# Enabling a Mathematics-learner identity through team-based learning initiatives

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## 1. Abstract

A review of some of the literature regarding the construction of a *Discursive identity* in students of Mathematics, in connection with *team-based learning* activities. To contextualise these, I will present two current initiatives at UU, in which one of the main objectives is to enable the students to develop this identity as well as a sense of belonging to the community of Mathematics-learners.

## 2. Introduction

Learning Mathematics is a complex process that involves developing new ideas while transforming one's ways of doing, thinking, and also *being*.

The aspects in which teaching the discipline traditionally is mainly focused are: building skills by solving problems following certain procedures and in the construction and/or acquisition of mathematical concepts. The development of the *being* part of the transformation towards a Mathematics-learner identity is usually taken implicit or obliterated. But learning Mathematics involves becoming a *certain type* of person, aligned with the practices of a community, where learning occurs through *social participation*. This includes not only thoughts and actions but also belonging to social communities. Through relationships and experiences with their peers and teachers (who in my opinion are no more than advanced learners), students come to know who they are, relative to Mathematics.

Therefore, it seems natural that students, as learners of Mathematics, they will not only need to develop mathematical concepts and skills, but also the identity of a Mathematics-learner within a community.

Team-based learning relies on small group interaction which allow students to use and to improve their abilities, concepts and skills, both mathematical and social. Moreover, since participants share responsibility for the learning that takes place, these collaborations help the development of a learning community.

The objectives of this project are:

- To review some literature concerning the notion of *identity* in social theories of learning and *team-based learning* strategies.
- To present two initiatives currently running by some members of the department of Mathematics at UU, in which one of the main objectives is to stimulate the creation of an identity as Mathematics-learners within a community of students of the *Kandidatprogram i matematik*. These initiatives are mainly run in team-based research learning tasks rather than in expert centred lecture formats.

## 3. Identity and Matematics-Learner identity

A quick look for references about the concept of *identity* and *identity development* in social sciences, immediately unveils that multiple different perspectives can be found (see for instance the discussions in [3] or [4]). So, I have decided to focus my attention to the concept of *Discursive identity* introduced by G. P. Gee [4]. Following Gee's approach, *identity* is described as 'Being recognised as a certain "kind of person", in a given context'. The author describes four perspectives, not separated from each other, on identity:

- Nature-identity (defined by forces in nature )
- Institution-identity (defined by authorities within institutions)
- Affinity Identity (defined by the domain of shared experiences and practices)
- Discourse Identity (defined by the descriptors used to define an individual)

Focusing in the last facet, discourse identity 'is produced and reproduced in the ways in which people talk to and about others in discourse and dialogue', where discourse can be described (see [1]) as 'certain ways of using language, acting, interacting, behaving, believing, using tools, sign systems, which characterise a particular community'. From this perspective, identity is thus a continuous process constructed in the social interaction, between multiple actors in a specific framework. So, quoting [2, 3]:

> 'The term "discursive identity"reflects an understanding that speakers apply as they select genres of discourse with the knowledge (tacit or implicit) that others will interpret their discourse as an artefact of their cultural membership'.

In some literature, identity development is described as the process of becoming a member of a *community of practice* (see [10] and references within), which can be described as 'groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly'(see [9]) . From this point of view, identity is a constant process of becoming, where an individual continually negotiates who they are through their practices as they become and belong to a community. It is through the process of sharing information and experiences with the group that the members learn from each other, and have an opportunity to develop themselves personally and professionally

Within the mentioned above, student's identity is a multifaceted entity formed through their life as members of a community, which incorporates their knowledge, abilities, skills, beliefs, dispositions, attitudes and emotions. In a broad sense, it reflects 'who the student is', and it is brought to the classroom with them.

Learning the content and language practices of a discourse-rich subject matter like Mathematics requires some appropriation of an identity adequate with the language use. The goal of mathematics education, is to develop, beyond than just learn mathematical concepts and skills, a strong mathematics discursive identity, that I'll call Mathematics-learner (ML, for short) identity. But, paraphrasing [1], in order to achieve successful learning, we need to recognise the multiple identities held by the students and provide an authentic range of mathematics-related activities through which students can develop a ML-identities and make more explicit key aspects of the discourse of Mathematics.

One important factor that limit the student's learning alluded in the bibliography is the conflict between their everyday language and the academic discourse. That is, students suffer an 'identity crisis' that lead many of them to drop-out joining the practising community [1].

Moving from the abstract of education to the specificity of the Mathematics classroom, it is pointed out in [5] that an important role of the teacher of Mathematics, as a expert practitioner of the ML discourse, is to scaffold the development of students' ML identity and to facilitate the naturalisation of the ML discourse into the student's everyday practice, bridging student and subject . So, the teacher should work towards the creation of a classroom environment that should provide a space for acquisition and rehearsal of the ML discursive identity .

> I do not know how to present mathematical ideas so effectively that students can take possession of them simply by sitting at my feet and smelling my socks.
>
> Ask a dozen of your students [...] and you'll be astonished to learn about the bleakness and academic isolation in which some of them exists.
>
> George Piranian, *The problem of Learning to teach*

I choose the previous quotes, extracted from [6] because, in my opinion, they are related to two aspects needed to achieve the objectives of naturalise the ML discourse and enable a ML identity cited above:

- Mathematics practitioner must have a pro-active role in the learning of Mathematics, dedicating substantial time to ruminate and juggle mathematical concepts.
- Mathematics are developed within a community of practice.

A methodology that address these two points is the so-called Team-based learning (TBL for short) (see [7, 12] and the videos [13, 14]. A good source of material for TBL activities can be found at [8] ). TBL is a type of cooperative learning, organised around small group interaction (5-7 students). The primary learning objective in TBL, beyond covering subject content, is to ensure that students have the opportunity to practice using course concepts to solve problems in a work group environment. With this aim, the objective for the teacher is to create the framework that promotes the interaction required to transform groups into highly effective self-managed learning teams. The four essential elements of TBL are:

- Groups: Groups must be properly formed and managed.
  - The groups have to be diverse
  - Maximization group cohesiveness
  - Enough time to develop group dynamics
- Accountability: Students must responsible for the quality of their work
  - Individual pre-class preparation
  - Ensure that members contribute time and effort to group work. Involve the students in a peer assessment process
  - High-quality team performance
- Frequent immediate student feedback
- Assignment design:. Assignments must promote both learning and team development. Must ensure that they truly require group interaction

About the benefits of such type of methodology, in the article cited above, Piranian makes a plea to teachers of Mathematics to engage students in cooperative work tasks, citing his own experience on that:

> (The students) may meet for a great jam session. Leaders emerge and the strong give guidance to the weak. I should share my salary with four or five students. They learn how to communicate (and the social networking goes beyond the classroom environment).

The main benefits of TBL (when it is well implemented) mentioned in [7] are:

- Students can progress considerably and achieve a depth of understanding greater long-term knowledge retention compared to a traditional passive lecture curriculum
- Students learn to appreciate the value of teams for solving complex problems
- Increase peer tutoring helping the students to stay on track
- Enable students to learn a great deal about the way they interact with others
- Allow honest peer-evaluation among students
- Prompts most students to engage in their learning process

## 5. Particular Initiatives

The initiatives described below are study-groups type initiatives, so they are within the type of extracurricular scholar activities voluntary run by two members of the Department of Mathematics at UU. They are focused on the process of discovery and open-ended exploration, and pretend to introduce students to the deeper kinds of mathematical thinking as well as to provide the atmosphere for the creation of the ML identity within the ML community. In these sessions, students can put in practice their abilities to use mathematical concepts for solving transversal problems. These activities promote interpersonal and team interaction skills, needed in any future workplace. They also help participants reach out and connect with others which share similar interests, from different backgrounds, and to create a sense of belonging.

These initiatives are initially aimed at students of *Kandidatprogram i matematik* in UU. It is worth mentioning that, since the participation is also volunteer, the commitment and implication of the students is extremely high. The participation is not closed to academically excelling student at all.

### 5.1. Mathematics Olympiad Preparation group

*Objectives*

Provide a peer environment of people who have an interest in thinking about challenging mathematical problems.

Allow the participants to put in practice their ML-discourse though peer interactions.

*Methodology*

Students work in small groups using structured problem-solving strategy to solve complex problems from the International Mathematics Olympiads. Usually these are too difficult for any one student to solve individually and require the cooperation of the whole team.

Once a month, the students are gathered for sharing and discussing the solutions, partial solution, thoughts that each group has obtained and/or developed.

*Instructor effort*

Creation and maintenance of groups

Organisation and facilitation of the sessions: Preparation of assignments. Provide immediate feedback

*Similar initiatives*

There exists similar initiatives around the world. Some are preparatory for competing in the Mathematics Olimpiads and other just recreational.

### 5.2. The 'Wulfings'

*Objectives*

Giving students the possibility of learning mathematical concepts beyond the academic curriculum and applying those that they have learnt to develop Mathematics.

Building the sense of belonging to a community of MLs, which support extends beyond the academic atmosphere, and contributes to the creation of the students' ML identity.

*Methodology*

The activities are run in a classroom environment for five days in a row, twice a year, before periods 1 and 3 start. In each sessions, that are day-long with pauses, students interact socially in and out the classroom.

Students receive some materials for reading previously to these meetings as a preparatory material.

These session are a mixture between classical lecturing, team solving problem sessions, and Moore method [11] sessions.

*Instructor effort*

Preparation of reading material and coordination of the activities.

*Similar initiatives*

To my knowledge, the department of Mathematics at Charles University of Prague, organises a similar activity, once a year in spring time. In that case, students are in a mountain resort and practice social activities (like team sports, hiking) beyond academic ones.

There exists similar initiatives, like the *Math retreats* organised by the University of Wisconsin-Eau Claire.

## 6. Conclusions

For students of Mathematics to learn and to participate in the ML community, they must master the discourses of the community and develop the kind of discursive identities for someone who belong to this community, integrating these with their other identities.

An effective way of the development of the ML discursive identity is through cooperative learning activities. The social interaction enables the practice of the discourse and foments the feeling of belonging to a community of practice. In this setting, TBL is a learning methodology that creates social learning environments and abets the student to have a proactive role in the learning process.

These cooperative learning activities allow also the development of social interactive and team-working skills, that students are going to need for their future professional career.

## 7. References


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