Exploring pre-established performed roles in a networked learning activity: a sociomaterial study case

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Abstract

This paper presents the first part of a wider sociomaterial research, which aims at exploring alternative ways to look at and analyse the learning activity in a university course, which would lead to an understanding of what learning activity emerges from a learning design, and therefore, to the improvement of the own learning design by promoting decisions for informed change and innovation. This study analyses a university undergraduate pre-service teachers course run by a professor and followed by 58 students divided into 8 workgroups. The course includes networked learning activities, where the connections between three basic structures (cooperative work, activity-based learning and pre-established work roles) are cornerstone, therefore: students perform different pre-established roles in a workgroup and develop week tasks related to the topics of the course (ICT for primary schools). The main goal of this paper is to visualise and analyse students' learning activities based on pre-determined roles through VNA and the students' perceptions on the roles, which is one of the three basic structures mentioned before, as well as its comparison with the declared learning design. As methodology for this sociomaterial research, we followed a mixed analysis approach that combines data from the learning design of the course, the documented performance of the different roles during the course (blog posts) presented in the form of networked maps through the technique of visual network analysis, and the students' questionnaire on the perceptions of those roles. As examples of the performed roles, the cases of the Analyst and the Journalist were studied from that threefold data approach, but we reflect on the general aspects of all of them. The results of these analyses show that the students' documented performance of the roles highly corresponds to the learning design, and suggest that there are some operational chains between roles -that would be confirmed by further studies-. The bias of starting from a given previous structure (the learning design and the students' documented performance) should be considered as a limitation for a sociomaterial research like this one, but a first step of a broader analysis; therefore, future studies will explore other perspectives. As conclusions, we stress that the visual network analysis may be a fruitful approach to learning design and learning activity in a more complementary way to other types of traditional analysis.

Keywords

Networked learning, sociomaterial research, learning design, students' roles, visual network analysis (VNA).

Introduction

This paper is a part of a bigger research that is exploring the reality of a university undergraduate course that has been detailed in a previous work (Castañeda, 2019). As Castañeda (2019) explains, learning design of the course is based on three structural elements: work in groups, task-based learning and developmental performing roles, each one of these elements has been specified (from the epistemic and organizational perspective) and has been characterized as crucial in the learning design. The study uses a variety of artefacts created in the learning design process by the teacher, as well as artefacts created by students along the course, and some student's data collected by the teacher during the course or in surveys. The main goal of the study presented in this paper is to visualise and analyse students' learning activities based on pre-determined roles through VNA and the students' perceptions on the roles, which is one of the three basic structures mentioned before, as well as its comparison with the declared learning design.

The broader research within this study is framed aims at looking for a better understanding of networked learning activities from a sociomaterial perspective; this perspective continues the path other authors started

before (Carvalho & Yeoman, 2019; Decuypere & Simons, 2016; Eynon & Salveson, 2018; Gourlay & Oliver, 2016, among others). For this purpose, we are exploring different approaches to the reality of a course, in order to understand diverse perspectives of the same course relationally, and trying out some techniques to analyse, also in a relational way, the information we have about the learning activity and different data collection and analysis processes, as well as to triangulate and analyse them. The main goal is to enrich the process of getting information about how the relationships among the different actants in the learning activity appear, how the learning activities happen and integrate them as information that would be useful in the following design processes, not in a deterministic way, but as a source of learning design taking-decision process' information. However, as highlighted above, in this paper, we will be focused on the comparison among the learning design proposal of a course, and the students declared vision and perception regarding the work roles performed in the course, in order to visualise and analyse students' learning activities based on those pre-determined roles through VNA.

Exploring the sociomaterial character of Networked Learning

One of the challenges of networked learning is to make the connection between situations or contexts a crucial part of the learning activity itself (Dohn, Sime, Cranmer, Ryberg, & de Laat, 2018; Goodyear, 2005) in where the elements that participate in the activity must be understood in a sociomaterial way (de Laat & Dohn, 2019; Gourlay & Oliver, 2016). Nevertheless, to explore what is happening in the entire educational process (learning design and learning activity together) and how it would be understood, changed or improved, it is mandatory to recognize learning as an emergent activity that only emerges when learners perform their activity (Carvalho & Yeoman, 2017; Goodyear & Carvalho, 2016).

Teachers – learning designers and even educationalists – like to think that this learning happened "profiled" by the learning design and seems proved that improving the learning design would impact on the learning activity. Nevertheless, improving aspects in the learning design that clearly impact the learning performing, implies understanding in a complex and relational way, how the learning activity is enacting the elements of the learning design (Yeoman & Carvalho, 2019).

Nevertheless, the learning activity setting in motion is far away of being simple of exploring and understanding; especially if the activity is conceived as a networked learning process and, moreover, is perceived as a sociomaterial process where the analysis of any of the elements in isolation is not sufficient (de Laat & Dohn, 2019; Fenwick, Edwards, & Sawchuk, 2011). Yet, it is also almost impossible to try to understand the entangled reality on its entire way (even when we do not have the possibility to access to the entire reality in a view), so the best option is trying to create a complex representation of the relationships that enact the activity from different perspectives of that reality and try to work with them (Decuypere & Simons, 2016).

For achieving an analysis like this, we considered that some archeological approaches would help us to structure and organize the exploration of the learning activity (Carvalho & Yeoman, 2019). These approaches will not only try to make evident the actants that are included in the activity, but trying to make explicit the relationship between them, and also, some operational chains that are enacted on the learning activity (Hodder, 2012); as a way for illuminating some contacts between the design and the actual activity.

In this study, we argue that Visual Network Analysis (VNA) will be used as a tool for the sociomaterial research, or what is the same, that VNA would make explicit not only people relationships, or relationships expressed by people, but to explore other relationships that would be evident from the people's discourse. As a technique to study the dynamics of networks and their components, Social Network Analysis (SNA) was explored in Wasserman & Faust (1994). SNA has been already used effectively in other studies in the field of educational technology with different kind of data; for example, to study the relationships between scientific communities based on journal citations (e.g., Marín & Zawacki-Richter, 2019) or analysing thematic trends through keywords used in publications (e.g., Bozkurt, Koseoglu & Singh, 2019). Differently to SNA, where the focus is on the structural (social) properties of networks, VNA is rather concerned with the visual characteristics of networks and allows them to be interpreted qualitatively. VNA has been explored and detailed as sociomaterial methodology in the recent work of Decuypere (2019). Therefore, VNA can support us to visualise the relationships between learning design of the course, roles and students' performance (actors) based on the text-mining analysis of students' groups and blog posts during the course.

Research Context

As mentioned above, in this study we are exploring the learning activity that happened in the context of a preservice teacher training course in a Spanish university in order to visualise and analyse students' learning activities based on pre-determined roles through VNA. As Castañeda (2019) describes, the face-to-face course, "Educational Resources and ICT for Primary School", is offered in English for students of the first year during the spring semester and on its version of the course 2018-2019 with a complete organization of 6 ECTS

(European Credit Transfer System) credits, and a student's work estimation of 150 hours. The course is run by one professor (female) along 12 weeks of duration (5 hours per week). No teacher assistants are involved in this course.

The studied course's edition was followed by 58 students, 47 women (81%) and 11 men (19%). Students were between 18 and 39 years old ($\sigma = 2.9$). Students were divided into eight different groups. Two groups consisted of five people, three groups of six people, three of seven members and just one group with nine members. Even they all started with at least six members; some students dropped out in the first two weeks.

From the designing point of view, the course is designed around three big functioning structures that shape the course environment, not only from the social but also from the epistemic point of view:

● Cooperative work
● Activity-based learning
● Pre-established work roles

These structures can help us to analyze different aspects of the learning activity and will also be used as research focuses.

Additionally, in the context of this course, and in order to document the learning process, a variety of artefacts has been collected; those artefacts have been developed during the course and reflect the course work. The majority of them has been developed by students (blogs, websites, pictures, videos, diagrams, and so on, especially related to task, as well as questionnaires for peer-reporting and a final questionnaire about their course's perception), and others have been developed by the teacher (assignment instructions, assessment instructions, among others).

Even all those artefacts are considered part of the learning activity; each one reflects better specific parts of the design structure explained by the teacher. So, the artefacts will be used to analyse the course from three different perspectives that coincide with the three main structures declared by the teacher in the learning design.

As we have previously said, in this paper, we will focus on the analysis of this course from the perspective of the performed roles developed by students during the learning activity.

Performed roles in the learning design

In the studied course, "social and metacognitive groups interaction is based on a dynamic of cooperative work that use pre-established work roles" (Castañeda, 2019: 31). The model of pre-established work roles (Scripted Roles (Dillenbourg, 2002)), aims above all, to put emphasis on the type of tasks and processes that should be implemented in the context of the subject, as well as to try to make explicit the type of competencies that are intended to be developed in each of the proposed tasks so that students know exactly what is intended of them in each case (Strijbos & Weinberger, 2010).

As mentioned before, even if students are working in this course with pre-established working roles, they are aware that, in the informal organisation of the group, roles specific to the organisation of the group will emerge (emerging roles (Strijbos and De Laat, 2010)), although we cannot foresee them, nor do we have sufficient capacity to follow them up.

The roles that have been defined for this course have the main goal of developing the student's transversal competencies defined by the university in which the course is developed, for this specific degree (Castañeda, 2019). For the definition of roles, previous proposals (such as that of De Wever et al. (2010) and Strijbos and De Laat (2010)) coming mainly from the world of Computer-Supported Collaborative Learning (CSCL), as well as the teacher's own experiences in previous courses, are taken into consideration.

Every week, students perform six roles that are designed to be developed individually (with a few exceptions, especially regarding the star figure). Roles are assigned in a discretionary manner by the team members, using the method they consider more appropriate for the assignation but with some restrictions, such as e.g. that the distribution of the roles is valid for a week, the same role can only be performed once, and members must take turns so that all of them perform each role at least once during the course. Every week, each role must upload a post in a groupwork's development portfolio documenting their work.

The six designed roles are: Analyst; Curator-Farmer; Journalist; Translator; Facilitator and Star. The correspondence of each of the roles with the transversal competences that it covers, are shown in figure 1 as they appear in the original configuration.

	Analyst	Curator-Farmer	Journalist	Translator	Facilitator	Star
Be able to express themselves correctly in the disciplinary field of Primary Education.			■			■
Be able to manage information and knowledge in the disciplinary area of Primary Education, including knowing how to use the basic tools in ICT as a user.		■				
Consider ethics and intellectual integrity as essential values of professional practice.	■				■	
Be able to project the knowledge, skills and abilities acquired to promote a society based on the values of freedom, justice, equality and pluralism.	■	■	■	■	■	■
Ability to work in a team and to relate to other people in the same or different professional fields.	■	■	■	■	■	■
Developing skills of initiation to educational research in the disciplinary field of Primary Education.				■		
Understanding of the theoretical and practical foundations: scientific and didactic knowledge of school subjects, of the individual and cultural diversity of students, of the complex interaction between processes and contexts of learning, and of the principles and structures of educational systems.		■		■		
Justifying and managing interpersonal skills: relationships between teachers, students and families based on democratic values of social inclusion and respect for human rights, as basic principles of school coexistence.					■	
That students can transmit information, ideas, problems and solutions to a specialized and non specialized public						■
Students have developed those learning skills necessary to undertake further study with a high degree of autonomy	■					

**Figure 1: Correspondence of performance roles with the general competences of the degree.
(translated from Castañeda 2019: 33)**

Study

Objective

The main goal of the part of this research presented in this paper is to get information to improve the definition of the roles developed by students, as well as to reduce the gap between the design and the actual role performance. In the same way, researchers wanted to propose new strategies that would help students to improve their performance and teachers to understand better the learning activity, using for it different strategies of data analysis and triangulation.

Data collection and analysis

The data used in this paper come from three main sources that have been analysed in different ways, and that will be triangulated in order to get conclusions about this perspective of the learning activity:

Learning Design Document

The learning design of this course has been documented, justified and explained, in a document that introduces most of the elements that have been taken into account in the course. The document includes all the theoretical references that consolidate the teacher's decisions, as well as some crucial information about resources, spaces and instructions for students (Castañeda, 2019).
The main statements included in this documentation related to every aspect of the design have been used to be compared with the actual learning activity that happens.

Blogpost Development Portfolios

All the learning activity development has been documented by students using a blog. On it, each member of the group, depending on their mission and role of each week, has to write a post following the instructions for its specific role, as well as to explain what is happening from its point of view, how, and their reflections.

This portfolio should serve not only to reflect the reflection of the groups, but should also serve as a field notebook to help them make subsequent decisions about each of the parts of that work, the processes they carry out to develop it and, of course, how it could be optimized. In addition, during the course, the importance of some of the elements of the portfolio is stressed as material for future reference; beyond the end of the course itself.

In total, we are analysing 550 blog posts, written by all the students. For the objective of this part of the study, blog posts have been divided by role, so we have six groups of approximately 70 posts each.

Blog posts per each role were analysed via the text-mining functionality and visualised through the construction of maps based on networked data with VOSviewer 1.6.11 (van Eck & Waltman, 2010). The posts related to each role were separated in different text data files and used to create co-occurrence maps, where the items (nodes) are terms used in those posts, and the links represent how often two terms appear together (distance between items). The higher the weight of an item, as connected to the number and strength of its links, the more prominent it appears in the map. Terms in the text data are identified and linked using natural language processing algorithms based on text-mining (van Eck & Waltman, 2019). These text-mining algorithms, which include the identification of noun phrases and the selection of the most relevant noun phrases, lead to a process of identification of clusters of items (van Eck & Waltman, 2010). Clusters may be seen as a topic, which in our case, should be connected to our actors and are represented with different colours. Clusters could include one or more items with strong links among them, although there are no overlappings between clusters in VOSviewer.

In order to create the different networked maps regarding the roles, the set-up of standard procedures were needed to obtain depurated maps that could aid in the identification of the relationships between the learning design of the course (tasks, contents, connections), the roles and the students' performance; for instance, the removal of terms that did not relate to the actors to be identified or the replacement of terms that were mentioned in different ways. The network visualisation is one of the three offered by VOSViewer and was selected for our co-occurrence maps, since it seemed to distinguish better the relationships among the actors in our sociomaterial analysis. That is why we will use networked maps as the term to identify the visualisations that we obtained as follows.

From clusters, we will analyse included nodes, their relationships, size and we will classify the nodes into five main categories: terms related to concept or processes (understanding that sometimes the same term refers to both), formats (for presenting information, slideshow, presentation, blog, word processor, etc.), tools (apps, software or hardware clearly identified by brand or name), spaces (physical or online), people (by its role, name or function).

Final Questionnaire

Once the course was finished, students were asked to participate in a final questionnaire anonymously, they could show their perception and satisfaction with the performance of many aspects of the course.

For this study, we are going to use the questionnaire's items about each role (Scales items from 1 -the lowest- to 10 – the highest): where learners were asked about (1) Level of difficulty in the role's performance, (2) Level of satisfaction, (3) Role's relevance in the group work and finally, (4) The relevance of what they have learnt doing this for their professional future.

Some Results

Even if the analysis has been done for all the six performed roles, and that all those analyses will be reflected in the conclusions of this paper, taking into account the space limitations of this paper, we will include only two of them as example: the Journalist and the Analyst.

Journalist

How is the role designed?

The role Journalist is defined in the course's learning design as the student in charge of writing a weekly chronicle about what has happened in the group during the week and of documenting everything that happens in the group (Johnson, Johnson, & Holubec, 1999; Mackey & Jacobson, 2011), being free to carry out his/her task in the format he/she considers more appropriate. Students are encouraged to 'tell their groups' stories' using the variety of formats provided by ICT. The post is expected to be useful as a group's field journal, allowing them to make decisions about maintaining or modifying their internal work's dynamics. Besides, the journalist has the mission of exploring sites of interests which may be interesting either for the subject development or for the teaching training of the class members. The blog must include, at least, a reference to a website by a class group and another by somebody outside the class, explaining the reasons of choice and leaving a comment in the site that is available for review.

How is the role perceived/performed by students in the learning activity?

Students perceive the journalist as the easiest role of all (5.72/10 points of the level of difficulty, σ = 2.10) with almost 2.5 points of difference with the star that is perceived as the most difficult). Also, the journalist is perceived as relevant in the group-performance (7.36/10 points, σ = 2.14) but one of the less relevant among the roles (the only role considered less relevant than this, is the curator). Despite the fact that the role is perceived as relevant for the future professional performing of the student as a teacher (7.78, σ = 1.84), it is also perceived as the second less relevant of the six roles performed.

In addition, in the journalist's networked map, the 11 found clusters seem coherent with the pre-definition of the role, there are some clusters centred in the "story", the "history" of the group, another that includes "fun" and "process". Moreover, it appears a cluster around "environment" and other around "education" that seem related to the exploration of other web sites. Remarkably, there is a cluster around "problem" that seems evidence of the inclusion of difficulties in the process and how this cluster includes words as "member", "classroom" and "image". Moreover, one of the identified clusters rounded about the role itself -journalist- and includes a remarkable node: "reflection".

The main nodes of the relationships shown on the role visualization would be classified principally as concepts or processes (25 of the 70 identified nodes, that appear 309 times), other nodes refer to specific tools (10 with 144 hits) or formats for presenting information (15 nodes, 204 hits) and 13 nodes mention spaces (virtual or physical) even if they appear on 236 references in the text. Only 7 of the nodes refer to people, even if they appear a lot (209 hits). The only other role that appears on this visualization is the facilitator, regardless, there are other actors that appear but not defined (member, kid, girl).

Figure 1: Journalist's Blogposts Networked Map

Analyst

How is the role designed?

The analyst is the role in charge of conducting the assignment "final reflection" and the weekly evaluation of the group members' performance. The performance evaluation is carried out following a general rubric, which enables analysts to value the contribution of each group member. At the end of each week, each analyst must include that assessment (numerical and qualitative) in an online ad-hoc questionnaire.

This role is inspired by the role of "Analyst" described in some of the works referred to in Strijbos and De Laat (2010) and it is designed as one of the most important roles of the work. Not in vain, the role is in charge of carrying out the reflection of the work, paying attention to the work carried out by all the other roles, looking at what aspects they have approached, thinking about how they have worked and agreeing with their colleagues on a reflection on what they have learnt. Ultimately, he/she is in charge of explaining and agreeing on the process of reflection and metacognition of the team.

In addition to this assignment, following the teacher's description, the analyst is responsible for making the weekly reflection of the team, which should include comments on what they have learnt both on the contents of the subject and the group work, as well as for becoming a teacher. It is the only role that includes on its design, a reminder about the importance of this role in the entire course.

How is the role perceived/performed by students in the learning activity?

Students classify the analyst as the second most difficult role of all the performed roles (7.81/10 points of the level of difficulty, σ = 2.30), as well as the second most relevant in the group-performance (9.17/10 points, σ = 1.28), but also the second most satisfactory (9.37/10 points, σ = 2.06) and the second most applicable in the future teaching professional performing (8.83, σ = 1.55), just below the star.

9 clusters were identified in the network map process. 5 of them focus on the development of the task itself and that makes relationships on instrumental resources and concepts; those clusters are identified around nodes as "video" (surrounded by other instrumental resources and concepts as dropbox, google drive, reflection or communication), "picture", "photo", "app" and "result". The other 4 clusters are related to aspects that focus on the learning reflection: "classroom" (surrounded by other nodes related to the teaching itself as book, fun, learning, methodology, question, among others), "future" (where they connected other nodes as world, change, society, mind or life), "technology" and "education".

Almost half of the 55 nodes showed on the network map would be classified principally as concepts or processes (26 nodes, 446 hits), followed by those nodes related to formats (14 with 211 hits), tools (7 nodes, that appear 98 times), other nodes refer to people or spaces (4 nodes each), even when nodes about people appear 39 times in the posts, and the nodes about spaces 67.

As in other roles, the only other role that appears on this visualization is the star and, for the first time, "children" does not appear as a node, only as "kid", but there is also a node for "pupil".
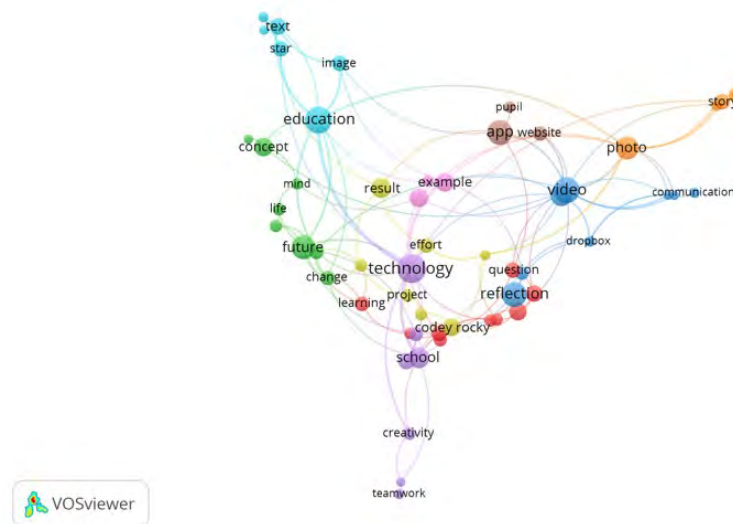
Figure 2: Analyst's Blogposts Networked Map

Limitations

First of all, this analysis suffers from an evident bias: the reality is being analysed starting from a given previous structure, which would be incoherent with the pretending sociomaterial vision; nevertheless, the objective of the research itself (being useful to following designs) would, at least partially, justify this.

Also, it is crucial to remark that we are contrasting the learning design not with the performance itself, but with the declared performance and the perception about the task from students, how they interpret it, and how they want to show their performance to the teacher. Not in vain, this is an assessed assignment. So, as we have previously said, this is just one partial perspective of the learning activity performance.

Conclusions

Being our main goal in this study to visualise and analyse students' learning activities based on pre-determined roles through VNA and the students' perceptions on the roles, we can affirm that the sociomaterial nature of the emergent activity around the roles seems clear in the networked maps, even if the possibility to entirely analyse and understand the sociomaterial nature of the learning activity would not be possible until the entire research within this study is framed will be done. Although we have included in this work only two of the analysis already done, concepts (or process), tools, formats, spaces and people appear on almost every networked map as nodes of relationship, and their relationship in the clusters do not suggest any differentiation among them (e.g., specialized clusters for technologies, people, or so) in the task performance. Nevertheless, some roles

accumulate more nodes related to some categories, for example, facilitator and curator that accumulate more nodes related to tools and information formats, or analyst, journalist, star and translator that accumulate more nodes related to concepts and processes. Therefore, we can affirm that the use of networked maps has helped us to visualize the processes and elements related to each role clearly and to check its coherence with learning design.

The majority of roles' declared performance included the main features described by the teacher in the design, so it suggests that the definition of the roles is very well explained and understood by students. Despite this, this coherence between the declared student's work and the learning design, also implies the bias of the collecting data sources, not in vain we have analysed the declared work, and it is, in fact, directed to achieve the best evaluation from the teacher.

The role Star is perceived as the most important of all and also appears as node in three of the other roles' networked maps. The Translator and the Facilitator are connected to other role's performance. The Analyst, Curator and Journalist are not explicitly included as nodes of relationship in the declared performance of students. Even if those data do not make explicit the perceived relevance, they show us the relationship between roles that are explicitly perceived by students, and at the same time, suggests the importance of making more evident the relationships between them in order to enrich the cohesion between roles. The Translator, Journalist and Facilitator's networked maps show specific clusters dedicated to the explanation of the role's performance, some of them in a very explicit way (journalist and translator have specific nodes with their role's names). Even if those roles are not those that are declared as "more difficult", it seems that their task is more undefined or needs more explanation, at least when they are declaring the performed job.

This is just one part of a necessarily wider exploration of the learning activity that is still being done. There are other perspectives to explore. In this first level of exploration, we will explore at least two more perspectives related to the other big tasks that structure the course work: the week learning activities as well as the workgroup performance. On the other hand, we understand that the use of networked maps can reveal itself as a good way of finding new elements and visualizing expected and unexpected relationships, although in this specific study, it has not been like that. We consider it as one more complementary technique, and we are sure that more works in this line, and our future work with the two complementary perspectives of this work (groups and weeks) will give us more light on the usefulness of the technique for the proposed objectives and for other possible sociomaterial research, this may also be a development to be offered to learning designers in order to help them refine their design in future courses. Once these other two analyses are ready, their integration would be key to understand how the whole activity is performed, as well as how every structural task is related to one another and, if there, they would establish hierarchical relationships in operational chains.

Finally, we want to venture that the analyses of the other structures, as well as diverse visualisations, in comparison with the declared learning design may offer new perspectives of the sociomaterial analysis of the course. Nevertheless, the next steps of the research need still to be carried out and other studies would be necessary to have more firm evidences of that.

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