



Guidelines for the development of teaching units from concepts

Environment	<p>When developing teaching units for linguistically and culturally heterogeneous classrooms, it is essential to be working in learning environments that are accessible to all learners in the group, regardless of their cultural and linguistic background.</p> <p>The teacher looks for a substantial learning environment rich in mathematics allowing differentiation, supporting individual learning and collaboration. Thus, the environment is truly inclusive. Differentiated tasks allow learners at all levels, of all backgrounds to achieve their best and experience the sense of achievement.</p> <p>The basic principle is the principle of inclusive mathematical environment, i.e. the environment is student-centred, creating opportunities for learning mathematics. If the cultural setting of a teaching unit is distant to the learners, they may fail to recognize the mathematics they know outside of school (e.g. from their homes), which may result in lower performance than they could in fact achieve.</p> <p>The teacher thus adapts the units in a way that they support pair-work, communication and collaboration and allow the learners to work on different levels of difficulty. A set of tasks from the easiest to more difficult ones (sometimes referred to as graded tasks) may be one of the options – the students themselves make the decision on the difficulty of the task they are working on.</p> <p>With respect to possible language obstacles, the environment should allow more mechanical (mathematical) tasks that require less knowledge of language as well as more demanding tasks including higher order thinking skills, e.g. reasoning. When it comes to justification and argumentation, pupils whose mother tongue is not the language of instruction will struggle and before they become proficient in language of instruction they should be allowed to use their mother tongue and translator or skip the tasks until their language skills are more developed.</p>
Age of students/grade	<p>A teaching unit suitable for the use in culturally and linguistically heterogeneous classrooms may can be developed for students of any age and grade. There are no restrictions.</p>
Length of the unit	<p>A teaching unit may vary from 1 lesson to several lessons. However, it is recommended that the teacher plan the unit shorter, 1 – 2 lessons. That does not mean they cannot develop several teaching units in one environment that has proven to be efficient. However, if the teaching unit is shorter, it is easier for the teacher to bear in</p>

	mind all the special needs of their learners. Also, the later units are then developed taking account the previous lessons.
Materials needed	<p>This depends on the lesson plan developed. Generally, a teaching unit supporting diversity does not need many additional materials although pupils may benefit from having the chance to use the internet, e.g. for translating texts or looking up new words and terminology in case they do not understand in language of instruction yet.</p> <p>It is recommended that pupils whose mother tongue is different from the language of instruction keep their own glossaries or personally made dictionaries where they keep all the new mathematical vocabulary and terminology. This works best if the new term is translated into their mother tongue but also to illustrate the new term by examples, drawings, symbols etc.</p> <p>Since technology is becoming a widely-used tool in mathematics lessons, it will be used in teaching culturally and linguistically heterogeneous classrooms as well.</p> <p>Since not all learners can be expected to understand the language of instruction, it may be important to use visual aids, models, drawings etc. In geometry, using e.g. dynamic software may help learners visualize.</p>
Objectives	Objectives of each developed teaching units will depend on the curricular documents, i.e. what a learner is expected to have achieved in the particular mathematics lesson.
Content related anchor points	<p>The anchor points are:</p> <ul style="list-style-type: none"> • Enriching the content by the experience of migrant students, e.g. in the beginning of the lessons allowing migrant pupils to present how things work in their country (e.g. food, drinks, hobbies, money etc.) • Differentiation • Ensuring that all the mathematical content has been covered
Methodology related anchor points	<p>The anchor points are:</p> <ul style="list-style-type: none"> • Selecting tasks that allow cooperation, especially pair work where students can work in mixed pairs (one pupil whose mother tongue is the language of instruction, one migrant pupil) • Selecting differentiating tasks, allowing individual work, respecting the pace of each individual learner • Using student-centred perspective • Using visual aids • Using modelling • Allowing hands-on experience • Supporting individual discovery • Giving formative assessment, e.g. using rubrics to give each student individual feedback
Language related	<p>The anchor points are:</p> <ul style="list-style-type: none"> • In-depth analysis of language structures that can be

anchor points	<p>expected to be used in the lessons, detecting the possible obstacles and sources of not understanding</p> <ul style="list-style-type: none"> • Presenting new vocabulary in the beginning of the lesson • Checking understanding (the learner understands the instructions, knows what they should do) • Allowing students whose mother tongue is not the language of instruction to use dictionaries • Using visual aids, illustrations
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The 3 pillars for developing teaching units

Pillar 1 - Context of interest for all pupils in the classroom regardless of their cultural and linguistic background

Context selected for teaching can be either of equal interest to everyone in the classroom or may be quite distant to some of the pupils and their experience (e.g. pupils from different linguistic and cultural backgrounds). If the latter is the case, the situation may result in a decrease in some pupils' motivation to work, may cause they do not recognize the mathematics they know from home and previous education in the alien context, may make them feel isolated or second-rate. Therefore, when selecting a topic, the teacher should make sure that it really is something that can be discussed with pupils from any country and from any linguistic and cultural background in their classroom, i.e. should be universally interesting. Suitable topics can, of course, vary widely, depending on the particular pupils' background and interests.

A teaching unit based on this pillar can be organized e.g. as follows: It can start with a discussion or a brainstorming activity about the chosen topic. Topics that are usually of interest to all pupils in the classroom may be sport, food, popular culture, fairy tales, computer games, animal realm, free time, family, board games, money. This starter activity may (and will in most cases) be not limited to mathematics but bears a rich potential for the following lesson of mathematics. It should be complemented by meaningful questions solvable by mathematics.

The starting activity should be followed by an activity that makes the connection to a mathematical topic; for example, it may offer a solution to one of the issues raised in the starting discussion or brainstorming, it has to make a convincing connection between the context and the mathematical topic.

In the rest of the teaching unit, the connection to the context should be kept. Particularly at the end of the unit, it is important to come back to the originally raised issue, so that the pupils can be convinced that mathematics can really play an important role in solving problems in the chosen context of the unit.

Pillar 2 - Using cultural differences as funds of knowledge and using this to empower all pupils in the classroom

The teaching unit must see the cultural differences in the classroom as an advantage, as a source of new, rich and innovative content, not as an obstacle. The unit should have a rich potential for every culture. It should exist in all cultures present in the classroom, be of interest for the participating pupils. Every pupil should be able to say something about it during the discussions. One of the teacher's important tasks is to find a topic with mathematics involved. It would be frustrating for pupils to start discussing the topic enthusiastically and then find out that they cannot work with it any further because the mathematics is above their level or there is "no mathematics" in it.

To start this unit, it would be good if all pupils could bring samples from their own cultural background to the classroom or have access to useful resources. Even if that is not possible, the teacher elicits the pupils' knowledge and experience, which becomes the source of knowledge for everyone in the classroom. Pupils from various cultural backgrounds bring their own experience, learn more about each other and different cultures and feel that mathematics lessons are inclusive, appreciating diverse experience.

In the unit, it is recommended to discuss materials and ideas brought by pupils through the lenses of mathematics. Such analyses can emphasize similarities and/or differences between different cultures present in the classroom. It is of value not only for minority pupils, everyone should benefit. It is particularly important to stress that the cultural input from all the pupils is seen as equally valuable.

What is of utmost importance here is giving all pupils the opportunity to be heard, to show that their experience matters and that it is a source of knowledge for others in the classroom. Showing that they have a culture and a language of their own, that they have rich repertoire of knowledge, albeit different from the rest of pupils is extremely important for their motivation and self-confidence. At the same time, it promotes mutual understanding, respect, tolerance, helpfulness, empathy and open-mindedness in all pupils in the group.

Collaboration between pupils from different groups (language, culture) should be encouraged by the teacher as pupils can learn a lot from each other and they can help each other out.

Pillar 3 - How (seemingly) simple things can be very different (and difficult) in other places and cultures

In heterogeneous classrooms, there are, to generalize, two groups of pupils - majority and minority culture and language pupils. This pillar is based on the situations when something seems obvious and natural for pupils from one of these groups and completely alien to the others. The used materials and activities are supposed to help to overcome this obstacle and to help pupils better understand their cultures and backgrounds. For example, the names of numbers in French include quite a lot of additional information that is not in the words in Czech or German. Another example could be the use of units or non-decimal number systems.

As proposed in (Novotná, Moraová & Ulovec, 2021), the unit may start with pupils from various backgrounds and countries (also from the majority culture) reporting on how the particularly chosen topic works in their country and language. Alternatively, videos can be watched dealing with the topic. In any case, it is important to stress right from the beginning to all pupils that just because something works differently in another country, it does not mean that it is of less value, less sophisticated, or “not as good” as in the majority culture. Advantages and disadvantages may be discussed, under the careful guidance of the teacher. It is also possible that pupils (or the teacher) can bring suitable demonstration objects that fit with the topic.

The unit can then continue with either concentrating on one particular cultural/practical setting, or by comparing different settings from different countries or cultures. It is important to take care that the connection with the mathematical topic seems natural to the pupils, and is not artificially introduced. If possible, a teaching unit based on this pillar may also discuss different mathematical notations in different countries.

From: Novotná, J., & Moraová, H. (2024). Cultural and Linguistic Heterogeneity as a Type of Learning in an Environment of Disadvantages. In *Inklusives Lehren und Lernen von Mathematik: Konzepte und Beispiele mit Fokus auf Grund- und Förderschule* (pp. 23-33). Springer Fachmedien.