Journal on Teaching Engineering, 3:1 (2024) 2-14
ISSN 2795-4005
DOI: 10.24840/2795-4005_003-001_1884

Received: 21 October, 2022
Revised: 30 January, 2024
Published: 2 December, 2024

Discord in a university STEM learning environment: collective learning

Renato Soeiro
INESC TEC, Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 PORTO, Portugal (rsoeiro@fe.up.pt) ORCID 0000-0002-8188-9475

Gabriel David
INESC TEC, Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 PORTO, Portugal(gtd@fe.up.pt) ORCID 0000-0001-5974-9989

Ana M. A. Neves
Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 PORTO, Portugal(ananeves@fe.up.pt) ORCID 0000-0002-4662-2716

Author Keywords

Author should use keywords using natural language. Keywords must be separated by commas

Type: Research Article

Open Access
Peer Reviewed

Abstract

We implemented *Discord* as a pedagogical tool in the academic year of 2021/2022 in two mathematics curricular units of the first year of an Informatics Engineering university program. We analyze and discuss the experience, reflecting on usability and influence on learning processes and engagement. We compare the impact of using the platform: 1) when combined with different methodological and pedagogical approaches; and 2) to previous years with other (or none) classic virtual forums.

Introduction

The COVID pandemic induced a sudden switch from in-person attendance to classes to remote attendance, mobilizing several online resources, some new and some previously available. It also forced youngsters to find new spaces and languages that allowed developing relationships and building communities and their own identities, while subject to physical distancing restrictions.
As pandemic restrictions are alleviated, how can we rethink classes based on the skills acquired and mobilized by educators while promoting learning by furthering a relationship with students in their new spaces, languages, and culture?
Discord is an open and flexible social platform (VoIP, instant messaging, and file sharing) that outgrew its initial purpose with a fast and transversal adoption rate. In 2019, it had 56 million active users per month; in 2021, 350 million registered members with 150 million active monthly (Geyser 2021). The significant growth could come from how communities looked for new ways to hold and develop bonds during lockdowns and while facing physical distance restrictions. With 68% brand awareness among 18 to 24-year-olds and highly adopted amongst the gaming community (CNBC-disruptor-50 2022), mobilizing this tool and experience into a formal learning environment of an informatics course shows vast potential.

As a pedagogical tool, *Discord* falls in the category of a virtual forum or online discussion platform. However, many virtual forums used in educational contexts are designed from the educator's perspective, often mirroring or replicating a traditional classroom environment. They often lack a social perspective and more natural enmeshment in students' social behavior. Consequently, they may not consistently foster easy and natural student engagement and enthusiasm. In some cases, students may view these platforms as a mere requirement for completing assigned tasks or accessing course-related information, with their use requiring a specific effort forced by assigned tasks or the need to access course-related information. The way to use them is often a detour from their natural daily activities, and these platforms are often ready-to-use, without the flexibility for students to customize or modify their functionality to suit their specific needs or preferences. As a result, students may be less likely to use these forums and find the language, cultural references, and overall experience less familiar and natural. The reduction of potentialities of these educational resources hampers their support of a learning environment that promotes engagement, critical thinking, and a community of inquiry. (Bayne 2015; Dale, Robertson, and Shortis 2004; Oliver and Herrington 2003; Garrison, Anderson, and Archer 2000)

Discord differs significantly from this scenario. Originally developed as a tool to help the gaming community collectively solve complex situations in games, it fosters an environment where the problem discussed determines the language and representations it requires. Embedded in the typical informatics course candidates' culture and language, it diverges from the traditional educator-centric design. Thus, it facilitates a meeting point between teacher and student languages and promotes collective approaches to problem-solving, research, and study, building on the sense of community. Moreover, although it is not open source, it is a more flexible and adaptable environment allowing users to create a hierarchy with different permissions to modify and customize some of its functionalities, which opens pedagogical possibilities closer to open educational resources (DeRosa and Robison 2015). The conjugation of these features creates a natural environment aligning and embodying the approaches of constructivism, collectivism, and connectivism while enhancing the possibilities of pedagogical lurking (Vygotsky 1978; Garrison, Anderson, and Archer 2000; Siemens 2005; Dennen 2008). With a focus on user-friendliness and minimal impact on performance, it is a technically efficient platform for screen sharing, audio, and text. All this provides increased usability and potential for engagement.

We describe and analyze a one-year experience of first-time use of *Discord* in the context of two mathematics curricular units (CU) of the first-year in an Informatics Engineering program. *Discord* was proposed, but not restricted to, a subgroup of classes within each CU. Two CU allow comparison of impact along different methodological and pedagogical approaches and classroom typologies. The analysis takes into account activities in-class and in-between classes. We perform quantitative content analysis concerning *Discord* activity, classifying and distinguishing between messages directly related to subject/curricular content and social content, which also comprises social discussions about how the CU works. A second quantitative analysis uses students' grades from three consecutive years, the last with *Discord*. In particular, we focus on a discussion of variance using Levene's test. The qualitative discussion follows from observation, reflection on the experience, comparison to previous years, and informal discussion with students.

The article has the following structure. The subsequent section presents the context, course and curricular units, and the *Discord* platform. In section 2, we describe the methodologic approach for setting a structure for the *Discord* server created and discuss its evolution. In section 3, we analyze, discuss, and compare the platform's impact in both units from a quantitative point of view. Section 4 contains a qualitative reflection

on the learning process, the social and pedagogical implications, and the reactions using the platform evoked. Finally, we conclude with some suggestions for the future.

1. Setting

We implemented *Discord* during the academic year 2021/2022 in a subgroup of classes of two curricular units, A and B, in the first year of an Informatics Engineering program, one in the first semester and the other in the second semester, respectively. Both are from the area of mathematics. Classes comprise two moments: a biweekly one-hour theoretical class and a weekly two-hour practical/lab class. Because there are more than 400 students enrolled, they are divided into smaller groups: in two/ three groups for theoretical classes; in 14/15 groups for lab classes (practical).

1.1. Curricular unit A

In CU A the approach follows an active methodology, where students are encouraged to explore the subject and discuss the concepts presented.
For most of its curricular content, it builds upon a content-specific software package for both in-class and out-of-class study. The software is central in classes and evaluation moments, promoting a more autonomous learning process with automatic feedback for students while avoiding repetitive and rote exercises in favor of a more inquiring approach. Lab classes and tests/exams are in computer classrooms. Tests are built cooperatively by the teaching team and done on Moodle learning management platform. Moodle also contains all information, documents, and a forum, while most bureaucracy is kept in the academic information system SIGARRA. The teaching team uses a cooperative approach with weekly meetings to discuss and adjust strategy, besides building and discussing evaluation questions.
The evaluation comprised four tests in four different moments, covering four parts of the curricular content. These determined a grade for CU A on a scale of 0 to 20. Students could then, if they wish, improve their results in a 'final exam' moment with questions about all the curricular content leading to a final grade. Students who obtain ten or higher are approved.
In this unit, for biweekly theoretical lessons, students were split into two groups, and for lab classes, into 14 groups of an average of 28 students.

1.2. Curricular unit B

In CU B, the approach is more teacher-centered. The objective of lab classes is to evaluate students' skills and assimilation of the content presented in theoretical lessons through pen-and-paper resolutions of a list of selected exercises.
The evaluation comprised two written tests (on paper, by hand) in two different moments, each covering half of the curricular content. These determined a grade for CU B on a scale of 0 to 20. Students could then, if they wish, improve their results in one 'final exam' moment with questions about all the curricular content leading to a final grade. Students who obtain ten or higher are approved. Evaluation tests/exams have a clear pattern of questions presented over the years.
The academic information system SIGARRA contains bureaucracy, resolutions to some exercises, solutions to all, and exams from previous years, with criteria for an evaluation in each question.
In this unit, for biweekly theoretical lessons, students were split into three groups, and for lab classes, into 15 groups of an average of 28 students.

1.3. Discord

Discord is a social platform that allows users to communicate in private chats or as part of communities called "*servers*". A *Discord* server is a collection of persistent channels, either text or voice (with a screen-sharing possibility). Joining a server requires an invitation from another member with such permission (directly or through a published link/code). After signing up, the user can join existing servers or create a new one. When setting up a server, the user can create channels, organize them into categories, and devise a permission structure based on a user-created hierarchy of roles. The latter can have associated different permissions regarding what they see and actions they can perform (e. g. read, write, react, share, etc.). Messages in each channel are permanently stored, except for *threads*, which are side-conversations derived from a specific message (and eliminated after 24h for non-premium servers). The permission structure devised for the server determines the access to channel history. A *Discord* user can join different servers and choose a server-specific name (the user image is bound to the profile for non-premium users). A list of members, divided into roles and their online status, can be visible to all members. *Discord* allows *Bots* that perform different automated actions, opening possibilities and helping with server management.

2. Server setup

We created a server with four channel categories and four roles. The latter had different permissions and the following hierarchy:

- **teacher**
    - **op** assigned to selected students that would help with server management;
        - **din** a student per class, chosen to help promote the server activity;
            - (5) **class X** these correspond to the 5 groups that used *Discord* in class (e. g. class 2). So, each student who joined the server should be assigned one of these roles.

A student can have associated more than one role. Each role is generally assigned to a subset of students. For example, say there are 400 students divided into 14 groups for lab classes. Each of these 14 groups has a number associated, from 1 to 14, and is called class X, where $X \in \{1, \ldots, 14\}$. Class 3 is to the set of students of class (group) 3. We proposed *Discord* to 5/14 groups, hence 5 of such roles.
Channels were organized according to the following four categories:

root

- landing zone (first thing seen upon arrival, with auto welcome message allowing the teacher to know who entered);
- server rules;
- auto-assign class role;
- announcements;
- suggestions/support;

study

- several channels including resources, tools/ shortcuts/ tips, bugs, forum for doubts, student forum and a screen-sharing+audio study room

(5) in-class

– text and screen sharing channels, to use during the class;

social

– free posting and discussion space.

The structure also comprised an *admin* area used for testing and discussion among server managers. We added a configurable LaTeX rendering and maths bot, which facilitated the use of math expressions and symbols. Channel purpose and simplified permission structure are presented in Tables 1 and 2, respectively. Observe that students without a class role associated could not participate in study discussions or raise questions. As having a class role was an auto-assignment task, which required a simple reaction to a message, this seemed like a minimum threshold for participation.

	Purpose
root	welcoming; describing the server rules and structure; making announcements; auto-assignment of class roles
Study	in-between classes discussions, sharing, resources;
Class X	in-class discussion and sharing; class specific announcements (e.g. weekly plan)
Social	free use

Table 1: Purpose of channel categories.

	Channels	Permissions	
		read/react	**write**
root	- welcome/landing - server description/rules - role auto-assignment - announcements - suggestions/support	everyone	everyone, social bots
			teacher
			teacher, op
			teacher
			everyone
Study	- resources - doubts - forum - audio/screen-sharing	class roles	teacher, op, din
			teacher, class roles
(5) Class x	- text - screen-sharing	class x	teacher, class x
Social		everyone	everyone
Admin	drafts/test channels	teacher, op	teacher, op

Table 2: Initial server structure and read-write permissions.

2.1. Server evolution

The initial idea for the server was mostly for in-class use in CU A. As lab classes are in computer classrooms, *Discord* presented some advantages over other technologies tested in previous years, as those tested during pandemic restrictions. Screen-sharing, for example, is efficient and has minimal impact on computer performance, which is particularly important for students using their laptops. The persistent text channels allowed substituting the whiteboard for most cases (which eliminates the '*copy before it's erased*' effect)

while instantly creating a repository. It also allowed fast reactions to messages (for example, the teacher can react with a green arrow). Both of these things were difficult to do the previous year (even when trying different platforms).
Using different roles with different permissions creates a dynamic but organized environment where students can be involved in server organization and management. It is usual for a *Discord* server to have similar settings, although in different contexts. Restricting permissions allows some control and management of a safe environment for the participation of everyone. The hierarchy of roles and permissions is something students value, are used to, and respect.
We proposed *Discord* to 5/14 groups in their lab classes for both in and out-of-class use. Later, as we detail next, other students joined the server by invitation of those using the server (something we did not restrict). It then became necessary to create another role, called "*other classes (groups)*", that would contain all students from groups that did not use *Discord* in class (students from the remaining 9/14 groups). Students to whom *Discord* was not suggested directly (by their lab class teacher).
We were overcautious at the beginning. For example, we thought it would be necessary that teachers would do the assignment of class roles. It would be a daunting task doing it for so many students, one by one. We enrolled a student as *op*, who quickly devised a way (through a Bot) so those *class X* roles would be auto-assigned upon choosing the correspondent reaction to an explicative message. Due to technical limitations, it allowed some to pick more than one class role which did not correspond to their class (note these are mutually exclusive in practice). However, this posed no problem.
The *op* role was crucial in creating some sense of responsibility and molding the server with students' ideas. For example, an idea that appeared later was a *Bot* with a participation ranking, attributing levels to students according to their participation and gamifying the activities. It was something we considered while setting up the server but that we discarded. However, it was one of the first things students proposed (and implemented by themselves).
Initially, there was only one channel for doubts in the *Study* area. After 1/2 weeks of classes, we felt the need to create a second channel, a *student forum* in which the teacher did not intervene. The *doubts* channel became too focused on teacher-student discussions, so this aimed at incentivizing student-student discussions.
Later we also felt the need to use *threads* for specific doubts, concepts, or exercises that led to prolonged discussions. These work as topic sub-channels that prevent the main channel from becoming cluttered but, in the non-premium version, are eliminated after 24h hours of inactivity.

3. Quantitative analysis and discussion

In the first lab class of the semester (CU A), we asked 5 of the 14 groups for lab classes, by raise of hand, who used Discord previously. In all five groups, the majority of students raised their hands. We then proposed Discord for use in class and helped those without previous experience with the platform. In computer classrooms, it is easy to use the platform through a web browser on shared computers. These five groups all had the same teacher, the only teacher-member in the server in the first semester.
At the end of the semester, students asked about the possibility of continuing to use the platform in the subsequent semester at CU B. We followed up on the request and added a second teacher to the server, who was part of the CU B teaching team. (At that moment, the use of *Discord* had been generalized and not restricted to any subgroups of students, as we detail next.)

***Discord* activity.** Although we proposed *Discord* to 36% of students (5/14 groups in the first semester), we allowed members of the server to create and share invitations. Through invitations from colleagues, the server quickly rose to usage by more than 75% of enrolled students. It was an unpredicted effect (which we did not restrict). Our initial intention focused on in-class use, with the possibility of some out-of-class activity. In CU A, the first semester, the use blew up for in-between classes and round-the-clock discussions. The students requested following up in the second semester with CU B using the same server. We replicated the structure, replacing some channels that required clear channel history.
Table 3 shows the number of messages sent by the eight students with a higher total by the end of the year (after A and B finished). The counting identifies the corresponding curricular unit by message date. We present a separate column with messages sent in the social area, an area dedicated to messages not meant for curricular content discussions. Even though dedicated to socializing, these messages were often meta-discussions or related to the feeling elicited in students. Some examples include sharing a *meme* or joke related to one exercise. Others were: "*Question 3 was hard!*"; "*I couldn't finish the test!*"; "*Took me 30 min to correct my proof in exercise 3 after understanding it properly, then submitted the wrong file.*"; "*When are grades coming out?*". Messages in the social area being so closely related to CU meta-discussions is possibly due to students being aware of the teacher's presence, even in this area.
In both units, the (vast) majority of messages were not in the social area but curricular content related. Furthermore, the tendency of higher activity in CU A is transversal in both fields. Let us also emphasize the high number of messages associated with CU A.

Grades. At the end of the semester, students get a final grade based on evaluation moments (tests/exams), ranging from 0 to 20, and a student is approved if that grade is 10 or higher. Table 4 presents the percentages of approval and participation in sufficient evaluation elements for A and B. Table 5 shows the respective variances. The number of enrolled students was higher in 2021/2022 because of a merger of two programs within the university. Associated with the increase in *numerus clausus* is a lower worst score in candidates accepted. One could expect no change or a decrease in CU A and B grades and approval rates.

	A		**B**	
	total	social	total	social
Student 1	1435	79	110	0
Student 2	587	8	102	42
Student 3	354	4	0	0
Student 4	286	25	44	3
Student 5	313	3	7	0
Student 6	241	5	73	0
Student 7	188	0	0	0
Student 8	159	0	5	0

Table 3: Number of messages posted by top 8 student-members overall.

3.1. Curricular unit A

In Table 4, we present the percentage of students approved, not approved, and those for whom there were not enough evaluation elements. There was a significant difference (statistically speaking) in grades in 2021/2022. We do not feel confident building a hypothesis

Year	Students	Approved	Not approved	No-show
		A		
2019/2020	211	71.5%	20%	8.5%
2020/2021	252	73%	17.5%	9.5%
2021/2022	**394**	**84.5%**	**9.9%**	**5.5%**
		B		
2019/2020	205	68%	7%	25%
2020/2021	259	68%	8%	24%
2021/2022	**448**	**63%**	**10%**	**27%**

Table 4: The proportion of approved, not approved, and students who did not participate in minimum evaluation moments, in three consecutive academic years in CU A and B. Recall *Discord* was implemented in 2021/2022.

	A	**B**
2019/2020	17.24	17.3
2020/2021	18.78	17.55
2021/2022	**14.26**	**17.61**

Table 5: Variance of final grades

based on such analysis due to changes in the teaching team in the year 2021/2022, which in this CU affects the formulation of evaluation questions. However, we point out that a higher percentage of (successful) participation in evaluation moments is in line with the idea of an increased engagement with the subject. We found no significant difference in grades between groups that used *Discord* in class and those that did not. It suggests again that out-of-classes activity was the more relevant change produced by the implementation of *Discord*.

One interesting aspect that stands out while analyzing the final grades data, which we believe can contribute to formulating a working hypothesis, is variance reduction. (Table 5 shows variances in respective years.) We performed Levene's test for a year-to-year pairwise comparison of final grades to assess the equality of variances across years in CU A. There was no significant difference between 2019/2020 and 2020/2021, suggesting equal variance. When comparing 2019/2020 with 2021/2022 we obtained $p = 0.02707$, and for 2020/2021 versus 2021/2022 we obtained $p = 0.04649$. It suggests rejecting the hypothesis of equality of variances at a significance level of 0.05.

We hypothesize, then, a homogenization effect. Students have different study tempos and depths in their approaches to the subject. They may study in groups, but these generally lead to separate studies and questions. *Discord* worked as a shared space where anyone could see (and be a part of) what others discussed, studied, and the difficulties and solutions. The teacher can follow and redirect or suggest *in loco*. As the platform has increased usability that promotes widespread participation, this can provoke a homogenization of all learning processes, even for those just observing. One student said: "*I thought I was following everything quite well, then I would look at discord, see others discussing and realize I was not really understanding.*".

Homogenization can have the negative connotation of eliminating differences in behavior or activities, but here we take it to mean the opposite. The homogenization effect we refer to stems from creating a more inclusive space for discussion, where different personalities could more easily find a participation space, and access to group and individual discussions

becomes less dependent on social skills. An effect that also results in a collective approach to understanding.
On the one hand, this means a homogenization of acquired knowledge across various learner profiles. On the other, a homogenization of learning opportunities, of space that potentiates a symbiosis of different study, understanding, and learning processes. Results then become more homogeneous because there is a dissemination of acquired knowledge, collective learning, and a reduction of the excessive valorization of a specific typical *good-student-profile*.

3.2. Curricular unit B

We found no statistically significant difference in grades (or their variance) when comparing the three years in this unit (as suggested by Tables 4 and 5). There is a slight decrease in approval and participation in evaluation moments. It is not statistically significant, and in fact, as mentioned before, expectable with the increase in *numerus clausus*.
Although this is in contrast to data for CU A, it does not seem surprising, given the activity gap between the two CU presented in Table 3. However, it is more interesting than may appear at first. The activity in *Discord* was relevant! Students, especially those who used *Discord* only in this unit (not in CU A), referred to it as a good experience that helped them. The weeks leading to the tests concentrated the majority of activity, with students admitting that it was how they found *Discord* helpful to their study of this CU (with a token of appreciation for the time teachers dispensed dealing with such peaks of activity).
For this CU, we made some changes to the channel structure of some areas in the Discord server to try and produce some optimization, considering previous experience in CU A. One of these changes was splitting the discussion text channel in the Study area in two: a fast forum and a slow forum. The idea was to provide two spaces for different discussions: one for easily solved doubts or questions; and a second channel for more in-depth discussions of some concepts or exercises. The fast forum essentially absorbed all activity. One student said: "*I already know:* [CU B] *test coming? There goes the fast forum!*". It suggests some students took on a different perspective for the platform than the one envisioned at the beginning of the year.

3.3. Comparative analysis

The difference in activity between A and B is clear from Table 3: a significant reduction in activity when comparing A and B. It is also clear that most messages are related to curricular content, with reduced social activity. Furthermore, the level of social activity is dependent on curricular content activity.
In the three years analyzed, CU A used a virtual forum in a different platform, concomitant with *Discord* in the last. While, in previous years, the activity was relevant, it significantly reduced in 2021/2022 to practically zero, suggesting *Discord* replaced the classic forum. However, the activity level attained in the last year using *Discord* is incomparably higher than in previous years. The typical forum activity involved around 20-30 topics/messages with 1/2 responses on average. That means the level of *Discord* activity in B is higher than that of a classic virtual forum in previous years in CU A. In the years 2019/2020 and 2020/2021, there was no such forum in B, so we lack a comparison, but we observe the level of activity is not low. It is, when compared to *Discord* activity in A. The fact that this led to no significant difference in grades in B reinforces three ideas: i) the level of engagement possible to obtain with *Discord* is higher than that of a classic or academic virtual forum; ii) the type of activity is different; iii) *Discord* is a tool that does not work

by itself, as the setup was identical in both units.
Our hypothesis for explaining the gap is the methodological and pedagogical difference between CU A and B. In this difference, we include three key aspects in A:

1. the active methodology builds on a proposal for students to explore the subject following an inquisitive approach;
2. the evaluation moments, with a different periodicity, in which questions don't have a pre-defined structure that repeats from one year to the other;
3. the centrality given to the support software (in exploring the curricular content, in exercises, in evaluation moments);

The software promotes engagement and exploration of the subject, provides feedback for home study, and frees time from some routine /rote exercises to explore understanding. Combined with 2), which encourages students to understand the subject and prepare for different perspectives, it fosters sharing and discussion. It stimulates a collective approach to understanding, and the experience becomes more closely related to *Discord*'s original purpose: as a tool to help the community collectively solve complex situations in a gaming context. Student 1, reflecting on the experience by the end of the year, recalled: '*...I recall one occasion where we got together on a voice channel trying to solve a proof using the software. With people I didn't know at all.*'. This hypothesis could help explain the gap in activity.
In curricular unit B, some teachers also used and proposed (a different) software to some groups. It evoked some questions, and some students integrated it as a tool in their study. However, the exam did not contemplate it (as in CU A), which may be the driving motivation for widespread use. The software was not a central tool to solve exercises, nor was it required. It was an optional complement.
Another aspect, which may play a key role, is that resolutions were available for many of the proposed exercises (solutions for all) in CU B, which, when combined with tests/exams that have a similar set of problems (type exercises), can reduce the level of discussion. The difficulty of exercises here generally resides in being able to solve, compute and visualize the same problem for different objects, in general by application of a formula provided in theoretical lessons. For example: "*compute Frenet-Serret formulas*", which involves differentiation and normalization and often leads to a one-time question. The approach is more focused on explaining how to do and then asking students to use that knowledge to do it by themselves. If students expect such type of questions on an exam, the approach reduces the level of activity of virtual forums to a "*is this correct?*" form of participation. We asked students why such a decrease in activity took place (recall that extending the use of the server from A to B was the students' idea). Some answers were: "*There's not much to ask*"; "*You have that way to do the exercises, either you know it, or if you don't, go and learn it*"; or "*We know what we need to do in the exam*". A more detailed answer, comparing both units was: "[CU B] *exams follow a very similar pattern every year. A student managing to do the exams of the last 5 years, manages to mechanize well the exercises that may appear and be well (not necessarily 100%) prepared for the tests/exams without understanding the real meaning of the concepts. In* [CU A] *it was necessary to have the concepts better internalized which led to a search for a better understanding of the concepts and discussion about them. At least for me.*"
Other effects may contribute to differences in activity. For example: i) the novelty effect: it is the first year, a first university experience when, possibly, relationships are still not yet built, and A came first; ii) A has more evaluation moments which boosts activity; iii) lab classroom typology: computer rooms versus classic white/blackboard room; or iv) a

second teacher added to the server could have changed the environment. However, even if these variables have an impact, we find it unlikely that the latter variables could by themselves sustain such a large gap.

4. Reflections on the learning process

For the most part, reflecting on *Discord*'s impact as a pedagogical tool, on its benefits and drawbacks, follows typical parameters of a forum methodology. The main difference is that it incorporates students' culture and language, and many already use it daily, which provokes a significant difference in activity level. It is also easily accessible by comparison with other forums, which sometimes require students to connect through a web browser specifically to participate in the forum. This potentiates activity and engagement by boosting the trinity: usability, user experience and accessibility (Sauer, Sonderegger, and Schmutz 2020).
We discuss the characteristics and impact on the learning process along the lines described below.

(i) ***Culture and language.*** *Discord* facilitates that students transport curricular content and learning processes into their language and cultural references, incorporating and appropriating it, often in a playful manner (close to a gamification process). It promotes learning with interest and implication, stimulates discussions that make sense to them, and increases usability.

The environment does not have a direct correspondence to that of the classroom. Identities in the server do not indicate the students' identity in the course (by methodological option in setting the server). It opens the possibility of anonymity and the imagination of a persona/role for the discussion and community. The more active students in such environments are not necessarily the same as in in-person classes, which diversifies discussion and participation, enriching it. However, it can prevent the teacher from making the identification between server members and enrolled students.

(ii) ***Relationship.*** The possibility of playful interaction with the curricular content and with other members is enhanced, creating new paths to develop and strengthen the relationships between students and teachers (student-student, teacher-student, and teacher-teacher).

For example: *some students started changing their identification name on the server to ones (alias) that were a joke relating to curricular content and other situations which involved either the teacher or other students.*

There is a game and engagement with who your persona is and the role you take on the platform, which then translates into the role you take in the learning process of the community. This highlights the sense of community and bonds developed.

(iii) ***Collective learning.*** Everybody benefits from each other's doubts. Everybody sees what others are studying and gets a new perception of their understanding in context.

With increased usability, strengthened relationships, and without a language barrier, it promotes a sense of community facing the same problem, which leads to a collective approach to its solution, that is, to a collective understanding.

(iv) ***Tempo.*** Classes and other in-person moments pass from a weekly intense periodic event to a moment that is part of a continuous learning process. It no longer elicits

a stressful feeling of a short and only time for doubts and questions. Writing down questions and doubts to ask in an in-person moment or a formal language often creates a need for accumulating *relevant and knowledgeable questions* that are worth the teacher's or the class's time. A platform that provides a way to ask a question when it occurs frees in-person moments and provides students with a more fluid learning process.

It allows the teacher to follow the students' study process in-between classes and, as classes *gain time*, invest more in an *answer-with-question* methodology. The latter often creates impatience in some students that feel the need to advance in the content and dispense questions of a more philosophical nature. These can be discussed in *Discord* but also during class, as students know they will have time to discuss their doubts in *Discord*.

Classes become a place for *understanding*, not merely a place to solve exercises on your own, aided by the teacher.

(v) ***Availability.*** Being available on both mobile and computer and being user-friendly opens the window of interaction to a 24h possibility. It significantly improves the fluidity of the learning process and the relationship with the teacher. It is, however, a double-edged sword. We are invading a space students use daily and their mobiles with school content when there aren't many of these spaces left anymore. It is also a decision the teacher needs to make regarding notifications and when/ where to use the platform and be available.

5. Conclusions

Compared with similar tools, the main advantages of using *Discord* are usability and engagement (increased activity), ludicity and implication (stronger relationships), and cooperation and collectiveness (enhanced sense of community). All this while fostering an inclusive environment. The visible (for students) effort of having the teacher meet students in their language, and using their cultural references and spaces, is highly valued and potentiates the effects. The recognition of this availability for dialogue is a crucial aspect in fostering student's autonomy and critical approach, building a stronger learning process (Freire 2014).
We identify four key aspects to consider while setting up a similar platform in the future:

(i) **Involvement and dynamism.** The first step toward improved usability is a structure that can be adapted as activities evolve. Involve the students in building and updating it from the start. Not only do students get motivated, but it enriches the space while building up usability.

(ii) **Safe and ludic.** The teacher's language and reactions determine the environment and attractiveness of the space as a discussion forum. It is crucial that different languages, both formal and informal, are incentivized, as it is to engage in the playful approach to discussion.

(iii) **Early availability.** Fast response in the start is determinant in making members understand the space will be helpful for discussions when questions occur, and not just another platform with a periodicity similar to in-person classes.

(iv) **Danger of exclusion.** Maintain different spaces and channels of communication open. In particular, ensure there is no confusion as to what is the official channel of communication. Such platforms work ably as optional, but they carry the risk of absorbing all activity and excluding those who are not proficient in using it.

References

Bayne, Sian. 2015. "What's the matter with 'technology-enhanced learning'?" *Learning, Media and Technology* 40 (1): 5–20. 10.1080/17439884.2014.915851.

CNBC-disruptor-50. 2022. *Discord - How digital natives converse.* Web Page. https://www.cnbc.com/2022/05/17/discord-disruptor-50.html.

Dale, Robin, Steven Robertson, and Tim Shortis. 2004. "You can't not go with the technological flow, can you?" *Journal of Computer Assisted Learning* 20:456–470.

Dennen, V. P. 2008. "Pedagogical lurking: Student engagement in non-posting discussion-based courses." *Journal of Educational Computing Research* 39 (4): 395–413.

DeRosa, Robin, and Scott Robison. 2015. "Pedagogy, Technology, and the Example of Open Educational Resources." *EDUCAUSE Review* (November). https://er.educause.edu/articles/2015/11/pedagogy-technology-and-the-example-of-open-educational-resources.

Freire, P. 2014. *Pedagogia da autonomia: Saberes necessários à prática educativa.* Paz e Terra. ISBN: 978-85-7753-226-1.

Garrison, D. Randy, Terry Anderson, and Walter Archer. 2000. "Critical inquiry in a text-based environment: Computer conferencing in higher education." *The Internet and Higher Education* 2 (2-3): 87–105.

Geyser, Werner. 2021. "Discord Statistics: Revenue, Users & More." Accessed April 24, 2023. https://influencermarketinghub.com/discord-stats/.

Oliver, Ron, and Jan Herrington. 2003. "Exploring Technology-Mediated Learning from a Pedagogical Perspective." *Interactive Learning Environments* 11 (2): 111–126.

Sauer, Juergen, Andreas Sonderegger, and Sven Schmutz. 2020. "Usability, user experience and accessibility: towards an integrative model." PMID: 32450782, *Ergonomics* 63 (10): 1207–1220. 10.1080/00140139.2020.1774080.

Selwyn, Neil. 2010. "Looking beyond learning: Notes towards the critical study of educational technology." *Journal of Computer Assisted Learning* 26:65–73.

Siemens, G. 2005. "Connectivism: A learning theory for the digital age." *International Journal of Instructional Technology and Distance Learning* 2 (1): 3–10.

Vygotsky, L. S. 1978. *Mind in society: The development of higher psychological processes.* Harvard University Press.

Acknowledgments

We thank João Ramos for all the support and helpful discussions.