

Exploring Peer Evaluation Methods in Group Projects of Software Engineering Education

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Abstract—This Innovative Practice category full paper proposes an innovative approach to enhance peer evaluations in group-based learning. It aims at enhancing the overall peer assessment experience for students in software engineering education. In the software industry, it is all about teamwork for software development projects. There is a need to nurture students to work collaboratively in group-based learning. The collaborative milieu inherent in group projects has long been acknowledged within the sphere of software engineering education. In our university, students are cultivated the effective teamwork within the purview of CSC2101 - Professional Software Development and Team Projects (PSD & TP1), an undergraduate course in the domain of software engineering. The terrain of software group projects still presents its own array of obstacles, such as unequal contributions, internal conflicts, peer evaluation mechanism, etc. This paper first discusses the limitations of the current peer evaluation methods in this course. Next, the proposed methodology is presented that embodies four key elements: transparency, anonymity, structured assessment, and qualitative feedback. The implementation details of the proposed approaches are then described consisting of the following features and mechanisms: online platform, anonymous profiles, public results, and structured evaluation forms. The rationales for the proposed peer evaluation techniques are discussed. The experiment studies are conducted involving 40 students in our university. It includes numerous characteristics of the peer evaluation experience in order to gain a full picture of existing peer evaluation approaches within software engineering education. The survey results show a generally positive mentality toward the proposed features.

Keywords—Group-based learning, peer assessment, peer evaluation approaches, software engineering education.

I. INTRODUCTION

Collaborative training in group projects has been acknowledged as an important part within the sphere of software engineering education [1]. The collaborative spirit stands as a pivotal element of group project and student

learning, that teaches students how to work as a group towards a common goal. It meets industry requirements where software developers usually play a part collaboratively in a software project considering different human aspects [2]. But concurrently it serves as one of major challenges due to the complexities, as group projects involve multiple factors such as team dynamics, interpersonal communication, and teamwork within the realm of educational pedagogy [3].

In the context of our university, CSC2101 - Professional Software Development and Team Projects (PSD & TP1) is a undergraduate computing science (CS) course in the domain of software engineering education. The course furnish students with a bedrock of knowledge pertaining to methodologies, strategies, processes, of software development life cycle (SDLC) to contemporary software projects. This course adopts group-based learning to guide students who are from diverse backgrounds and jointly develop software projects to address real-world problem statements of companies. Students are taught that the success of the delivery of software group projects does not solely depend on the acquisition of technical skills, but equal contributions, effective communications, and harmonious teamwork. To better motivate each fellow team member in group projects, the course incorporates an important element that is the peer evaluation into the assessment structure. Each student receives the peer evaluation scores from all group members. The calculated mean value of the peer evaluation score of each student will be multiplied with the group assessment grade, to derive the individual assessment grade for this student in the group project.

In this paper, review and discussions are firstly conducted on relevant methods employed in peer evaluations for group projects in software engineering education. The potential trade-off and balance are depicted between transparency and confidentiality in the dissemination of peer evaluation scores among group members. After analysing the challenges in the

current peer evaluation methods, we propose an innovative approach of peer evaluations in the CSC2101 - PSD & TP1 course to enhance the overall efficacy of the peer evaluation process within the ambit of group projects.

The remaining of the paper is organised as follows. Section II introduces the related work in the literature. The proposed peer evaluation approach is presented in Section III. The analysis and finding discussions are described in Section IV. Section V concludes the paper.

II. RELATED WORK

There are benefits in learning by employing peer evaluation mechanisms. The effects of peer assessment on students were gauged with improvements in academic grades before and after the use of peer assessment [4], where peer assessment would provide students with improved overall examination results. Peer evaluation was utilized as a tool in aiding improvement of teamwork effectiveness in promoting team-based learning, which was measured using a survey of students at the end of the semester [5]. Another benefit of the peer evaluation mechanism is to boost the confidence of students in assessing their team members in projects. Study was conducted within three semesters, where the quality of narrative comments were analysed as the supplement of the peer scoring and the confidence of evaluators in peer evaluations were measured [6]. This study showed that after practicing the peer evaluation from some time, students became more confident in assessing their peers as a skill in their future workplace.

The glaring issue persists with the need for more accurate evaluations in graded peer assessments. As peer evaluations in group-based learning would directly impact the grades of students, it is needed to implement comprehensive measurements on true contributions of each member [7]. Peer evaluation should be substantiated with ample supporting evidence for each team member.

There are various methods to gauge peer assessment with accurate grades. Usually peer evaluation methods adopt a recurrent usage of Likert-like scales as a means of conducting assessments. These qualitative scales serve as a structured framework to express nuanced judgments and insights. Five-point Likert scale is the most commonly seen method ranging from “1 - strongly disagree” to “5 - strongly agree”, compared to other points such as four-point, seven-point, etc. A five-point Likert scale was used to measure individual contributions in software projects [8]. A five-point Likert scale was used to collect participant responses in team projects to evaluate peer ratings [9]. A peer evaluation instrument was introduced using design-thinking method consisting of 12 items, with a five-point scale per item [10].

Despite the convenience of employing Likert scales or similar measures to provide feedback for peer evaluation in current implementations of peer assessment, students often provide insufficient comments or explanations to back up their grading [11]. The use of Likert scales to measure peer performance often gleans qualitative data that is mapped to quantitative data. It can be further statistically analysed to test study hypotheses. Data obtained from the qualitative analysis can derive performances into perspective viewpoints of team

members and possible reasoning for grade distribution [7]. Quantitative data can be derived by the calculation of average peer evaluation grades from the peer evaluation feedback.

Some methods are reported to improve the peer assessment process that involves revising marking rubrics for peer evaluation to align with specific behavioural patterns [12]. The revision of rubrics could establish a more consistent marking approach [13]. Perceptions of students on the efficacy of peer reviews are put in consideration for the reduction of conflicts in grading activities. Aligning student perspectives with professor perspectives through peer assessment can contribute to a more effective learning experience. Transparency is advocated to ensure consistent assessment and handle argumentative peer feedback on peer evaluation. But there is potential consequence of the method to revise marking rubrics. The leniency of peer assessment may vary depending on the specification of the rubric criteria. A vague description of criteria in peer assessment could result in a scale ranging from barely qualifiable passes to overzealous failures. It would lead to further skewing of peer assessment grades, and thus hinder the accuracy of the overall peer evaluation.

Another method to possibly improve peer evaluation would be to rework the peer evaluation process to include the design-thinking methodology in creating the questionnaire, and splitting the assessment questions into certain distinct categories [14]. It would help provide more insight into the strengths and weaknesses of an individual in team-based learning. This study had further recommendations of the marking rubrics to minimise confusion and anxiety in team members.

Leveraging collaborative tools and applications, such as GitHub and team chats is another method to enhance the accuracy of peer evaluations [15], that utilized metrics such as the number of GitHub commits and quality of communication in team chats to assess individual contributions. This method yields substantial results with a comprehensive assessment of an individual's work. But it may raise privacy concerns due to use of communication data in team chats.

The observations of related work offer valuable insights into the role of peer evaluation in group projects. There are multiple factors to consider when implementing the method of graded peer evaluation in group-based learning. Student convenience and privacy should be a consideration in the choice of peer evaluation method. The trade-off between accuracy and comfort should also be considered prior to conducting the peer assessment. A potential method could have a better balance of accuracy with privacy, in order to produce accurate results that reflect the individual contributions, without being too invasive. By carefully examining the dynamics of peer assessments, we gain a practical understanding of the significance, benefits, and outcomes associated with implementing such methods. This nuanced exploration helps us appreciate the tangible impact of peer evaluations on students' experiences in group projects, providing a measured perspective on their educational value. It serves as a pragmatic guide, helping us navigate the complexities of group-based learning and highlighting the positive contributions of peer evaluation methods to educational outcomes.

III. METHODOLOGY

In this section, the current methods of peer evaluation that is currently in use in the CSC2101 –PSD & TP1 course is discussed. Our proposed method of peer evaluation is then introduced next.

A. Current Peer Evaluation Methods

There are currently two methods of peer evaluation used in CSC2101–PSD & TP1. The first method is to use Microsoft Forms and the second method is to use email to send our evaluations of each peer.

Microsoft Form-Based Peer Evaluation

A student can only give peer evaluation scores to other peers but cannot give scores to himself/herself. In this method, students will fill in a form with the student ID of their team members and grade them from an integer score among 1 – 10, e.g., 2, 3, 4, etc. The integer score is indicative of how you perceive that each member has contributed to the group project. The integer score “1” meaning that a team member did not contribute at all or contributed minimally; and “10” being that a team member contributed a fair share. The mean value of peer evaluation scores given by all group members is calculated for each student. From the mean value, each team member is then awarded the appropriate grade. At the end of the form, there is a text box to write comments and justify the peer evaluation score given to each team member. But this portion is not compulsory to fill in.

Email Based Peer Evaluation

In this method, team members are required to send an email to the course lead listing the student ID of each peer and assign them a peer assessment score with an integer percentage number from 0% to 100%, e.g., 10%, 11%, 12%, etc. The mean percentage value of the peer evaluation scores from all group members is calculated for each student. No other details are to be provided besides the score making this evaluation method extremely simple. The score serves a similar purpose as that of the form-based peer evaluation. But this version offers a more precise level of assessment by having smaller divisions or higher precisions. The respective members are then given the appropriate grade of peer evaluation at the end.

The current methods of peer evaluation used have both advantages and disadvantages. In our opinion, the disadvantages outweigh the advantages. The advantage of the current form-based peer evaluation is that it is fast and efficient. It allows students to quickly give feedback to each peer anonymously. However, the disadvantage is that every student is required to fill in sizeable open-ended texts, including student IDs of all his/her team members in the same group which are usually difficult to memorize. The current method does not allow a student doing self-evaluation. The form also only has one comment box at the end of the form. It is inconvenient as a student has to state which student ID would like to give comments to multiple members. We believe that having a comment text box for each student ID would make it more seamless to give comments to the peers.

For the email-based method of peer evaluation, the advantages are that it is fast and efficient with only a minimal

amount of detail needed in order to give feedback to our peers. The disadvantages are that it may leak out the scores by mistake, although the peer evaluation scores are kept as confidential by the course lead. The email is tagged to the student ID. Therefore, it is easy to track who sent the email in peer evaluations, if the students made the mistake of sending it to other students. With such incidents, the peer evaluation scores of their teammates will be revealed. There have been several occasions whereby students sent their peer evaluation scores to the wrong receipts. This makes it difficult to be honest in the peer evaluation, as there is a fear of making such mistakes.

B. Proposed Peer Evaluation Methods

To address the limitations of the current methods, we propose the innovative approach to peer evaluation, aimed at enhancing the overall assessment experience for students in software engineering education. It embodies transparency, anonymity, structured assessment, and qualitative feedback. It comprises the following key elements.

- 1) Transparency with anonymity – It aims to strike a balance between transparency and anonymity by making peer evaluation results accessible to all team members while maintaining the privacy and anonymity of individual students. The peer evaluation results will be released to all students regularly, such that students are able to know their learning progress constantly and how to make improvements if peer evaluation results are not good. Yet, students will not know which grades are given by which group members, with the anonymity maintained for a fair peer assessment.
- 2) Likert scale assessment – It aims to transition from a numerical score-based system (“1” to “10”, or 0% to 100%) to a five-point Likert scale (“1” to “5”). This modification simplifies the peer assessment, encourages nuanced evaluations, and have standardized granularity to the feedback process. The evaluation elements are structured according to the context of hands-on practical group projects in the software engineering course, where industry companies are involved as the real world customers and provide their problem statements to student groups. All students in the same group collaborate to develop the software project in several sprints, with regular project progress presentations to the industry customers. The combination of hands-on group software projects with real world industry customers provides the unique contexts in the assessment elements.
- 3) Qualitative feedback – It aims to include explicit examples and justifications for each peer evaluation score. Students will be prompted to provide detailed narratives explaining their peer assessments. This qualitative feedback will offer valuable insights into the reasons behind the assigned scores.
- 4) Marking rubrics – It aims to publicize the marking rubrics of peer evaluation to all students. These rubrics offer comprehensive guidelines for assessing team members based on the predefined criteria. To facilitate a deeper understanding of each rating on the Likert Scale,

we will provide sample scenarios for various performance levels within the rubrics.

To operationalize our proposed peer evaluation approach, the following features and mechanisms are introduced:

- Online platform – We will leverage an online platform that is specifically designed for peer evaluations, to facilitate data collection and result dissemination.
- Anonymous profiles – Individual student identities will be concealed. Each student will be assigned a unique anonymous identifier within the online peer evaluation system.
- Public results – Peer evaluation results, including qualitative feedback, will be made accessible to all team members via the online platform. However, the individual identities will remain confidential.
- Structured evaluation forms – We will design structured evaluation forms that prompt students to provide explicit examples, anecdotes, or instances to support their peer assessments. These forms will guide the evaluators in offering constructive and specific peer feedback.

Our proposed peer evaluation approach aims to improve teamwork, motivation, and problem-resolution within group projects in software engineering education. By making the peer evaluation results public yet anonymous, we foster transparency and accountability without compromising the privacy of individual students. This approach ensures that students can confidently assess their peers while maintaining a sense of fairness and equity.

Furthermore, our transition to a five-point Likert scale assessment system encourages a more nuanced evaluation process. It not only simplifies peer assessment but also encourages students to provide detailed evaluations. However, the success of this transition relies on a structured framework that guides students in assigning ratings accurately.

To address this, we introduce marking rubrics as an integral part of our proposed approach. The marking rubrics provide comprehensive guidelines for assessing team members based on predefined criteria. By offering a clear framework for peer evaluation, marking rubrics ensures that students have a deeper understanding of each performance level on the Likert scale. For each criterion, a sample scenario is provided within the rubrics, offering students a tangible benchmark for their peer assessments.

IV. ANALYSIS AND DISCUSSIONS

In this section, we present a comparative analysis of the current peer evaluation methods with our proposed peer evaluation method. The objective is to evaluate the advantages and disadvantages of each approach, considering their impact on teamwork, transparency, and constructive feedback.

A. Comparison of the Current and Proposed Methods

In comparing the current methods with our proposed solution, several key observations emerge as follows.

- Transparency and anonymity – The current peer evaluation methods prioritize anonymity, but they are not transparent enough as the peer scores are not shared to team members. Peer learning and accountability may be hampered by this lack of transparency. Our proposed approach, on the other hand, preserves individual privacy while striking a careful balance between transparency and anonymity. Evaluation findings are made available to all team members. This promotes transparency and equity within the group while guaranteeing that accountability is upheld.
- Structured assessment – The current methods, particularly the email-based method, lack a structured framework for assessment. The absence of structured guidelines may result in less informative and consistent evaluations. Our proposed approach introduces the marking rubrics, providing students with clear and comprehensive guidelines for assessments. These rubrics offer predefined criteria and sample scenarios, ensuring a structured and consistent evaluation process. This structured assessment enhances the clarity and quality of peer evaluations.
- Qualitative feedback – The current methods, especially the email-based approach, lack mechanisms for providing qualitative feedback or justifications for assigned peer scores. This limitation restricts the comprehensiveness of assessments. In our proposed approach, we encourage students to provide explicit examples and narratives to substantiate their assessments. The process of providing feedback is enhanced, which makes it easier to comprehend the contributions made by each team member. There are significant advantages in terms of granularity and depth of feedback, even though it could involve more work.

Our proposed approach represents a holistic and transformative way to peer evaluation that addresses the limitations inherent in the current methods. By fostering transparency, introducing structured assessment through marking rubrics, and encouraging qualitative feedback, it strives to enhance the overall quality of peer evaluations. This method is poised to the improvement of teamwork dynamics within group projects, aligning with the pedagogical objectives of software engineering education.

B. Results Analysis

A survey is conducted on the peer evaluation experience where 40 participants are invited for the experiments, including university students from Computing Science, university educators, and administrative staff from the software engineering education community. These participants are briefed for the current peer evaluation and the proposed peer evaluation methods. They attempt the survey questionnaire based on their own experience and preference. It is to gain a full picture of the peer evaluation methods within software engineering education. It uses the five-point Likert scale for the survey questionnaire, with “1” denoting “Strongly disagree”, and “5” denoting “Strongly agree”. The graphical narratives are obtained from the 40 participants’ responses, who provide the

feedback on the efficacy and motivational influence of the current peer evaluation methods, as well as their attitudes toward the enhancements of the proposed peer evaluations.

In the first survey question, students are asked how they agree if the current evaluation methods are efficient in the five-point Likert scale with “1 – Strongly disagree” and “5 – Strongly agree”. It is seen in Fig. 1 that about 62.5% of participants do not think the current methods efficient.

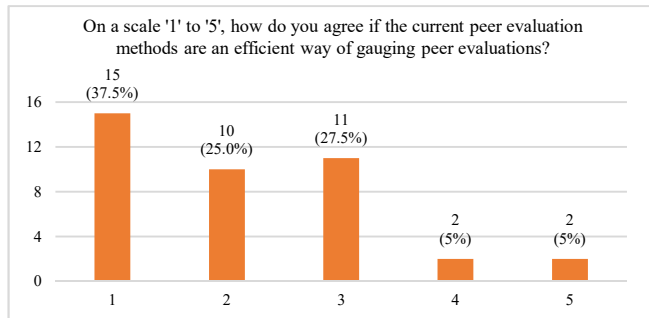


Fig. 1. Response to Q1 - “how do you agree if the current evaluation methods are efficient?”.

In the second survey question, students are asked on their perceptions on the assessment structure if the peer evaluation should take up a significant percentage in deriving their own individual grades in the group project. It is observed from the responses in Fig. 2 that about 55% of participants disagree with the high percentage of peer evaluation which may potentially impact their individual grades.

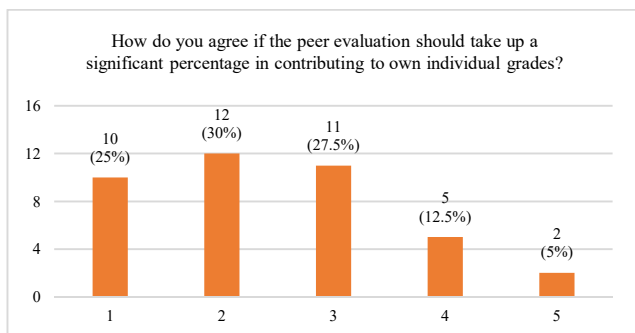


Fig. 2. Response to Q2 - “if the peer evaluation should take up a significant percentage in contributing to own individual grades”.

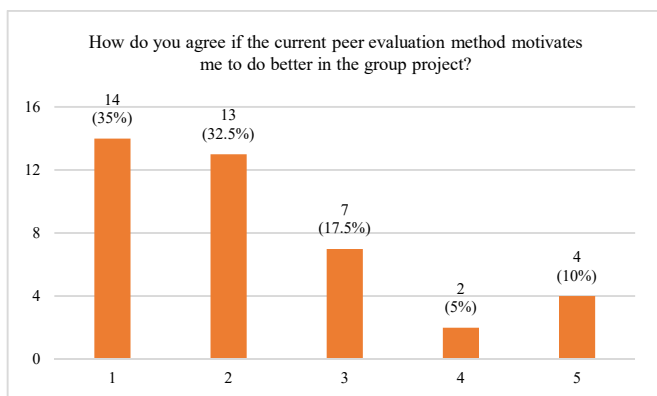


Fig. 3. Response to Q3 - “if the current peer evaluation method motivates me to do better in the group project”.

In the third survey question, the responses of the participants on whether the current peer evaluation method could motivate team members to do better in the group project are shown in Fig. 3. It is shown that about 67.5% of participants disagree with the current peer evaluation method motivating team members in projects.

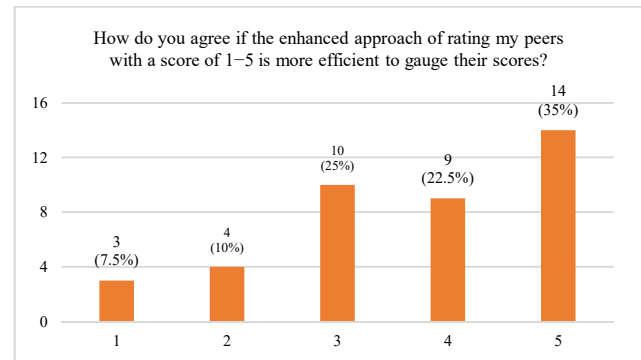


Fig. 4. Response to Q4 - “if the enhanced approach of rating my peers with a score of 1–5 is more efficient to gauge their scores”.

In the next three survey questions, the feedback of the participants on the proposed peer evaluation approach is collected. The responses on if the enhanced approach of rating my peers with a score of 1–5 is more efficient to gauge their scores are shown in Fig. 4. About 57.5% of participants agree that the enhanced peer evaluation approach is more efficient in gauging their peer evaluation scores.

The fifth question is on if having marking rubrics to follow while doing the peer evaluation can help students better. Shown in Fig. 5, about 77.5% of participants agree that the marking rubrics are helpful to guide them conducting the peer assessments.

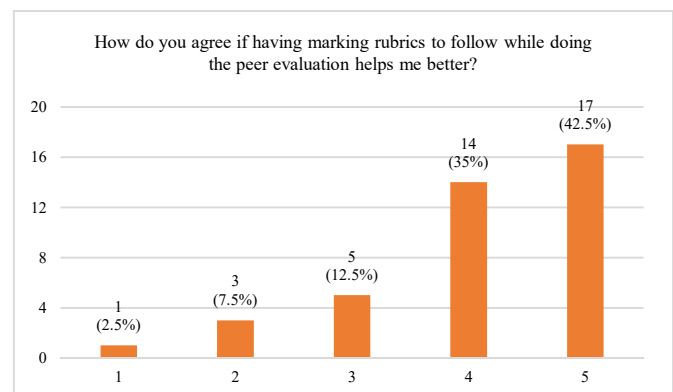


Fig. 5. Response to Q5 - “if having marking rubrics to following while doing the peer evaluation helps me better”.

The responses of participants on the sixth question are shown in Fig. 6, that examples should be provided to students to justify the peer evaluation scores in the enhanced approach. It receives very positive responses as most participants prefer to examples to be referenced from.

Overall, the survey finds moderate satisfaction with current peer assessment methods, and a strong interest in the proposed enhancements. These findings provide valuable insight into the ongoing debate regarding effective peer evaluation practices

and highlight the potential impact of our proposed approach in group projects of software engineering education. The positive acceptance of the proposed approach strongly aligns with the goals for more structured, transparent, and example-based peer assessment features. It could potentially improve the overall effectiveness and fairness of the peer evaluation process.

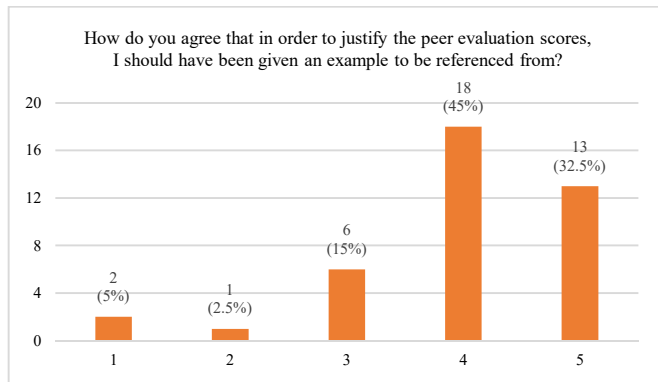


Fig. 6. Response to Q6 - "In order to justify the peer evaluation scores, I should have been given an example to be referenced from".

There are some study limitations in the survey, including the small sample size and potential of response bias. These factors can affect the generalizability of the results and should be considered when interpreting the results, in the improvements of the future study. Another limitation is that the designed survey does not differentiate the opinions of students, teachers, and administrators. Differentiation will be helpful to better understand the perceptions of students and educators.

V. CONCLUSION

Through studies of related works and reflecting from our personal experiences, peer evaluation methods in group projects of software engineering education are explored in this paper. It has revealed the gaps in the current peer evaluation methods adopted in our course which have their merits but also existing limitations. The limitations include issues related to transparency, fairness, and overall efficiency of the peer evaluation process.

A peer evaluation approach is proposed to tailor for the teamwork in software group projects and to mitigate the uncovered limitations. The proposed approach has four key features as the enhancement. It could bring upon clearer communications, more transparent feedback, and fairer grading metrics. The survey study is conducted to collect feedback on the perceptions of the current methods and proposed approach for peer evaluation. Positive responses of the survey are observed from the participants for the proposed enhancements.

By fostering an environment with fair and effective peer evaluation in Higher Education, we aim to enhance the collaborative learning process, encourage fairness, and better handle teamwork in group projects. These implementations will play a pivotal role in shaping the peer evaluation methodology in software engineering education.

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