that help to identify these patterns: equality of contributions, distribution of responsibilities, reciprocity, revision of the final report and degree of consensus. Our results show that the procedure is useful for analyzing and identifying how virtual groups are organized. Likewise, as previous studies, three main collaborative patterns were detected: aggregation, integration and addition. Practical implications of these results point out the relevance of guiding the groups not only throughout the task but also in relation to the organizational decisions.

1 INTRODUCTION

For several years, information and communication technologies have caused a remarkable transformation in traditional university institutions, prompting many organizations to increasingly use instructional designs based on the interconnection of students, given the ease of collaboration from different time zones and in distributed locations (Putnam, 2001). As a consequence, the use of collaborative learning activities in virtual learning environments has grown, since group tasks provide a natural space for processes of a certain cognitive demand such as conflict resolution, argumentation or inquiry in community.

When students have to work out a complex task, such as solving a case or developing a group project, they need to organize the task development as a team. Students exchange messages concerning the task (conceptual contents) and others related to the procedures necessary to develop it (non-conceptual participations). Students need to agree on processes, times, milestones and dates, as well as how to do the work, such as breaking it down into parts or working it out together. Several studies have shown that an important part of communication among group members in a virtual group focuses on planning, coordinating and supervising the joint work (Arvaja,

Salovaara, Häkkinen & Järvelä, 2007; Hara, Bonk & Angeli, 2000; Van der Meijden &Veerman, 2005; Veldhuis-Diermanse, 2002). Even more Liu and Tsai (2006) showed on their study of small virtual groups collaborating on a programming task, that the greater frequency of interactions among members corresponded to questions and suggestions on how to coordinate the work effectively and not on the content of the task itself. For this reason, several researchers (Kanselaar, Erkens, Prangsma, & Jaspers, 2002) consider that the analysis of students' participation in a virtual group that develops a common product should be carried out at two levels: in relation to the content of the task and in relation to the socio-organizational level or collaborative pattern.

Besides, Thomas and McGregor (2005) conducted a study among university students on a project-based learning activity in a virtual learning environment. They found that the groups of students who participated in a rich dialogue, with a high degree of exchange of ideas, soon began with the task, were consistent with the frequency in which they sent their messages and were good organizers and coordinators of the task within the virtual environment. On the other hand, the students who were late collaborators and showed an erratic and inconsistent behaviour in the publication of their messages were as well not effective in organizing

and carrying out their task.

Collaborative patterns of virtual groups are one of the elements of their interaction and influence their group outcomes. It is therefore important to propose methods that allow practitioners to identify how each group organizes and to provide guidelines meanwhile. This study contributes to provide educators with elements to identify the way in which virtual groups organize and share knowledge. Considering that previous research show that knowledge construction requires active commitment and high participation by its members, early detection of the type of collaborative pattern that a group uses can help educators reorient students in their shared learning process.

2 PATTERNS OF GROUP COLLABORATION

Previous researches have identified different patterns of group collaboration. Basically the distinction is made between a lower or higher degree of co-participation shown by group members. In one end there is the individualistic way, which implies that students work on their own and after they share their ideas in the group. And in the opposite end there is the collaborative mode, which would reflect a joint elaboration of the task.

A first proposal comes from the analysis carried out by Paulus (2005). He made a distinction between cooperative or collaborative organizational structures in virtual groups. In cooperation, the task is distributed and carried out independently and then combined and added to the efforts in a final product, while in collaboration, the members undertake a mutual commitment to clarify concepts and build the final product through a process of dialogue and negotiation (Rose, 2002). Paulus (2005) distinguished between conceptual and non-conceptual functional moves (logistic, social and technical) to establish differences between cooperation and collaboration.

In other research carried out by Engel and Onrubia (2010), they found three types of organizational structures of virtual groups to develop a collaborative report: (1) "jigsaw coordination", a cut-and-paste type, in which each member of the group contributed with a different part and the final document was a juxtaposition of these parts and a person was responsible for the final outcomes; (2) "star coordination", in which students decided that everyone completed the entire activity individually,

and then produced the joint product, and finally (3) "chain coordination", where one group member presented a document that constituted an initial task proposal and the other members of the group contributed successively to this document, proposing and justifying modifications or discussing whether they were in agreement with what had been previously written. The proposal of these three patterns was based on the analysis of interactions specifically associated with the organization of the task by the students: "The organizational segments basically involve the decision made by students on how to carry out the task that occupies them at all times. The focus of these segments is, therefore, the planning and management of the joint work, and in particular the coordination of the actions of the different members of the group" (Engel & Onrubia, 2010, p. 520)

Some of these collaborative patterns presented significant relationships to the phases of collaborative knowledge construction of Gunawardena et al., (1997), although they observed that not only a certain type of pattern allowed to reach a certain phase of knowledge construction, but that these could be achieved by groups of students with different collaborative patterns.

Finally, Ng (2008) analyzed the postings of the members of virtual groups that carried out a collaborative task, in this case of a semi-structured nature. This author found three types of collaborative organizational patterns: (1) based on the active collaboration of all team members, like everybody reading each other's postings, with one member facilitating the interaction; (2) centred on the leader of the group, in which one of the members contributed the main content and the rest accepted it and made suggestions, and (3) lack-of-coherence collaboration, showing contributions separately from each member of the group.

Based on this theoretical framework, the present study seeks to facilitate a qualitative method to provide insight into different collaborative patterns that virtual groups develop to achieve their common goal.

3 METHOD

3.1 Context

The research was carried out within the framework of a professional master's degree from the Graduate University Institute. This is a Higher Education centre in Spain that delivers online graduate

education in Social Sciences, Media and Education. The study was done in the Masters degree on Technologies applied to Education, aimed at teachers and education professionals.

The main aim of the study was to apply a qualitative method in order to identify collaborative patterns that virtual groups develop to achieve their common goal and compare our results with those of previous researchers.

3.2 Participants

Forty students participated in the study. They had previous experience as teachers (between 3 to 15 years). Twenty-seven participants were female and thirteen were male, located in different parts of Spain and Latin America. Average age was 40. The study was done during course two about integrating ICT strategies in schools. They were allocated randomly at the beginning of the course in groups of four people. They worked collaboratively to develop a report on how to integrate ICT in schools following a structure facilitated by their instructor.

They could access contents developed by experts in html in the virtual learning environment and access Internet whenever they needed it. Participants exchanged messages and files during four weeks by means of a restricted forum. At the end of the four weeks, their report was evaluated and got a mark.

3.3 Data Collection

Messages and files exchanged by the groups that participated in the study were collected at the end of the educational period from the various asynchronous forums. A total of 1,161 messages were collected from 10 groups.

The complete message was used as unit of analysis. Rienties' et al., (2009) method was applied to the analysis of messages. The message was considered a unit unless coders considered that a message consisted of several elements. So, the message was then divided when two or more coders thought that a message consisted of multiple elements.

3.4 Data Analysis

The messages were analyzed considering categories that respond to the patterns mentioned in the literature review (table 1): equal contribution to the task, distribution of responsibilities, reciprocity, review of final report, degree of consensus (Engel, 2008). Besides, three qualitative values for each one

of the categories were applied: high, average and low.

Table 1: Categories of analysis.

Equal contribution to the task	Degree of contributions of participants to the whole task, to a single part or to different pieces of the report; being low if the task was done separately and high if it was done together.
Distribution of responsibilities	Degree of responsibility of members concerning the final outcome, being low if a member was responsible for a part and only one, and high, if they all were responsible for all parts of the report.
Reciprocity	Degree of acceptance of peer proposals. The lower end implies little acceptance and therefore little subsequent modification of the content and the high end implies acceptance and positive valuation, and therefore, integration of the contributions of all members of the group.
Review of the final report	It refers to the degree (high or low) in which the members of the group examine, evaluate and contribute to the final result of the written report.
Consensus	It would be high if almost all the members of the group expressed their agreements and possible disagreements and have reached a consensus, and low if they have provide any opinion or have not reached a common opinion.

Thus, groups with lower levels in almost all categories would have used a collaborative summative pattern, groups with the highest levels an integrative collaborative pattern, and groups with intermediate levels a collaborative aggregation pattern.

Then, we selected the students' participations, previously categorized as related to organization, and we gathered them in the same text file. We analyzed the messages concerning the distribution of work and the assignment of responsibilities. Secondly, we analyzed messages about the development of the work, the degree of reciprocity of the contributions of the members of the group, the

critical acceptance of the proposals by all participants, the degree of review of the final work and the degree of consensus on the final document to be delivered. We gave a value to each group in each category.

The procedure for encoding the data was as follows. First the qualitative scale was translated into a quantitative value: 5 points corresponding to a high rating, 3 to an average value and 1 to a low value.

The units of analysis of each group were then separated according to each of the 5 categories: equal contribution to the task, distribution of responsibilities, reciprocity, review of final report, degree of consensus

Each group was given a score in each category.

Groups that obtained a total score between 5 and 11 points were given the category of summative collaborative pattern, those who obtained a total score of between 12 and 18 points, the category of aggregation collaborative structure and, finally, the groups that obtained a total score of more than 19 points, the category of integration collaborative pattern.

4 RESULTS

The evaluation carried out provided the following results (table 2): two groups (6 and 10) adopted an addition pattern, another five (1, 2, 7, 8 and 9) an aggregation pattern and finally three groups (3, 4 and 5) an integration pattern.

As seen in table 2, this qualitative method helps to identify clearly three collaborative patterns. These patterns move along a continuum that ranges from a more or less homogeneous division of labour with minimal overall supervision (summative or addition pattern), to a democratic contribution model (integration pattern), through an intermediate model where, starting from of a leader's work, the contributions of others are added (aggregation).

Table 2: Collaborative patterns.

Addition	Students decide to distribute the task among all the members and develop the document by joining different pieces prepared independently by each student. The final document is basically a sum of differentiated parts with few revisions and virtually no final feedback or questions between them.
Aggregation	Students approve an initial text (usually provided by one of them), which is added with partial contributions of group members, and they finally make a review of the final document between them, with little feedback.
Integration	Students decide to contribute practically to all the sections of the report and work together in the text with interaction, review and feedback in an integrated manner. Practically all the members provide feedback and the final text collects the revisions of all.

In order to validate the results of the analysis carried out on the students' participations, an inter-judge concordance analysis was applied.

For this, we counted on two external evaluators with experience in higher education and online teaching-learning processes. Judges were provided with 26% of the total messages (discussions of groups 1, 4 and 10) and a template for their categorization. The intraclass correlation coefficient (ICC) was used for the analysis. The ICC between the two evaluators and the researcher was 0.627 in relation to the collaborative pattern of the groups.

The result of the inter-judges analysis is high, which implies that the application of the five mentioned categories of analysis can be used as a qualitative method to analyse collaborative patterns of virtual groups.

5 CONCLUSIONS

The students use different ways to organize and elaborate the task in the group: three groups chose to do the task contributing in an equal way and working together in the text (integration pattern), two elaborated the product adding parts made independently by each member (addition pattern), and five chose to elaborate the task using a first document prepared by one of them and aggregating or progressively modifying the main text with partial contributions (aggregation structure).

The use of five different categories of analysis to assess what type of collaborative pattern each group followed, allowed us to clearly identify the functioning of the groups. Given that the collaborative patterns are related to the degree of interaction, and the shared construction of knowledge, it seems very relevant to be able to

identify how the groups decide to organize their work and elaborate their texts in a virtual learning environment.

The collaborative organizational patterns found in our study follow those organizational coordination strategies in virtual groups found by Engel and Onrubia (2010) in their research on collaborative writing strategies and knowledge construction phases in CSCL environments: "jigsaw", "star" and "chain" coordination patterns.

Our results on how the groups were organized to carry out the written report through the asynchronous forum, are also similar to those found by Ng (2008) about virtual groups that performed semi-structured tasks: a structure based on the active collaboration of all, which is similar to our "Integration Pattern" Another structure based on collaboration focused on a group leader, as our "Aggregation Pattern", and a third structure with a disjointed collaboration, like our "Addition Pattern".

It is evident that our study has certain limitations. On the one hand, the size of the sample prevents us from applying significant statistical analysis. On the other hand, it would be convenient to analyze the relationship between these collaborative patterns and learning results at an individual and group level. It would be interesting to relate patterns with the learning outcomes after a collaborative task in a virtual group: an analysis of relationships between collaborative patterns and learning outcomes, in the sense of knowing if a type of collaborative pattern facilitates a better learning outcomes at the individual level or at the final group outcome. Finally, technology plays a mediating role, so the study should also be done with other applications or collaborative tools, whether asynchronous or synchronous. However, it seems relevant to have a qualitative analysis tool to deepen these issues, since currently this type of educational activity has become popular with the growth of virtual learning programs and the use of collaborative environments and applications.

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