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Cooperative activity and its potential for learning in tertiary education

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Abstract: A learning situation can be structured in different ways, as an individual, competitive, or cooperative activity. Each of these structures can be used for different purposes and can lead to different learning outcomes. This paper focuses on cooperative activity and its potential for learning in tertiary education. After defining cooperative activity (or, in a broader sense, learning in interaction) and introducing the CAMS theoretical framework to analyse cooperative activity, the main discussion focuses on the theoretical reasons for the usefulness of group learning and on the research of effects of cooperative learning on cognitive (metacognitive), affective-motivational and social processes in university students. The key elements that should be established for successful cooperation are also discussed. At the end, a new direction in using cooperative activity in learning—computer supported collaborative learning (CSCL), which emerged with rapid technology development in the last two decades—is presented and discussed.

Key words: cooperative activities, cooperative learning, CAMS model, computer assisted collaborative learning, higher education

Sodelovalna aktivnost in njen potencial v terciarnem izobraževanju

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Povzetek: Učno situacijo lahko oblikujemo na različne načine, kot individualno, tekmovalno ali sodelovalno aktivnost. Vsakega od teh načinov uporabljamo za različne namene in vsak pripelje do drugačnih učnih rezultatov. Prispevek se osredotoča na sodelovalno aktivnost in na njene potenciale za učenje v terciarnem izobraževanju. Najprej je opredeljena sodelovalna aktivnost oz. v širšem smislu učenje v interakciji ter predstavljen CAMS teoretični model za analiziranje in razumevanje sodelovalne aktivnosti. Osrednji del prispevka se osredotoča na razloge in mehanizme, ki prispevajo k pozitivnim rezultatom učenja v skupinah ter na raziskave o vplivih sodelovalnega učenja na kognitivne (metakognitivne), čustveno-motivacijske in socialne procese pri študentih. Opredeljeni so tudi ključni

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elementi, ki jih je potrebno upoštevati za zagotavljanje uspešnega sodelovanja. Prispevek se konča z razmislekom o uporabi nove oblike sodelovalnega učenja, ki se je pojavila v zadnjih dvajsetih letih s hitrim razvojem informacijske tehnologije, z uporabo računalniško podprtega sodelovalnega učenja.

Ključne besede: sodelovalne aktivnosti, sodelovalno učenje, CAMS model, računalniško podprto sodelovalno učenje, visokošolsko izobraževanje

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Cooperative activity and its potential for learning in tertiary education

One of the most frequently emphasised goals in recent European endeavours in reforming tertiary education is higher quality of university studies, which should enable students to acquire higher levels of professional competencies. Besides a broad knowledge of a certain discipline, these competencies also include very complex professional skills, attitudes, and values. In acquiring these goals, energy should be directed not only to the organisational aspects of university studies, but primarily to the content issues and teaching methods. One of the possibilities is to incorporate different cooperative methods in teaching and learning.

In the present article we will focus on cooperative activity (or, in a broader sense, on learning in interaction), and we will try to answer three main questions about learning in interaction, namely: what it is, why should we use it at different levels of education and especially at university, and how could cooperation be structured to promote learning.

Definitions of cooperative learning

The term cooperative learning refers to *different instructional methods* where teachers encourage students to cooperate in learning (Slavin, 1989). Cooperative learning is a set of instructional strategies which include cooperative student-student interaction over subject matter as an integral part of the learning process (Kagan, 1989). The interaction is a central feature of any cooperative activity.

Damon and Phelps (1989) tried to introduce more clarity into the field by focusing on the quality of peer interaction in a cooperative activity. The quality of interaction can differ according to two dimensions: equity and mutuality. Equity refers to the degree of control over learning material and within the interaction. Equity exists when both persons are equally included in interaction, when the activity flows from one participant to another and in the opposite direction, when no participant is subordinate to the one-way influence from another participant and the control is not in the hands of one participant. Mutuality refers to the amount of interaction in the group. It is high when all group members cooperate in extensive, personal, task related discourse. According to the degree of equity and mutuality in peer interaction, three major modes of cooperation were defined: peer tutoring, cooperative learning and collaborative learning.

In *peer tutoring*, equity and mutuality in interaction is usually low. One peer usually has more knowledge (competence) than the other. He takes the role of the teacher in the learning situation and the other the role of the learner. The teacher controls and directs the learning. In *cooperative learning***,** different methods are used for structuring group work. At the beginning, students are assigned different roles or tasks, but afterwards they have the opportunity to change roles and tasks, so the equity in interaction is high. Mutuality in groups can differ from medium to high level, depending on the method of cooperative learning which is used. Some of them may include a lot of individual work and peer tutoring, whereas others promote discussion, feedback, explanation, joint planning, and evaluation more extensively. In *collaborative learning*, students who are relative novices in the certain filed are jointly solving the challenging task that they could not solve individually. There is a lot of discussion, explanation, contribution of ideas in a collaborative situation. Equity and mutuality are high in these situations. Collaborative learning is characterised by relatively unstructured processes through which participants negotiate goals, define problems, develop procedures, and produce socially constructed knowledge. In this article we will focus mainly on these latter two modes of interaction, on cooperative and collaborative learning.

CAMS theoretical framework and research on cooperative learning and its effects

The second question we can pose is: why should we learn in interaction if we could learn alone? The reason lies in the capacity of group interaction to affect different levels of students functioning. An attempt to develop a theoretical framework for understanding and explaining cooperative learning in general was made by Dansereau (Dansereau, 1986; O'Donnell & Dansereau, 1992; O'Donnell, Dansereau, Hall, & Rocklin, 1987). In this model, he integrated the characteristics of the learner, learning situation, and learning outcomes. At the centre of the model is interaction among learners in a cooperative learning situation. Group interaction involves a complex combination of cognitive (C), affective (A), metacognitive (M), and social (S) processes. Based on the four areas of functioning—cognitive, affective, metacognitive and social—the framework was called the CAMS framework for understanding cooperative learning. Cognitive activities refer to comprehension, recall, and problem solving. Affective factors include motivation, anxiety. Metacognitive factors include monitoring of comprehension and performance, error detection and correction. Social activities refer to awareness and effective use of communication and appropriate social skills in a learning situation.

The outcomes of cooperative learning are the result of the synergy of all four levels of functioning in cooperative groups. The best outcomes, task dependent and transferable, will be achieved by the synergetic effect of cooperative learning when all four processes are in balance. Learning interaction and outcomes can also be influenced by other variables, such as group composition, establishment of group interdependence and individual accountability, social skills of group members and structure of interaction in group.

The research on cooperative learning and its effects, cognitive (metacognitive), affective-motivational and social, is very extensive. The best way to synthesize the results is to use a meta-analytic approach. The most important are meta-analyses of cooperative learning done by Johnson and his co-workers and by Slavin in the eighties in last century, and also more recent meta-analytic studies of cooperative learning at the university level.

In the first study, Johnson and co-workers (Johnson, Maruyama, Johnson, Nelson, & Skon, 1981) included 122 different studies that compared two or more ways of learning: cooperative, competitive, and individualistic, and their effects on knowledge. They used three different methods to evaluate results: voting method, size-effects and *z*-values. A comparison between cooperative and individualistic learning showed better results in cooperative situations in 108 studies, in 42 there was no difference, and in 6 studies the results were better in individualistic learning.

Slavin (1983) repeated the analysis with the same sample of studies two years later. He used stricter criteria for including individual research in the meta-analysis. He included only the research with experimental and control groups, with random assignment of subjects to groups, research conducted in primary and secondary schools, lasting at least 2 weeks (10 hours), with achievement measured by individual tests. Forty-six studies met all the criteria. The main result of this meta-analysis was that cooperative learning in comparison with other ways of learning leads to better achievement: this was found in 29 studies, in 15 there was no difference, and in 2 the results were better in control groups. Further analysis showed that positive interdependence and individual accountability in learning groups were critical for higher achievement.

Another meta-analysis, especially relevant for higher education, was the Springer, Stanne and Donovan (1999) analysis, conducted at the tertiary educational level in science, mathematics, engineering, and technology (SMET) courses. It showed that various forms of small-group learning are effective in promoting greater academic achievement, more favourable attitudes toward learning, and increasing persistence throughout SMET courses and programs. In the analysis the authors included studies that were published after 1980 and were conducted in actual classroom settings to ensure ecological validity. Studies reported on small group learning (i. e., on working in groups of 2 to 10 students) and they also had to report enough statistical information to estimate effect sizes. In the meta-analysis Springer et al.

tried to find out the effects of small-group learning on achievement, persistence and attitudes, and the moderator variables. Based on 49 independent samples from 37 studies, they found that students who learned in small groups demonstrated greater achievement ($d = 0.51$) than students who were exposed to instruction without cooperative or collaborative grouping.

Research on affective-motivational and social processes in students is also consistent with favouring cooperative learning in comparison with individualistic learning for promoting a more cooperative climate in the classroom and reducing competition (Lazarowitz & Karsenty, 1990), promoting intrinsic motivation for learning (Nicholls & Miller, 1994), learning self-esteem (Lazarowitz, Hertz-Lazarowitz, & Baird, 1994), and reducing anxiety (Burron, James, & Ambrosio, 1993). In their meta-analysis, Springer et al. (1999) found that (based on 10 independent samples and findings from 9 studies) students who worked in small groups persisted through SMET courses or programs to a greater extent ($d = 0.46$) than students who did not work cooperatively or collaboratively. Moreover, from 11 studies encompassing 40 findings, they found that students in small groups expressed more favourable attitudes ($d = 0.55$) than their counterparts. More favourable effects on attitudes were found for in-class instruction ($d = 0.56$) than for out-of-class meetings ($d = 0.24$). The ways of assigning students to groups were not associated with different achievement or attitude effects. No significant association was found between time spent in groups (low, medium, high) and achievement, but for attitudes, the *d*-value achieved by those with high group time was 0.77, by those with medium group time it was 0.26, and by those with low group time it was 0.37. The effects on attitudinal measures were the highest on attitudes toward learning and material ($d = 0.56$) and self-esteem ($d = 0.61$), but non-significant for motivation to achieve.

Johnson and Johnson (2002) published another very important meta-analysis that integrated research results on the relative efficacy of cooperative, competitive, and individualistic learning in university settings that were published in the 20th century. The majority of the 264 studies were published between 1950 and 1980. Sixty-one percent of studies randomly assigned students or groups to conditions, 81% of studies were published in journals, 80% of studies were of 9 sessions or less. Studies were conducted in numerous areas with a wide variety of tasks (verbal, mathematical, procedural). Results could also be grouped into three categories that measure achievement, social, and affective motivational processes. One-hundred sixty-eight studies compared the relative efficacy of cooperative, competitive and individualistic learning on university students' achievement. The results showed that cooperative learning promoted higher individual achievement than did competitive ($d = 0.54$) or individualistic learning ($d = 0.51$). These results held for verbal tasks (reading, writing, oral presenting), mathematical tasks, and procedural tasks (swimming, golf, tennis). Higher achievement promoted by cooperative learning can decrease the number of students who leave the university before graduation. With higher achievement, a higher quality of their intellectual functioning can be expected, better integration into academic life, and commitment to finish the studies at the university.

A lot of important outcomes of university experiences are related to the quality of students' relationships with other students during their study (Pascarella, 2001; Tinto, 1993). Fifty-eight studies in Johnson and Johnson (2002) meta-analysis focused on interpersonal attraction among students and found that cooperative efforts promoted greater liking among students than did competition with others ($d = 0.68$), or working individualistically on one's own ($d = 0.55$). They measured interpersonal attraction, cohesiveness and trust. Twenty-four other studies measured perception of social support. Cooperative learning can promote positive interpersonal relationships that are the heart of a learning community.

The benefits to affective and motivational processes were also connected with cooperative learning. The 27 studies that have focused on self-esteem found that cooperation promoted higher self-esteem than did competition ($d = 0.47$) or individualistic learning ($d = 0.29$). Cooperative learning can promote more positive attitudes toward university study and toward a subject area than competitive ($d = 0.37$) and individualistic learning ($d = 0.42$). Academic self-esteem and self-efficacy related to a certain subject and certain tasks promote students' persistence in studying and intrinsic motivation for learning. But cooperative learning also has the potential for social skills development: perspective taking, giving and receiving help, active listening, checking for understanding, conflict resolution skills (Burron et al., 1993; Hertz-Lazarowitz, Baird, & Lazarowitz, 1994).

Although the metacognitive level of learning processes was not included in the above cited meta-analyses, some other research confirmed that cooperative situation can promote regulation of cognition (planning, information management strategies, comprehension monitoring and evaluation). Artz and Armour-Thomas (1992) found in their research on cooperative problem solving in mathematics that better achievement was associated with more frequent use of metacognitive strategies. The importance of using metacognitive strategies in cooperative learning was also found in research with reciprocal teaching (Brown & Palinscar, 1989) and the Cooperative Integrated Reading and Composition (CIRC) program (Stevens & Slavin, 1995).

To sum up, the results of research clearly showed that different forms of learning in groups at university level can enhance the cognitive (metacognitive), affective-motivational, and social outcomes for students. The majority of effect sizes for all these effects are around 0.5. Cohen (1988) recommended that $d = 0.20$ (small), $d = 0.50$ (moderate), and $d = 0.80$ (large) effect sizes serve as general guidelines across disciplines. In education, researchers consider an effect size of 0.33 as the minimum for establishing practical significance (Springer et al., 1999). In the case of different forms of group learning in comparison with more traditional, individualist or competitive learning, effect sizes exceed the value of 0.50 for cognitive as well as for affective and social outcomes. For example, the 0.51 effect of small-group learning on achievement reported in these meta-analyses would move a student from the 50th

percentile to the 70^{th} on a standardised norm-referenced test. In reconsidering our teaching methods and practices at university level, especially in the light of improving the efficacy of the university study, teachers should think about exploiting the synergetic effects of cooperative activity and introduce group work as one of the instructional formats to complete lectures and individual study.

Reasons for the synergetic effects of cooperative activity in learning

All these processes and outcomes (cognitive, affective, metacognitive, and social) are reciprocally related. The more effort students invest into working together, the more they tend to like each other. The more they like each other, the harder they tend to work to learn. At the same time they can develop their social skills and self-efficacy, which in turn influence their persistence at a learning task and achievement.

Focusing on the cognitive level of students' interaction, there are numerous reasons why achievement is better when students are learning in interaction than when they are learning alone (Peklaj et al., 2001). One of the reasons is a more frequent use of higher-level thinking strategies, such as classification, analogies, formulations of relations, and metaphoric reasoning, when students have to explain some learning matter to other peers involved in a learning situation. There is a difference between the cognitive processes we use when reading a novel or newspaper for ourselves and the cognitive processes we use when reading and preparing ourselves for a presentation to an audience. We have to integrate our knowledge base differently in order to be systematic, clear, and well understood.

Another reason for better cognitive outcomes is the amount of repetition. Repetition is the necessary condition for storing information in the long-term memory in such a way that we will be able to retrieve it when necessary. But repetition is exactly the thing that students at different school levels hate to do the most, and university students are not the exception. In group work a lot of repetition goes on unnoticeably.

More participants in a group can produce more ideas regarding a problem they work on. There is greater probability that students will get an answer or an explanation to their questions and feedback to their own ideas. According to the cognitive viewpoint, a cooperative situation gives an opportunity for modelling, coaching and scaffolding that are frameworks for promoting a deeper level of understanding.

According to the socio-cognitive theoretical foundations and Vigotski (1983), learning in the zone of proximal development (the distance between the current level of functioning and potential functioning in the presence of a more able peer or adult) leads to a higher level of development in comparison with situations when one would work alone. A temporary supportive interpersonal framework in which a more competent other person uses social tools and artefacts (societal speech) to assist the less competent person in achieving a learning or problem solving objective is a scaffold (De Lisi, 2006, p. 20). A scaffold is temporary and it will no longer be necessary at some point in the future.

If we look from a Piagetian perspective (Piaget, 1956; Piaget & Inhelder, 1978), development is equilibrium between two processes: assimilation of the information into existing cognitive structure, and accommodation of the cognitive structure to incoming information. Experiences with objects, but also the experiences with other persons are the basis of the development. In order to achieve development, there has to be an optimal discrepancy between an existing cognitive structure and incoming information. Explanations and scaffolding from peers can sometimes be better adapted to the level of student reasoning than teacher's explanations.

According to socio-cognitive theories (Doise & Mugny, 1984; Garton, 1992), a socio-cognitive conflict, a conflict in situations where students have to compare their different ideas, ways of solving problems and different solutions in order to find the best one, is also a trigger for higher levels of reasoning. Noticing the difference between one's own perspective and other perspectives, the gaps in one's own knowledge, can lead to a revision of the cognitive system in order to incorporate a new dimension and thus to the construction of new knowledge.

And last but not least important, different perspectives on problem solving in a group can promote divergent and creative thinking, with several solutions to one problem, with promoting flexibility of thinking and with new original solutions that one would not think of alone.

Key elements that make cooperation work

The next question regarding cooperative activity and its influences is: What are the variables that influence the outcomes of interaction, and *how* to structure interaction in order to establish the best outcomes? What are the key elements that make cooperation work? Simply assigning students to groups and telling them to cooperate will not assure the desired outcome. According to the CAMS model (O'Donnell & Dansereau, 1992), we have to establish a certain set of conditions to develop cooperation.

Working in groups, or *face to face promotive interaction*, is the first condition. Research has consistently shown that the number of group members can influence outcomes (Gilies & Ashman, 2003; Slavin, 1983). When group size exceeds four participants, there is more possibility that something will go wrong, that someone will hide and others will have to do their work. Research of N. Webb and her co-workers (Webb, 1980, 1982, 1989; Webb & Farivar, 1994) also showed that cooperation in heterogeneous groups can be equally beneficial for low and medium achieving students, and also that cooperative work does not have any negative effect on high achieving students. Recent university students' research on a psychology introductory course (Stockdale & Williams, 2004) confirmed these results. The low-achievers' mean exam scores increased by 11%, average-achievers' mean exam score increased by 5%, and the high-achievers' mean exam score decreased by 2% during the cooperative learning phase.

Group work can take a form of informal cooperative learning, where students work together in ad-hoc groups that work together from a few minutes to a whole class period (at the beginning and the end of lecture, discuss a specific topic for a few minutes, summarise content, find arguments …). In formal cooperative groups students work together for a longer period of time, form one hour to several weeks to achieve shared learning goals and complete jointly specific tasks and assignments (writing a report, conduct an experiment, solve a problem, work on a project). Base groups are long-term heterogeneous cooperative groups with stable memberships, they give support and encourage each member to make academic progress and participate in university community life (Johnson & Johnson, 2002; Puklek Levpušček & Marentič Požarnik, 2005).

The second important key element of successful cooperation is the development of positive interdependence and individual accountability. *Positive interdependence* exists when students perceive that they cannot succeed in achieving their goals unless other group members can also achieve theirs (Deutsch, 1949). They cannot reach the group goal if they do not reach their own. Positive interdependence results in promotive interaction as students encourage each others efforts to learn (Johnson & Johnson, 2002). They are required to help each other in the group. Group interdependence can be structured by goal, reward, task, roles or resource interdependence. At the same time students also have to be personally responsible for their part of the task and for facilitating the work of others in the group. *Individual accountability* can be established by making sure that each student's contribution to group efforts can be identified. It can be structured by giving an individual test to each student, by explaining to others what they have learnt or by the teacher observing each group and documenting the contributions of each group member.

Certain *social skills* (Gilies & Ashman, 2003; Peklaj, 1998) are needed for successful group work, among them trust building, leadership skills, decision making, communication and conflict resolution skills as the most important ones. Teachers cannot assume that students will already have these skills developed. They also have to devote some time to teaching social skills through modelling, direct training, positive reinforcement, and most importantly, through group processing. Group processing is directed toward establishing effective behaviours that promote interaction and group outcomes and to changing non-effective behaviours that can hinder group work. In group processing students ask themselves how successfully they are working together, which behaviours are effective and which are to be changed.

The fourth and the central key element of successful cooperation is the *way of structuring interaction* in groups. There is a number of ways of designing the group tasks, methods, or structures (Peklaj et al., 2001; Sharan, 1994). The choice of a certain method is always connected with the learning goal. We can use short and open methods (such as group discussion, “think, pair, share”, round table, interview in three steps) to promote creative thinking, concept development, transfer from theory to practice, transfer among different topics, or we can use more complex and time consuming methods (such as group investigation, different projects, controversy, experiments) for developing problem solving, research skills, and argumentation skills. In choosing the method appropriate to the learning goal, we also have to consider the necessary social skills student will have to use to complete their task successfully.

Development in the future: Computer supported collaborative learning (CSCL)

In the last two decades, with rapid technology development, a new direction in the field of cooperative learning is emerging: an interest in the use of computers to support collaborative learning or, in short, computer supported collaborative learning (CSCL). The focus is on the role of interaction *at, around, and through computers* (Strijbos, Kirtschner, & Martens, 2004). It is an instance of technology blending into the previously worked out methods and approaches rather than an example of technology leading to the abandonment of the old in favour of the new (De Lisi, 2006). The case of using collaboration efficaciously in computer environment is even more complicated than structuring successful collaboration in face to face interaction. It requires even more aspects to be considered simultaneously in their interrelatedness, such as learning goals, the type of support required (instructional, computer software and human), and the technical environment (institutionally determined or specific). The research in this field is still lacking. It is more retrospective than prospective in its nature. Initially it focused on questionnaires and surface level characteristics of the communication (the number of messages sent, tread length, social-network analysis). There is a need for carefully designed experiments that would combine quantitative and qualitative research methods in order to find out how to structure computer supported cooperation effectively to promote higher quality of learning (O’Donnell, Hmelo-Silver, & Erkens, 2006; Strijbos et al., 2004).

Nevertheless, some practical tips for the effective use of educational technology in collaborative learning situations that will enable the construction of knowledge can be summarised as follows (Veerman & Veldhius-Diermanse, 2006):

- Use open-ended tasks in which information can be discussed from multiple perspectives and problems can be solved in many different way.
- Use the task structures that regulate organisational and planning issues, particularly when such issues are not related to task and learning goals.
- Arrange heterogeneous group composition, and if possible, provide students with different roles.

- Check students' assumptions and expectations. Provide guidance about participation, collaboration and communication.
- Choose transparent and user friendly computer mediated communication (CMC) systems. Provide students, tutors and moderators with sufficient time and exercise to get used to the system (e. g., introductory seminars).
- Organise close discussion treads. Separate discussion themes, technical issues, planning aspects, social issues. Support the use of clear titles when sending contributions.
- Give preference to asynchronous CMC systems, especially considering large groups of students (e. g., forums).
- Use synchronous CMC systems (e. g., chat rooms) only for small groups (dyads, triples), especially when interaction is not structured.

When implementing CSCL into university practice, teachers have to be aware that only including technology into their work with students will not automatically result in deeper learning processes. For that, it is necessary to consider the connection between learning goals and instruction very carefully and structure learning tasks accordingly. For example, they can use e-classrooms for promoting peer evaluation of and feedback to certain products such as essays or presentations. Each student can reflect on the work of at least three classmates. The best way of implementing CSCL is to take a step-by-step approach and introduce one method at a time. When the teacher and students are comfortable with it, it is the time to introduce another.

The comparison of CSCL with "face-to-face" cooperative methods reveals some advantages and disadvantages. One of the most important advantages of CSCL is its flexibility. Students can interact with one another according to their own needs and on their own schedule. CSCL is especially important in distance learning where it can promote a sense of belonging and consequently increase the participants' motivation for studying and reduce the drop out from these programs. Of course, we also have to be aware of the disadvantages of the use of CMC. The most important disadvantage is the mode of communication in CMC (McConnell, 2002). It is usually written communication. The exception is video conferencing, but it is rarely used in everyday practice. Written communication is different than live, oral communication. All aspects of nonverbal levels of communication and emotional reactions to this communication are missing in CMC. The second disadvantage is an overload of information that can occur especially when users are not participating frequently. If they feel overwhelmed by the amount of information, they can either ignore it or just skim over it to get a rough understanding of what is happening.

The most important advantage of face-to-face communication over computer mediated communication is its potential for promoting different social and affective-motivational processes in students and in establishing a real community of learners at the university level. The future of using cooperation in promoting learning at tertiary level probably lies in carefully combining both, face-to-face and computer mediated collaboration, or more precisely, to combine interaction at, around, through, and also without computers.

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