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UNDERSTANDING THE PERCEPTION OF STUDENTS REGARDING THE USE OF THE POGIL METHODOLOGY REMOTELY

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ABSTRACT

With the advent of the COVID-19 pandemic and the guidance of the World Health Organization (WHO) and the Ministry of Education (MEC) of Brazil, teaching started to be done remotely. As a result, the active methodologies used in the teaching-learning process began to be used in this format, among them, the Process Oriented Guided Inquiry Learning (POGIL), a methodology based on constructivism, which uses question-guided activities and follows a learning cycle, enabling the development of skills, such as the construction of critical thinking, resolution of problem-situations and the exercise of communication and teamwork. From then on, doubts were generated about its effectiveness when applied remotely, since there are not enough studies to prove its applicability in this format. In view of this, the study in question aimed to evaluate the perception of students regarding the application of POGIL remotely, when compared to face-to-face. Therefore, a survey was carried out, with the application of a validated questionnaire, to students of the Pharmacy course, who had contact with the POGIL methodology in person and remotely. After evaluating the data obtained, it was possible to conclude that the application of this methodology in the remote format can be carried out with some modifications in its conduction, both in the role of the tutor, as well as in the

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involvement of students in the resolution of activities and group discussion, in addition to the choice of an ideal platform, so that there is no harm in the teaching-learning process of the students.

Keywords: Active methodologies, POGIL, Process oriented guided inquiry learning, Remote teaching.

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INTRODUCTION

With the advent of the COVID-19 pandemic, in 2020, social distancing was determined by the WHO (World Health Organization) and, as a way to contain the spread of the virus, schools and universities had their face-to-face classes suspended for a period. As a result, it was necessary to adopt ways to maintain the safety of students without harming the teaching-learning process. Thus, the Ministry of Education of Brazil, in March of the same year, authorized the start of remote classes with the use of digital platforms to transfer content, through Ordinance No. 343, which was replaced by Ordinance No. 345 (Ordinance No. 343/2020).

In this new context, both traditional and active teaching methods, used to promote student engagement as the protagonist of their knowledge and provide more meaningful learning, had to be used in the remote format. Thus, it was necessary to build an Online Learning Environment (OLE), adapted to the reality of each institution and the available resources, through the use of online tools, such as social networks and teaching platforms (BERBEL, 2011; MYERS, et al., 2014; RODRIGUEZ, et al., 2020).

Active methodologies such as the Flipped classroom and Video-Based Learning, for example, already made use of Digital Information and Communication Technologies (DICT), such as videos, computer programs, and smartphone applications to promote teaching, before the pandemic (OSMUNDO, 2017; PARADA, et al., 2020). However, few studies have shown, until now, the use of other active methods using these online environments in remote teaching. Among these methods is POGIL - Process Oriented Guided Inquiry Learning (SANTOS, et al., 2021).

POGIL, initially idealized as a methodology to be applied in person, is based on constructivist theory. Thus, it aims at the construction of knowledge by the student himself, through data analysis and discussion of ideas with the team, and the development of important skills in the learning process, such as critical thinking, communication, group work, problem solving and metacognition (FARRELL, et al., 1999; POGIL, 2023).

In this process, the activities are designed following the Karplus learning cycle (ATKIN & KARPLUS, 1962), which consists of three phases, as shown in Figure 1, in which the teacher acts as a facilitator, from exploration and construction, to the application of knowledge in new contexts. The first phase is Exploration and in it students examine the model made available and extract information from it to answer the exploratory questions. At this point, the teacher minimally instructs the student to use previous knowledge and

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explore new ideas. In the next phase, Introduction to the concept, the relationships and concepts emerge based on the information extracted by the students when examining the model and with a brief introduction of principles by the teacher. Finally, the Concept Application phase presents questions where students have the opportunity to apply the learned concept to new situations, which increases the understanding of the concept (PEREIRA, 2019).

STUDY ANALYSIS: POSITIVE AND NEGATIVE POINTS OF ONLINE IMPLEMENTATION

Thus, some studies, carried out before and after the pandemic, evaluated the use of POGIL in remote teaching, considering the role of the facilitator/tutor, the interdependence of groups, and the development of process skills (JOSHI; LAU, 2021; Purkayastha, et al., 2019; Rodriguez, et al., 2020). With this, they observed that it is possible to implement this methodology online, without a significant difference in the cognitive development of students and, in some of them, with a greater or equivalent involvement in the process, compared to face-to-face application. However, it was also observed that there are points that hinder the applicability, such as: instability of the internet connection, teaching platforms that are not yet ideal for dividing the groups and interaction between them and the tutor and the need for modifications in the structure of this methodology, such as the additional support of the tutor during the activity and the proportional division of tasks.

Therefore, it was observed the need to evaluate, in the face of a reality different from those studied so far, whether the use of the POGIL active methodology in online classes contributes in the same way, when related to learning, the resolution of activities, the construction of knowledge and group dynamics, as in face-to-face classes.

Thus, the present study evaluated the perception of students of an undergraduate course, who made use of POGIL in face-to-face classes, in relation to the use of this methodology in remote classes, establishing a comparison. To this end, a questionnaire was applied to the participants, elaborated and validated using staggered and dichotomous questions, thus facilitating the measurement of the answers, and, at the end, a dependent question with space for suggestions, which were analyzed and discussed.

Thus, from this work we evaluated the use of the POGIL methodology in online teaching and the need for its implementation adapted to the remote format in institutions with similar sociocultural contexts, in order to maintain the achievement of the objectives initially outlined for this method in the face-to-face form.

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METHODOLOGY

This is a qualitative-quantitative observational study that uses a questionnaire as an instrument to assess the perception of a total of 20 students, constituting the sample, of the Pharmacy course of a University in the northeast of Brazil, regarding the use of POGIL in remote classes.

CHARACTERIZATION OF THE INSTRUMENT

The questionnaire was previously validated using the Delphi method (Azevedo, 2021). This instrument presents ten questions, among which seven are statements, on a Likert scale 1 to 5 (Table 1), ranging from "Strongly disagree" to "Strongly agree", and three are dependent dichotomous questions, where the student chooses between YES and NO and, depending on his answer, will be directed to mark some options (Figure 2). Of these three questions, only one allows the student to leave suggestions in writing according to the theme addressed.

Table 1. Statements evaluated on a Likert scale present in the questionnaire used as a research instrument to understand the applicability of the remote POGIL.

Número	Assertiva
01	A aplicação do POGIL é feita com uma dinâmica de grupos, juntamente com um professor que tem o papel de facilitador. Na aplicação do POGIL de forma
02	O formato do material POGIL aplicado de forma presencial também pode ser aplicado de forma remota sem que haja a necessidade de alterações.
03	A utilização do POGIL como metodologia de ensino-aprendizagem ajuda no desenvolvimento da capacidade de resolução de problemas em grupo, instigando nos discentes o instinto de futuro profissional que colabora com sua equipe de trabalho. Esse objetivo foi alcançado na aplicação do POGIL de
04	Na aplicação do POGIL de forma remota o material foi enviado previamente. Dessa forma, facilitou a discussão da atividade e também melhorou a compreensão dos discentes.
07	A metodologia POGIL tem dois objetivos amplos: desenvolver o domínio do conteúdo por meio da construção da sua própria compreensão e melhorar importantes habilidades de aprendizagem, como saber resolver questões em grupo, partilhar e buscar ativamente o conhecimento. Esses objetivos continuaram sendo contemplados na utilização da metodologia remotamente.
08	Comparando a aplicação da metodologia POGIL de forma remota e presencial é possível afirmar que a há diferença significativa entre as duas
09	Diante das modificações necessárias na aplicação do POGIL de forma remota, ele ainda assim é uma boa alternativa de metodologia de ensino-aprendizagem a ser utilizada.

Source: The author

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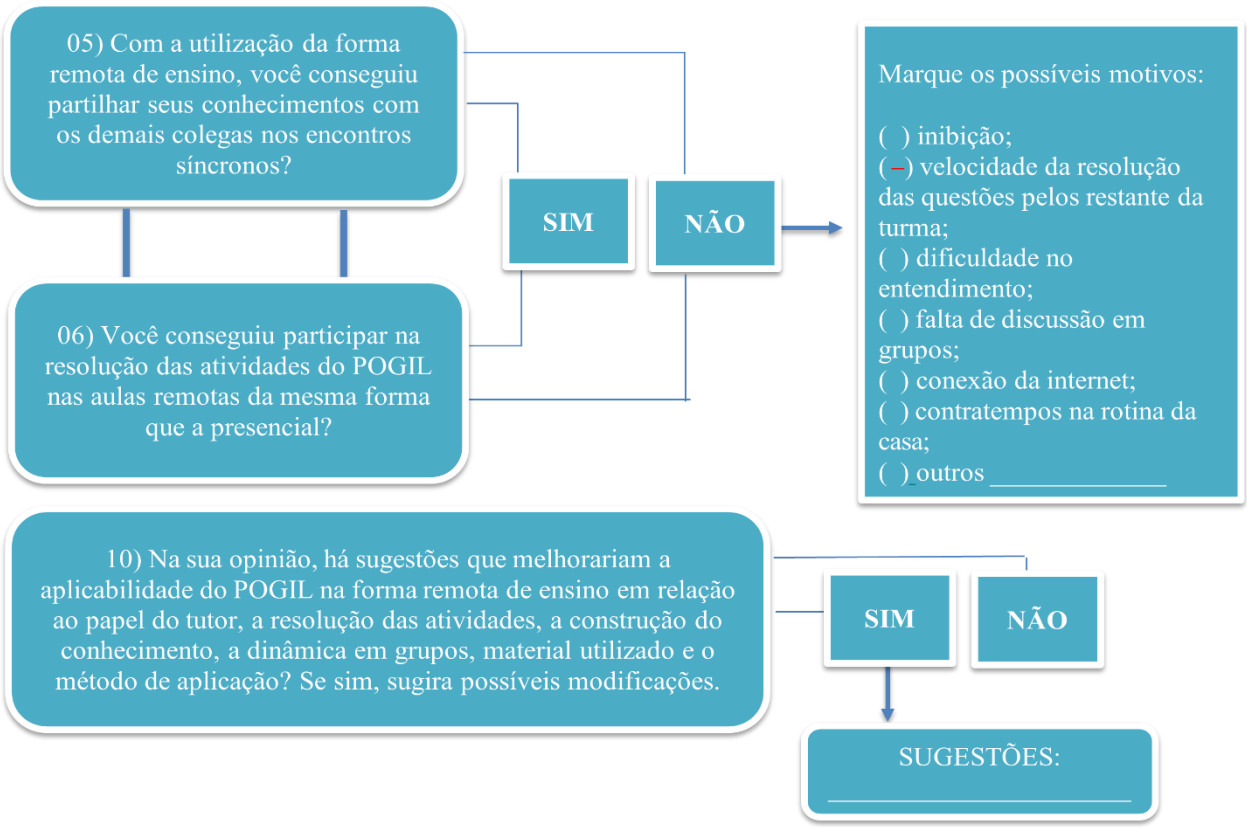
Figure 1. Dependent dichotomous questions present in the questionnaire used as a research instrument to understand the applicability of the remote POGIL.



Source: The author

These questions proposed to evaluate whether the POGIL methodology can be applied in the remote format, in the same way as it is in person without changes in its structure, or if it needs changes in order to achieve the objectives initially outlined, when its use was only in the classroom. For this, the questions were divided in order to evaluate some important points of the method such as: the role of the tutor, the resolution of the activity, the construction of knowledge, the group dynamics, the material used and its applicability.

The questionnaire in question was designed with the objective of being applied to students of the Pharmacy course who had contact with POGIL in person and, later, online. Thus, inclusion criteria were defined for the selection phase, namely: 1) being a student over 18 years old; 2) be regularly enrolled in the Pharmacy course of the Institution; 3) have contact and experience with POGIL in face-to-face classes and remote classes.

After the selection phase, the application took place in person and the objective of the study was explained to the selected students. Along with the questionnaire, they received the Informed Consent Form (ICF), authorizing them to participate in the research.

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Soon after signing, they began recording the answers to the questionnaire, which was collected and analyzed later, being approved by the Research Ethics Committee (CEP).

STATISTICAL ANALYSIS OF THE DATA

For the statistical analysis of the answers obtained, a score was assigned to each alternative marked. In the Likert scale questions, this score was gradual (DARROZ; ROSE; GHIGGI, 2015), from 1 to 5 being, Strongly disagree = 1; Disagree = 2; Indifferent = 3; Agree = 4 and Totally Agree = 5.

According to this analysis, the results were obtained by calculating the global average of the score obtained by the twenty participants of the research for each assertion on a Likert scale. To do this, the score of each student regarding the question was added and divided by the total number of students. Averages above three suggest that each POGIL characteristic, addressed in a given statement, did not suffer as much impact when the methodology was applied online and those that presented a result lower than three indicate that they suffered significantly from the change. In addition, the general average of the seven statements was also calculated, adding the individual averages that were previously obtained for each one and dividing the result by seven.

The individual averages of each participant were calculated from the sum of the score obtained by each one and, in sequence, the division of the resulting value by seven, referring to the number of statements on a Likert scale. For the statistical percentage analysis, it was calculated how many students had an average above three, equal to three and below three when compared to the whole (20 = 100%).

On the other hand, the dependent dichotomous questions were analyzed through the percentage survey of those who answered YES or NO to the questions, while question ten was analyzed by Bardin's Content Analysis method (BARDIN, 1979), since it is a subjective question. To this end, the Pre-analysis and Exploration phases were carried out, as well as the coding and categorization of the material to obtain the final analysis.

RESULTS AND DISCUSSION

Analyzing the global average, as shown in Figure 3, all questions elaborated on a Likert scale had an average response higher than three, indicating that the characteristics of the method are maintained, not leading to losses in the teaching-learning process and contributing to meaningful learning and the development of process skills, achieving the

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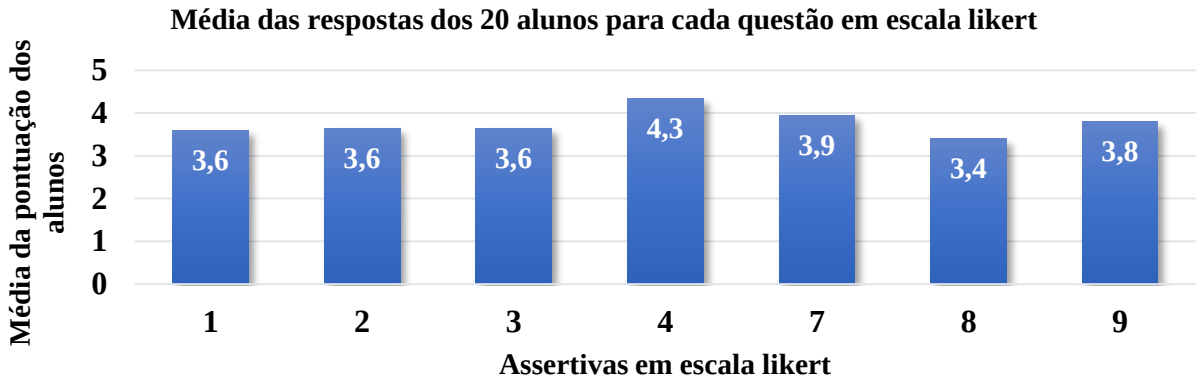
objective of the methodology (POGIL, 2023). This fact can also be seen in the general average of the responses of the seven assertions analyzed, where we obtained a value of 3.77, which collaborates with the study by Reynders & Ruder (2020), which explores the applicability of POGIL in online classes and its possible modifications.

Figure 3. Average of the scores of the twenty survey participants for each of the seven assertions on the Likert scale.



However, analyzing the individual average of the participants in relation to the seven assertions, we observed that only one, that is, 5% of the students, was indifferent to the application of the POGIL remotely compared to the face-to-face one, presenting an average equal to 3, which means that for him there was no difference in terms of the application in the two formats. The other 85% (seventeen) showed agreement regarding the application of POGIL in the remote format, taking into account the characteristics evaluated in each assertion and 10% (two) disagreement.

In addition, an analysis was made of the general topics addressed in the questions regarding the specifications of the POGIL (Figure 4), obtaining that: in relation to the role of the tutor, addressed by assertion 01, thirteen students stated that it did not present significant changes when exercised in the online environment, representing a percentage of 65% of the answers, while 35% (seven) considered the difference in the role of the tutor in this new format relevant.

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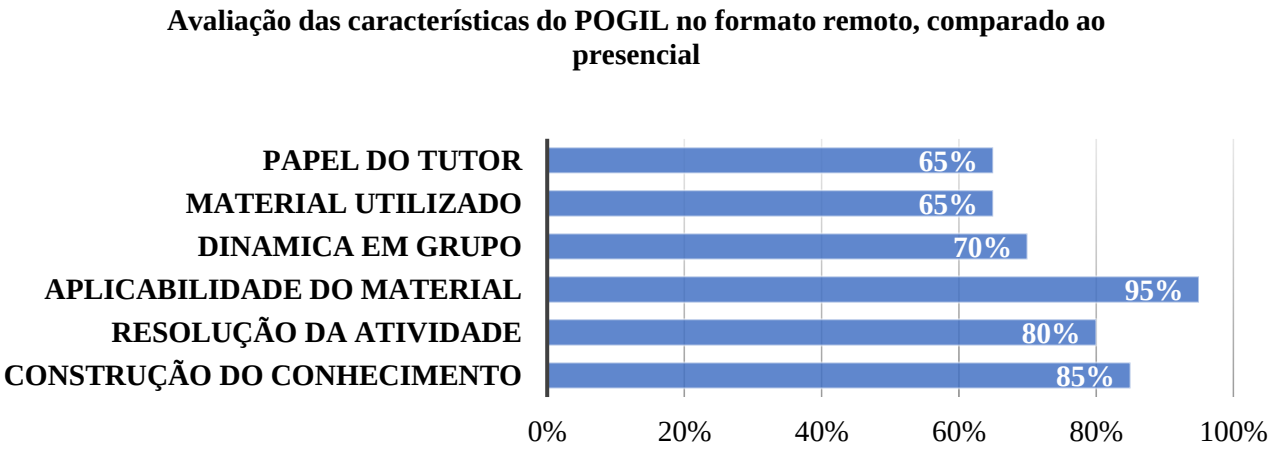
Figure 4. Percentage of agreement of the twenty students to achieve the objectives of the method, when evaluating the role of the tutor, the material used, the group dynamics, the applicability of the material, the resolution of the activity and the construction of knowledge.



Source: The author

This result demonstrates that the teacher can play his role as a facilitator in this teaching-learning process, achieving one of the objectives of this constructivist methodology, which is to create problem-situations for cognitive development and the construction of knowledge centered on the student, as stated by Farrell et. al (1999). However, this result also directs us to possible interventions in this online context, as observed in the study by Joshi & Lau (2021), in which students reported the need for greater tutor support in the online environment in order to establish an environment conducive to discussions and questions.

It is known that, with the online learning environment, teachers face even more challenges in the implementation of active methodologies, due to the division of environments so that they can know if the resources used are being effective in promoting teaching. According to Darroz et. al (2015), in order for students to be active agents in the teaching-learning process, the role of the tutor is to encourage argumentation and questioning, instead of exposing knowledge, to promote critical thinking and the construction of knowledge. For the method to be successful in its implementation, quality interactions between students and the teacher, as well as between themselves, are necessary, promoting a constructive dialogue (JOSHI & LAU, 2021).

Regarding the material used, whose mention appears in statement 02, 65% (thirteen) of the participants agree that it is not necessary to change its format for it to be applied in online classes, and the same material that is used in face-to-face classes may remain. Thus, he must maintain the characteristics of the original model, following the

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Karplus learning cycle and, with that, bringing models for exploration through exploratory questions, then those of critical analysis and, leading to the application phase of the concept learned during the activity (VINCENT-RUZ, et. Al, 2020). None of the participants was indifferent to this topic.

Within this aspect, an important point highlighted by the students was the benefit of sending this material in advance, as observed in assertion 04, which evaluates the applicability of the material. There was an agreement of 95% of the answers to this question, that is, nineteen students agree that prior contact with the subject facilitates the discussion of the activity throughout the class and promotes a better understanding of the content studied, even if this practice is not part of the typical characteristics of the model in the face-to-face format. This fact is reinforced by the study by Joshi & Lau (2021), when he states that prior contact with the material in remote classes, especially for students who do not have prior knowledge, provides contextual support and makes collaborative activities more effective, making it possible to apply the online method.

The third point evaluated by items 03 and 07 of Figure 1 was group dynamics. According to the POGIL Platform (2023), one of the objectives of the methodology is for all students to be actively involved in promoting collaborative learning through the distribution of tasks and participation in classes. Therefore, the research participants evaluated whether the contribution of the method to the development of process skills, such as communication and group problem solving, as well as collaboration with the team, was achieved when applied remotely. As a result, we obtained that most students, 70% (fourteen) agree that the application of POGIL online does not harm the group dynamics and manages to contemplate the proposed objective, also contributing to the construction of knowledge and resolution of the activity.

Analyzing these items in isolation, we have that in statement 03, 20% (four) of the participants were indifferent, that is, they neither agreed nor disagreed that POGIL online was able to contribute to the development of this skill that is group dynamics, and 20% disagreed with this statement, while in statement 07, four students disagreed that POGIL online achieved the objective of contributing to the discussion of group activities, totaling 20% and none remained neutral, constituting the minority of contrary responses.

Assertion number 07 also evaluates whether the resolution of the activity can be effective in the remote format. For this to happen, factors such as: interdependence of groups, division of tasks, influence of the tutor and the format of the material used, are

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taken into account. If each step prior to the resolution follows the criteria outlined for the POGIL methodology, the resolution of the activity will be successful. In view of this, the result obtained was that most of the students, 80% (sixteen) are able to carry out the proposed activities, through the preparation developed during all the previous stages.

Another aspect analyzed in the research, still in item 07 and in items 04 and 09, was whether the method achieved its main objective, which is the construction of knowledge during the process, with the modification of the learning environment and, consequently, of some important points of the methodology, and whether, even in the face of possible changes, it is a good alternative for teaching and learning. This topic, in turn, is the key point of the implementation of POGIL as an active method, since, in order for knowledge to be acquired, it must be built from the development of important learning skills such as communication, critical thinking, team problem solving, information processing and metacognition, which, according to Flavell (1987) it is the human being's ability to monitor and self-regulate cognitive processes (Farrell et. al, 1999; Pogil, 2023). Metacognition is a very important skill to be developed with the construction of knowledge over time and can be achieved through some strategies, such as: relating new information to what already exists, selecting thinking strategies with a purpose and monitoring and evaluating thoughts, as stated by Blakey & Spence (2000). Therefore, if this skill is developed together with the previous ones, through experience and accumulation of specific knowledge, the objective of the method is achieved and the student is able to build his knowledge effectively.

In view of this, the average number of responses to these three assertions has a value equal to 4.03, indicating that, with the remote format of POGIL, it was possible to achieve this goal, even with possible difficulties and challenges that had to be faced. For this result, the means of these three items were added and the value was divided by three, reaching the final average for these assertions.

Assertion 08, in turn, establishes a comparison of the application of the remote and face-to-face method. 75% (fifteen) of the students stated that there is a significant difference between the two types of application, 15% (three) remained indifferent, demonstrating that they do not consider the method divergent in its online application mode compared to the face-to-face one and 10% (two) agreed that there is no significant difference between the two formats of application of the method.

Analyzing the dichotomous questions, in turn, we have that questions five and six relate the change in the class format (face-to-face to online) with the ease that students had

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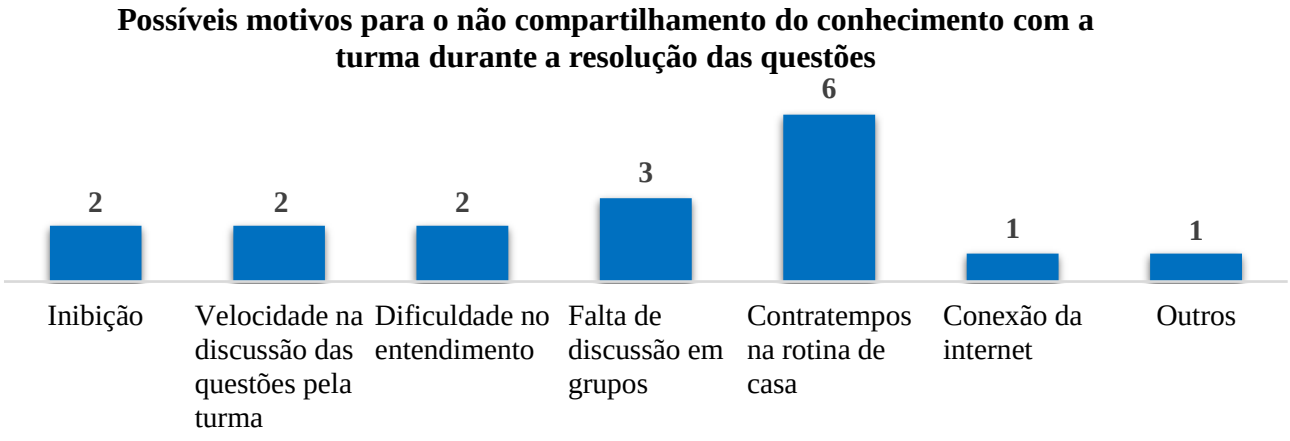
in participating in the resolution of activities and sharing their knowledge with the class. It is known that there are numerous factors that can directly or indirectly interfere with the objectives of the method being achieved in the remote format, as presented in the study by Myers and Trevathan (2013). One of the challenges cited by them is the promotion of student engagement in order to remain active even in a different space from the others and the dependence on the technologies used that can fail at any time.

From the answers, for question five, it is verified that 60% answered YES and 40% NO, that is, most students affirm that they were able to share their previous knowledge with the others at the time of the group discussion. The 40% who marked the answer "no" recorded the possible reasons why they were unable to perform this action, as evidenced in figure 5. Most students stated that they were unable to share their knowledge with others due to setbacks in the home routine, followed by the lack of group discussion.

Figure 5. Quantitative of responses for each item of assertion number five that indicates the reasons why the student was unable to share his knowledge with the class in online POGIL classes.



Source: The author

Thus, it is necessary to pay greater attention to the points that refer to the methodology and its conduction during the application in class, namely: 1) speed in the discussion of the questions; 2) lack of group discussion and 3) difficulty in understanding. If most students register these reasons as obstacles to the effectiveness of the method, the problem is not directly related to the change in the learning environment, but to the way in which the division and discussion of the groups, as well as the role of the tutor, are being conducted. The other points listed concern the student, his environment and the technologies used for this format, which are more related to the online application.

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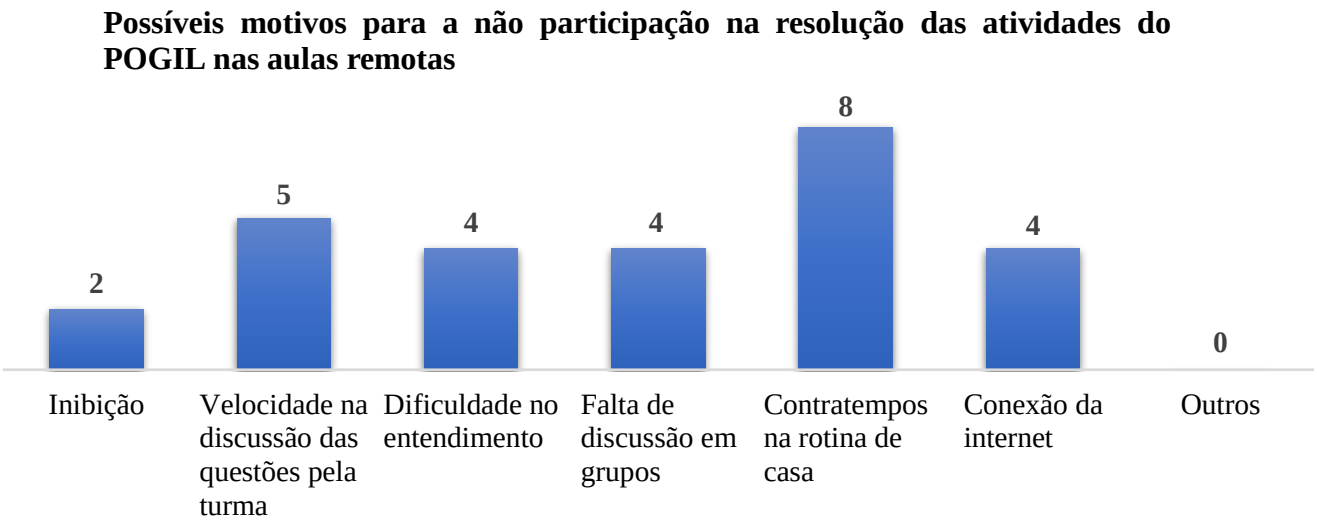
In agreement with these results, question six shows us that even more students were unable to participate in the resolution of POGIL activities in remote classes in the same way as in face-to-face classes, totaling 65% of the answers. The reasons listed were also similar to the previous question, with "setbacks with the home routine" being the prevalent, with eight answers, followed by "speed in solving the questions by the rest of the class" as shown in Figure 6.

Figure 6. Quantitative of answers for each item of assertion number six that indicates the reasons why the student was unable to participate in the resolution of the POGIL online activities.



Source: The author

Observing the frequency of the answers in the figures, we conclude that the main difficulty involved is the setback in the home routine, which ends up discouraging the student's involvement in the resolution of the activities and, consequently, their active participation in the process of knowledge construction, since they are more vulnerable and lose concentration easily. This was also confirmed with the study by Reynders and Ruder (2020), when trying to move a classroom in an organic chemistry discipline using POGIL to the online environment, reporting that the main challenges for students were motivation and distractions at home, which directly implies the learning result. The lack of discussion in groups, however, can be a lack of direction and encouragement from the tutor in the division of tasks and in the realization of questions, motivation of the students or also the lack of an ideal platform for the division of groups, as carried out in person, where the teacher can move through all the rooms and check the progress of the discussion.

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The speed of solving the questions as a limiting factor for learning, as well as the difficulty in understanding, may also have been due to the lack of interaction between the students and the tutor, because in cases where the student cannot follow the activity at the same speed as the others or has difficulty understanding what is being done, There is total freedom to signal to the tutor the complaints present at the time of the class, so that the best solution and the best way to achieve the initial objectives can be found. Therefore, it is necessary for tutors to pay greater attention to monitoring the students present, encouraging class interaction in the discussion of activities and generating feedback from students regarding the progress of classes and the achievement of the objectives set for the method, as well as possible complaints or points to be improved and suggestions. The "internet connection" factor, on the other hand, is a challenge to be faced by any activity and methodology that depends on this resource for its operation, being inherent to the role of the teacher and the student. In this study, this factor was not a determinant of the lack of student participation in POGIL activities, not making its application in remote classes unfeasible.

The platform used in the online classes was Google Meet and, during the adaptation process in this new environment, the available resources were discovered. Among them, the "raise your hand" option was used to organize the moment of speech of each student and the discussion of the activities in a sequential way, following the order of the waiting list formed. In question five, 5% (one) of the answers checked the option "others" and described this situation as a reason for not being able to share knowledge with others, since they often reported being at the end of the line and were unable to expose their ideas at the appropriate time, which made their participation unfeasible. Thus, it is necessary to seek new alternatives for a better involvement of students in activities and discussion, and other teaching platforms already available can be sought, such as Zoom, which has the option of opening several rooms at the same time for groups, while the teacher can move between them and follow what is being done, and also the option of the whiteboard for students to record their answers and share with others, in order to promote even greater interaction.

Finally, question ten present in the questionnaire aimed to extract from the students possible suggestions that would improve the applicability of the online POGIL in relation to the points that have already been addressed and discussed in the other questions. To this end, only three participants left their suggestions in writing. After the Pre-analysis and

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exploration phases, we coded and categorized the material, obtaining three answers that are part of topics already discussed in the previous questions: group dynamics and the resolution of the activity, which are interconnected. The suggestions recorded are shown in Table 2.

Table 2. Suggestion of three students for dichotomous question number ten of the questionnaire used as a research instrument, which evaluates whether there are interventions to improve the applicability of POGIL in the remote format.

Discente	Sugestão
1	Dividir a turma em subgrupos durante a resolução das atividades
2	Maior contribuição dos alunos na discussão e resolução das questões do POGIL online
3	Buscar estratégias para o não compartilhamento de respostas entre os grupos

Source: The author

Inferring this material, we observed that the application of POGIL remotely brought some challenges that can be solved with the execution of the method more faithfully to what was originally designed and the commitment of tutors and students. This would already solve the first problem mentioned by student 1, which is the large number of people, in the same environment, due to the lack of division of groups to solve the activities. One of the points defended by the POGIL platform (2023) is precisely teamwork and, for this to happen, it is advisable to divide the class into teams of three or four students, who receive functions within the group, in order to facilitate the development of process skills and extract from each student their maximum potential during collaborative activities.

Student 2 noticed that in the remote format, students showed greater inhibition to participate in the resolution and discussion of the questions, which was also a reason recorded in questions five and six, less frequently. In this case, the division of teams and the uniform distribution of tasks are also proposed to improve this scenario, since each member plays a different role, and this promotes an incentive for participation and contribution in the teaching-learning process, which is stimulated by the tutor through improvised questions to random students and the exchange of roles during class to keep them involved in the process. In addition, the use of platforms that encourage this interaction between themselves and with the tutor facilitates the achievement of the method's objectives (JOSHI & LAU, 2021).

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Student 3, on the other hand, reported the high frequency of sharing answers by a small group to the rest of the class before the tutor conducts the activities. When it comes to remote teaching, this is one of the most recurrent challenges, as the teacher does not have control over what happens in each student's environment, which is also accentuated with the prior submission of the material. Thus, based on the study by Reynders & Ruder (2020) who also faced this problem in the application of the online method, tutors can reduce the period available to carry out the activity and make changes that reduce or make this type of action unfeasible, such as, for example, creating more than one type of material, with different questions in each of them, as well as changing the sequence of questions that are the same and removing the possibility of returning to questions that have already been answered, if it is material on an online platform.

CONCLUSION

In view of this scenario of instability and uncertainty imposed by the COVID-19 pandemic, it is necessary to seek alternatives that enable access to information and the engagement of students in the construction of their own knowledge within the active method. There are many challenges, both for teaching practice and for students, in the midst of a virtual and technological context, in order to achieve these objectives. Therefore, this research brought the possibility of evaluating, in a context different from those studied so far, the applicability of the POGIL active method in remote classes and comparing it to its face-to-face form, with the objective of seeking improvements for online implementation.

Thus, the data collected allowed us to observe that it is possible to apply this method in a remote format, being able to promote the construction of knowledge. However, to achieve the same results as face-to-face implementation, some modifications are necessary in its structure and conduct during the teaching-learning process, both in the role of the tutor and in the choice of the platform to be used and in the performance of the students, in order to promote the development of process skills and critical thinking, in addition to the ability to solve problems as a team. For this, it is necessary that the tutor encourages interaction between the groups for the resolution and discussion of activities and the students strive to actively participate in all stages.

It was also observed that it is necessary to seek a new platform that is more appropriate for the application of the method, favoring the division of groups and the better performance of students in the discussion and resolution of activities, in addition to enabling

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greater support from the tutor to the students through their movement between rooms, simultaneously.

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