

# Structuring OER Using Learning Trajectories

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## Abstract

The Wikiwijs program in the Netherlands is experimenting in structuring a repository with digital learning materials by labelling these materials with the learning goals and subjects handled by it. This makes it possible to create an interdependent arrangement of learning materials as building blocks for a curriculum. Such arrangements are called learning trajectories. A datamodel is presented in which the entities involved and their relationships are depicted. A first implementation of this is realized and published in September 2010.

## Keywords

OER, curriculum, learning trajectory, Wikiwijs

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# 1. Introduction and problem statement

In the Netherlands the government has formulated learning goals to be reached for Primary and Secondary education. Secondary education in the Netherlands has three levels, each level divided in two sublevels (the first 2 or 3 years and the second two or three years). At the end of the second sublevel each student has the option to take a national exam in order to graduate. For Secondary education, the learning goals are formulated for each subject, level and sublevel.

The learning goals are formulated on a high level. This level is too high to be workable for a teacher or a group of teachers who want to develop learning materials aiming at covering the whole or part of the learning goals. It is at this point that commercial publishers bring in a lot of experience in developing curriculum plans (applying the high level learning goals of the government) and realizing this in a teaching method. Teachers who are using these methods can be certain that their students have covered all subjects of the curriculum sufficiently both in all aspects as in depth. Therefore, commercial textbooks are **the** guide for the majority of teachers in the Netherlands. The disadvantage is that these methods are in most cases not tailored to specific target groups (e.g. children with dyslexia) and specific situations (e.g. a school with a high percentage of allochthonous children). Furthermore, actual events are not covered, because most of the teaching methods are fixed in non-digital textbooks that last for several years. These disadvantages are only partly solved by the publishers with their offering of access to digital learning materials, in addition to the printed textbooks.

Most teachers developing learning materials take the commercial textbook as a starting point. Where they consider the method not sufficient for their needs, they will replace a small part of the method with their own materials. Some examples of situations that are considered "not sufficient" are:

- not enough learning materials to practise tuned to the specific group of students,
- not topical enough,
- not matching the didactics the teacher wants to use (e.g. group learning).

A possible answer on these problems is to structure a set of learning materials according to **learning trajectories**. In (Strijker, 2010), the following description of a learning trajectory can be found:

*A learning trajectory is a rationalized composition of learning objectives and subjects, leading to a specific learning goal.*

In this paper the Wikiwijs approach is sketched. Wikiwijs has to become the place on the internet where all teachers in the Netherlands, ranging from Primary education to Higher education, can (co)develop, share, rework and use digital learning materials, published under an open license.

Wikiwijs will not offer functionalities to use these learning materials in the context of a class (for which Electronic Learning Environments and Learning management Systems are used). The main reason for this is that most schools already use these systems.

The Dutch Educational System is described as the context of the use of Wikiwijs and in particular the learning trajectories. Then the approach in Wikiwijs will be laid out and compared with the design of a curriculum. Finally we will present the current implementation of the learning trajectories in Wikiwijs and the future plans.

## 2. The Dutch Educational System

The Dutch Educational System consists of several streams. Figure 1 gives an overview of the main streams in the Dutch Educational System.

Children move through this system from bottom to top. After Primary Education, the level of education increases from left to right (and, of course, from bottom to top). The arrows indicate possible transitions between levels after completing a lower level. In some cases, this requires extra work of the student (a homologation phase). It is always possible to move from right to left when the current level of education turns out to be too difficult.

Some tracks have a subdivision, like the Lower-secondary general level. This is divided in two tracks, one preparing for the Upper-secondary general and one preparing for the Preparatory scientific education.

The government finances all levels. In Secondary Education, parents pay some fee, meant for extra costs for e.g. lockers, travelling or other special activities. After Secondary education, every student can obtain a grant from the government (approximately €200 per month).

The government prescribes the final attainment level of the curriculum in Primary and Secondary education. These descriptions are formulated in very broad learning goals. Schools are responsible for the way they construct their lesson plans and the contents used. At the end of Secondary education, all children are to sit a national exam to earn their certificate. In this way, it is also checked if schools succeed in the way they interpreted the learning goals. Commercial publishers play an important role in this interpretation. Their school textbooks more or less guarantees a school that the curriculum is completely covered.

## 3. Developments on learning trajectories in the Netherlands

Different institutes in the Netherlands are developing and experimenting with learning trajectories for several years now. In most of these experiments, the Dutch Institute for Curriculum Development (Stichting Leerplanontwikkeling (SLO)) is involved. On their website (SLO, 2010) several examples of learning trajectories can be found. Many experiments and developments have taken place in the field of Arithmetic and Mathematic for Primary and Secondary education. An

important role in that field is for the Freudenthal Institute for Science and Mathematics Education (Freudenthal, 2010). Most developments in the field of Modern Foreign Languages are based on the European Reference Framework for Modern Languages (COE, 2010). In Secondary education, all children are taught Dutch, English, German and French, which explains the early interest in developments and experiments in this area. Furthermore, there is substantial interest in learning trajectories crossing the boundaries of subject fields to support a project based style of teaching in which several disciplines are taught in interaction around a specific problem statement. Another "hot issue" are learning trajectories crossing the boundaries between Primary and Secondary education, to support a smooth transition between those two sectors.

A recent development on the level of intermediate vocational training is the switch from discipline-oriented education to competence-based education. This development has led to different ways of describing the levels of attainment of knowledge and competences and therefore different learning trajectories.

All these experiments have led to examples of learning trajectories, differing in depth, ways of visualization or choice of subjects (subject oriented or time-oriented (e.g. a learning trajectory for a field for 2 months)). The challenge for Wikiwijs is to come up with a form of support suited to all subject areas and all levels of education. The approach chosen is described in the next chapter.

## 4. Approach within Wikiwijs

Within Wikiwijs, we distinguish several target groups for the functionalities of creating and maintaining learning trajectories:

1. Users who create their own learning trajectories from scratch
2. Users who will adapt available open learning trajectories by adding or replacing learning materials connected to the learning trajectory
3. Users who will look for alternatives for a small part of their commercial textbooks (where a commercial teaching method can be considered a learning trajectory).

We expect that the first target group will not consist of individual teachers, because of the complexity of the subject and the ample time most teachers have. Instead, expert organisations like the Freudenthal Institute for Science and Mathematics Education will develop examples of learning trajectories and make them available in Wikiwijs.

As was formulated in the introduction, the set of learning goals given by the Ministry of Education for a given curriculum are too broad for a teacher to enable his own learning trajectory, tailor made for a specific situation. Therefore, the **minimum requirement** for supporting these activities within Wikiwijs is to offer decompositions of the set of learning goals into more concrete learning goals. To be able for a teacher to judge if a learning goal is sufficiently covered, the **topics** that are used in achieving the learning goals need also to be visible. In figure 2 the datamodel that describes the situation is depicted.

The datamodel can be explained as follows. For each **curriculum**, determined by a **field of education** and the **level of education** (e.g. primary education, lower secondary vocational), **learning goals** are formulated by the Ministry of Education. These learning goals are decomposed

in a set of **learning objectives**. Also, a set of **subjects** is determined that has to be covered during the course of the curriculum. This leads to a set of **topics**, where each learning goal is connected to a set of subjects. This part of the datamodel is context-free. The rest of the entities of this datamodel is influenced by the context in which the learning takes place. A **learning trajectory** covers a set of topics. **Learning units** (the learning materials) also cover a set of topics. Learning units can be connected to a learning trajectory. These topics are also covered by, commercial teaching **methods (textbooks)**. The latter gives a teacher the freedom to look for alternative learning units for a small part (chapter or paragraph) of the method being used.

In this model, providing the set of subjects, the set of learning goals and the connection between those two sets in topics, are the minimum requirements to be able to create and work with learning trajectories. These three sets should be as value-free as possible to be useful for and accepted by teachers, using all the different didactical approaches offered in the Netherlands. Therefore, the entity **Learning objective interaction** is not used (yet?) into Wikiwijs. The current standpoint is that determining the interaction between learning objectives (e.g. the order in which they are meant to be taught) can depend on the didactical approach applied to the field of subject and is therefore not value-free.

For the current version of Wikiwijs, the SLO has developed these sets, implemented them into two vocabularies of learning objectives and subjects and a relationship-vocabulary 'Topic' that connects the subjects to the learning objectives. The sets are the metadata that will be connected to the learning materials and the learning trajectories. These vocabularies are developed for Arithmetic in Primary education, Mathematics in Lower-secondary general education and Dutch Language in Primary and Secondary education.

Collections of learning resources, that fit the national curricula, which are prescribed for a whole country can be prepared in such a way that all available resources, one way or another, exclusively or alternatively, can be placed into a course. Courses are considered the building blocks of a curriculum.

An example of this is the National Education Data Model as is it maintained in the US (see NEDM, 2010). This model gives a detailed description of the way curricula are being organized in which a course is the vehicle bringing together subjects that are to be taught in a curriculum. In situations where curricula are being defined in a prescriptive manner, this is a viable approach to organize learning on a national and institutional level. At the same time, it can hinder innovative approaches by teachers, who do not want to follow the 'standardized' curriculum in all instances.

Comparing to the datamodel of NEDM and of learning trajectories as modelled in Wikiwijs some clear differences can be distinguished:

- In the NEDM datamodel, an important entity is **Course**. Courses in that view are the building blocks for a curriculum. In the datamodel, the definition of Course (Postsecondary or Elementary Secondary) is: *The organization of subject matter and related learning experiences provided for the instruction of students on a regular or systematic basis, usually for a predetermined period of time (e.g., a semester or two-week workshop) to an individual or group of students (e.g., a class)*. Some of the attributes are *Available Credit, Course Attendance Requirement, Session Name (The name of the session during the school year in which coursework was completed (e.g., Fall Semester))*. These attributes indicate that **Course** has partly organizational entities, specific for an institution. Because of the scope of Wikiwijs (not targeted to individual institutions, but to the whole educational field of the Netherlands), this level is not applicable

- The entity **Learning trajectory** is not present in the NEDM datamodel. One could argue that this entity could be equivalent to Course. This is not the case however, because in NEDM Course is placed on a level between subjects and program curriculum, where in Wikiwijs the subjects are leading for a learning trajectory.
- The entity **Method** is not present in the NEDM datamodel. This entity is specific for the Dutch situation, creating a valuable starting point for a search to alternative learning materials as replacement for a small part of a teaching method.
- Entities like **Agency**, **Lesson plan** and **Instructional Day plan** in the NEDM model represents organizational aspects of a curriculum. Because Wikiwijs is not supporting the educational support as is provided by Electronic Learning Environments and Learning Management Systems, these entities are not present in the Wikiwijs datamodel.

As mentioned, the three vocabularies of metadata are a minimum requirement to be able to create and alter learning trajectories. A learning trajectory however has more attributes that have to be formulated to make these trajectories useful for teachers. In the introduction, a learning trajectory was described as a "rationalized composition". In Strijker (2010), the following elements are summed up as being part of this rationalization:

- Vision: Why are they learning?
- Goals: For what are they learning?
- Activities: How are they learning?
- Grouping: With whom are they learning?
- Role of the teacher
- Learning materials and sources
- Type of Location
- Time (both throughput time as actual learning time)
- Assessment

These elements have to be described when a learning trajectory is created. Currently, this is described by the creator of a learning trajectory in a document, attached to the learning trajectory.

## 5. Implementation and future plans

In the autumn of 2010, the first implementation of Wikiwijs with support for learning trajectories is published. For users, it is possible to

- create learning trajectories from scratch (although we expect this will rarely be used by individual teachers because of the complexity of this activity),
- label learning materials using the vocabularies to determine their position in a learning trajectory
- change existing learning trajectories by either add extra activities or replace learning materials added to the learning trajectory with other sources (especially for Science and Mathematics Education).

Furthermore, some repositories with learning materials are implementing the vocabularies and are labelling their learning materials with the values of these vocabularies. For support, background documents are provided, giving more information about learning trajectories and how to use them.

We plan to monitor the usage of these functions in the coming months to decide in which direction development will continue. The vocabularies for the other 39 subjects areas will be developed in the coming years.

Although we apply the position, not to offer functionalities typically of an Electronic Learning Environment or a Learning Management System, users already mentioned that using a learning trajectory is closely connected to registering the progress and learning results of individual learners. We will therefore look into connecting "hooks" onto learning trajectories so the progress students make in their learning trajectories can be captured and followed up electronically.

# Figures

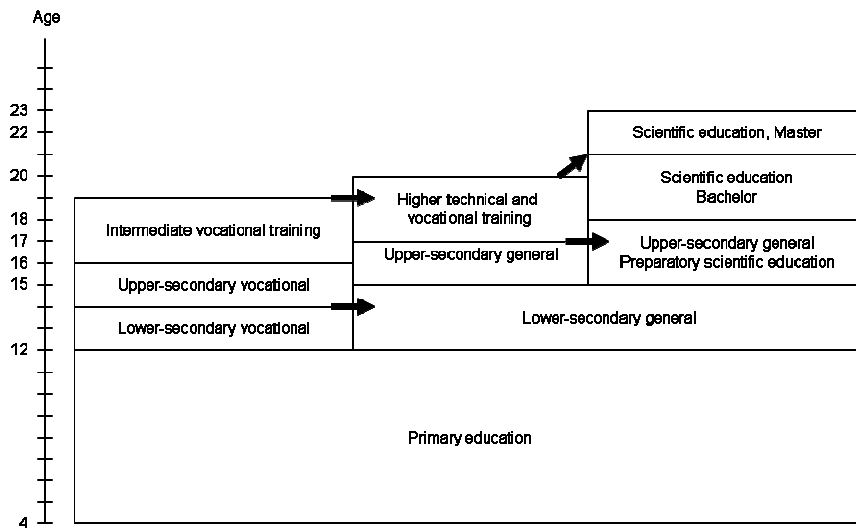


Figure 1. Main tracks of the Dutch Educational System

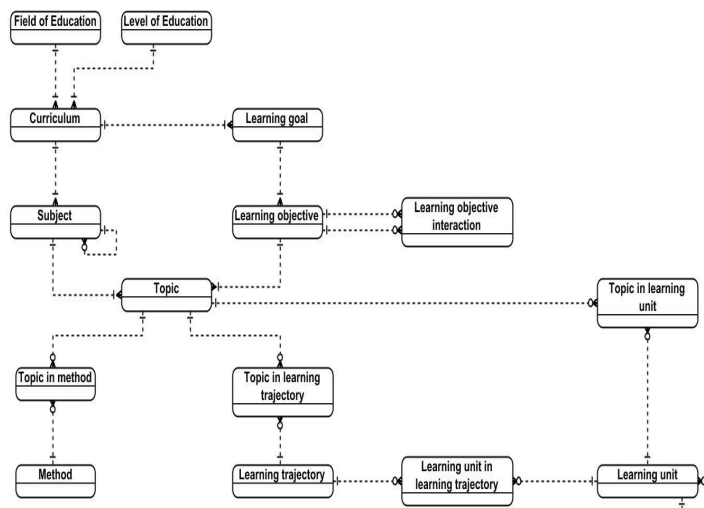


Figure 2. Datamodel for support for learning trajectories in Wikiwijs



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