

Analysis of the Austrian policy context

mathematics and science for life



mascil aims to promote a widespread implementation of inquiry-based teaching (IBL) in math and science in primary and secondary schools. It connects IBL in schools with the world of work making math and science more meaningful for young European students and motivating their interest in careers in science and technology.



1.13 National report of Austria

PART 1: A DESCRIPTIVE, EVIDENCE-BASED ACCOUNT OF THE NATIONAL CONTEXT

Introduction: Organization of education in Austria

According to a new law published recently, Austria will change the teacher education system. A master's degree will be required for all teachers (Primary school onwards) which includes a 4 year bachelor's and a 1-2 years master's study.

However, the following table (cf. bm:ukk 2013a) will give an overview about the current training structure which will be continued at least the following two years. We expect universities (Uni) and Pedagogical Colleges (PHS) to start with the new 5 year teacher training curricula in autumn 2014 or autumn 2015 (at the latest). However, teachers who have already started initial teacher training may be offered the opportunity to finish those and add additional qualifications.

Grade	Age	Type of school ¹	Disciplines ²	Type of teachers ³	Initial training ⁴
	3-6	Nursery		Generalist	2 years, colleges for higher vocational education
1-4	6-10	Primary	One	Generalist	3 years, PHS, ped. orientated, Dida
5-8	10-14	General Secondary / New Secondary	M & S3	2D	3 years, PHS, disc. orientated, Dida
5-8	10-14	Academic Secondary (lower level)	M & S3	2D	4.5 years, Uni, disc. orientated, Dida
9-12	14-18	Academic Secondary (higher level)	M & S3	2D	4.5 years, Uni, disc. orientated, Dida

9-13	14-19	Colleges for Higher Vocational Education	M & S2/3	2/1D	4.5 years, Uni, disc. orientated, Dida
9-11/12/13	14-17/18/19	Secondary Technical and Vocational / Part-time Vocational / Integrated Vocational Training	M & S	2/1D	- 4.5 years, Uni, disc. orientated, Dida - 5+4 years, Uni+economy, disc orientated - vocational education+6 years economy

1. Nursery, primary, upper-primary, lower secondary, upper secondary, vocational
2. Maths and sciences not separated (One), maths and integrated sciences (M & S) – 2 or 3 subjects in sciences (M & S2 or M & S3) or just one type of sciences Bio or Phys (M&Bio – M&Phys)
3. Generalist G, 2 disciplines specialists 2D, mono-discipline specialists 1D, nD, 2/1D...
4. Number of years in tertiary education of training (+n), type of institution (Uni, PHS – Pedagogical High School) Discipline (disc) or pedagogy (ped.) orientated, courses in Didactics (Dida)

Theme 1: State of affairs-recent changes

Wider policy perspectives

In order to prioritize science and mathematics education, many initiatives with partial political support were established in Austria: The Austrian federal ministry of science and research runs a funding scheme (Sparkling Science (bm.w_f 2013)). The federal ministry for transport, innovation and technology offers funding for a variety of STEM education initiatives (FFG, Talente (FFG 2013), summer apprenticeships in research institution). The initiative IMST (innovations in Mathematics, Science and Technology education (IMST 2013)) has been politically supported and funded for more than 15 years. Unfortunately their budget was reduced recently; financial support was given to

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initiatives such as the Young University and the researcher's night which also attempt to raise awareness and interest in science, science education and scientific carriers. The federal Minister for Education, the Arts and Culture supports initiatives in Science, Technology, Engineering and Mathematics (STEM) education at pedagogical colleges.

The main focus of the science and mathematics national curricula is to encourage and to enable students skills and competences to understand their environment (Volksschule), to critically analyse and reflect on their mathematic and scientific operations/actions and to apply their knowledge to new problems (Unterstufe und Oberstufe). There are and will be changes in the curricula for the New Secondary School (Neue Mittelschule), which partially already does or will offer science as one subject (including: biology, chemistry and physics). The academic secondary (lower and higher level) is expected to stick to individual subjects in the future. The number of science lessons has been reduced a couple of years ago and there is no sign that this will change in the nearer future ("Wochenstundenentlastungs- und Rechtsbereinigungsverordnung 2003", Minister of Education).

Science and mathematics teachers' education

The teacher education system will be changed in the nearer future. A new law (Bundesrahmengesetz zur Einführung einer neuen Ausbildung für Pädagoginnen und Pädagogen) has been approved recently (bm:ukk 2013b). There are attempts to improve science and mathematics education at primary school teachers' level. Especially, the teachers for the primary school have to complete a bachelor's and master's program. At secondary level all teacher students (general secondary and vocational education) will have to study for 5-6 years now, whereas some teachers (general secondary and new secondary school) had to study for three years formerly. Besides others, this will lead to more time dedicated to develop and improve subject knowledge and pedagogical content knowledge (PCK = Fachdidaktik). In addition, universities will mainly be responsible for training students in subject knowledge and PCK which will be definitely an improvement. In parallel with the new law for teacher education in Austria, there will be changes in the teacher's professional development system. Unfortunately, we do not know what will happen in detail yet. The universities will be able to apply for money to run professional development courses in the future, while pedagogical colleges had the monopoly on

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professional teacher training formerly – so this will be a change but how and whether universities will really get stronger in this field has not been clarified yet because universities are run by the state, whereas teacher’s professional development is in the responsibility of each Austrian country (bm:ukk).

Implementation in the classrooms

Mathematics is prioritized in all curricula and called a main subject – which include more than 2-4 h per week. Sciences are side subject which includes 0-3 lessons per week depending on the particular type of school. There are no recent changes in the taught time.

Method related science teacher training has been changing in the last years – at teacher training institutions and via continuous professional development offers. The Austria related PISA analyses addressing this issue give a state of the art perspective, but not a kind of “progress analysis”.

Education standards have been introduced to the education system in Austria recently (age 14-15 and age 18-19) thus these standardized tests will influence how mathematics in particular will be taught. Furthermore, in 2015 the final school examination (Matura) for the Academic Secondary and the colleges for higher vocational education will be changed into a standardized and competence-oriented examination (Standardisierte, kompetenzorientierte Reifeprüfung), the mathematics education will slightly change (new competence-oriented school books, (bm:ukk 2013d)).

Constraints in relation to the aims of the mascil project

Linking the aims of the mascil project to the standardized tests mentioned above will help to get the message across with teachers.

Theme 2: Schooling and the world of work

Wider policy perspectives

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In the curricula of the primary school, the contact to the world of work is explicitly stated, e.g. receiving insight into the world of work or getting to know the production chain (bm:ukk 2012:43, 52, 85, 186). The vocational guidance is not a separate subject but linked to economy and manual training (Werkunterricht).

Similar connections to the world of work also appear in the curricula of the general secondary school. The focus lies on the history of the economy and the impact on the environment (bm:ukk 2012a).

The curricula of the academic secondary (lower and higher level) mention in their general part the importance of the preparation to the world of work. It is recommended to use practical and authentic materials and media, visit different companies and invite non-school related people to the classroom (bm:ukk 2000, 2004a)).

In the general part of the curriculum of the vocational schools, one of the major educational tasks is to promote the contact to the world of work which is naturally given due to the in-company apprenticeship (bm:ukk 2011b:20).

Issues regarding schools/institutes

In Austria, the vocational schools group into Colleges for Higher Vocational Education (General higher education entrance qualification and higher-level vocational qualification), Secondary Technical and Vocational School, and part-time Vocational School/apprenticeship (both initial vocational qualification).

The Federation of Industry (Industriellen Vereinigung) organizes via their platform *Young Industry* (Junge Industrie) many events for students of general schools to get in contact with industry (Industriellen Vereinigung 2013). The Austrian Economic Chambers supports the Association Economy and School (Arbeitsgemeinschaft Wirtschaft und Schule), which offers on its website teaching materials for economic education (Institut für Bildungsforschung der Wirtschaft 2013).

Issues regarding classrooms

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In the mathematics curricula of the Academic Secondary (lower and higher level), there is no reference to the world of work (bm:ukk 2000, 2004).

One purpose of the new standardized and competence-oriented examination (Standardisierte, kompetenzorientierte Reifeprüfung) is to present authentic and practically relevant items (Bifie 2013).

The teaching methods of science in vocational schools has been classified in the PISA study of 2006 into four items: questioning-based teaching (fragend-entwickelnder Unterricht), experiments (Experimentieren im Unterricht), scientific research (naturwissenschaftliche Untersuchungen), and relevance to practical applications (Anwendungsbezug des Unterrichts). The results of the PISA study 2006 shows that the predominant teaching method in vocational schools is the questioning-based teaching (Ch. 9.1, Bifie 2009).

Constraints in relation to the aims of the mascil project

There are no obvious or known constraints to the implementation of the mascil project.

Theme 3: Science and Mathematics curricula and IBL

Wider policy perspectives

The Federal Ministry of Transport, Innovation and Technology (bmvit) disseminates and supports inquiry-based learning, e.g. (FFG 2013; Verein Science Center Netzwerk 2013).

In the curriculum of the primary school, inquiry-based and discovery-based learning is mentioned within the general teaching principles and in explicit in the section for mathematics (bm:ukk 2012b:147, 162). In the curriculum of the new secondary, inquiry-based learning only appears only in the section for the Gifted and Talented (bm:ukk 2012a:103). In the general parts of the academic secondary, the colleges for higher education and different branches of the vocational schools no reference is made to inquiry-based learning.

Issues regarding schools/institutes

No data available.

Issues regarding classrooms

Some EU-projects concerning inquiry-based learning with Austrian participation offer fully-prepared teaching materials in German, e.g. (Plantscafe 2013; Profiles 2011).

Furthermore, there is a large number of national or local projects which produce and disseminate also inquiry-based teaching materials, e.g. (IMST 2013)

Currently, there is no evidence that student's assessments are influenced by inquiry-based learning methods. However, the items in the new standardized and competence-oriented examination take a first step in this direction.

Constraints in relation to the aims of the MASCIL project

Since inquiry-based learning only appears in the more recent curricula (primary and new secondary), the justification for the implementation of teaching material linked to inquiry-based learning with connection to the world of work is given. For the other secondary schools, an official document is missing, but the introduction of the new final exam provides a good starting point.

Theme 4: Pre-Service teacher training in relation to i) IBL and ii) the world of work

Wider policy perspectives

Due to a new law published recently, Austria (see above) will change the training for prospective teachers' education system. A master's degree will be required for all teachers (Primary school onwards) which includes a 4 year bachelor's and a 1-2 years master's study. The major policy priorities for prospective teachers' training are to raise the teacher's status and to increase the academization of the teaching profession. Furthermore, the training will be competence orientated and the professional and scientific qualification is of high importance (bm:ukk 2013b).

Implementation

In the context of a new law concerning the teacher's education system, the Pedagogical

Colleges and the Universities will be responsible in terms of cooperation for the prospective teacher's training. Currently, the Pedagogical Colleges are responsible for the teachers for primary, general secondary and new secondary school only, and the universities train teachers for the other school types.

The planned curricula schedule a 4 year bachelor's study, which is followed by a 1-2 years master's study for teachers for any type of school.

Currently, the Pedagogical Colleges have a selection procedure, meanwhile the universities have no specific access restriction, except the so called orientation phase (STEOP=Studieneingangs- und Orientierungsphase). The new law requires a selection procedure an both institutions (bm:ukk 2013b).

Regarding the teaching methods at the universities, there are attempts to apply explicitly inquiry-bases learning methods in the courses Teacher Education (Fachdidaktik).

Teachers' voice

No data available.

Constraints in relation to the aims of the mascil project

Due to a new structure of the prospective teacher's education, an integration of the aims of the mascil project in the new curricula of the prospective teacher's education is possible.

Theme 5: In-Service teacher training in relation to i) IBL and ii)the world of work

Wider policy perspectives

As part of the new law concerning the teacher's education system, the organization of the induction stage will be changed (bm:ukk 2013b). At the moment, the new teachers are assisted during their first year by several courses on the Pedagogical Colleges. The new law plans an induction phase after the bachelor's study. In the induction phase the new teachers are accompanied by an experienced teacher to facilitate their entry into

the school. The training of in service teachers is a key point to react on new findings on the improvement on schooling.

Implementation

In Austria, there is a compulsory further education, but the formulation is very general, i.e. the teachers are obligated to keep up to date their knowledge and their teaching content. The provincial teachers (Landeslehrer) have to participate to further education for 15 hours per year (bm:ukk 2013c §43. (3) 2.).

At the moment, the Pedagogical Colleges are solely responsible for the organization and implementation of the different courses. The new law concerning the teacher's education includes a modification of the University Act 2002 to the effect that the universities should offer further education for teachers (bm:ukk 2013b TGÜ Universitätsgesetz, §3, 5.).

The programs for further education vary enormously. Offers span from 1 hour to two or more year lasting courses.

Currently, the teachers pass a one year compulsory "Unterrichtspraktikum" after finishing studies at a university level. If, though, they have finished studies at the Pedagogical College, the one year "Unterrichtspraktikum" is not compulsory for them. In the future, all secondary teacher will have to do an one year induction stage after finishing their bachelor's degree and their master's degree or they may do the master's degree alongside the induction year.

There will be selection criteria but at the moment no details are available.

The participation on the further education is voluntarily for teachers of the academic secondary and colleges for higher vocational education. The teachers of the primary, general secondary and new secondary can choose freely, but they need to do a certain amount of credit point each year.

Teachers' voice

No data available.

Constraints in relation to the aims of the mascil project

The implementation of the new standardized and competence-oriented examination entails additional further teacher training, which could be enriched by appropriate aspects concerning IBL.

PART 2: EMERGING ISSUES FOR REFLECTION

Equity specific issues

The results of TIMSS and PISA of the last few years allow the following analysis for Austria. TIMSS 1995 showed that in the fourth schooling year the gender difference in mathematics and science was not significant, but in advanced mathematics, males achieved higher performance than females (Eurydice 2010:35, 37). TIMSS 2007 revealed a higher performance of boys already in the fourth year of schooling in mathematics and still in science (Eurydice 2010:36, 37). PISA 2003 (focus mathematics) did not show any significant gender gap in mathematics and or science. However, PISA 2006 (focus science) found a significant male advantage in mathematics and small gender gap (boys scored higher than girls) in science (Eurydice 2010:36, 37).

A more detailed analysis of the PISA 2006 results (Bifie 2009:6.3), which separates “science” into the subjects biology, chemistry and physics, found a significant higher performance of boys in chemistry and physics and a higher performance of girls in biology. The author indicates as a possible explanation the fact that girls attend less hours in mathematics and science than boys do. This is because more boys than girls take optional courses in mathematics and sciences.

In order to understand national policies regarding gender issues, the general part of academic secondary school curricula explicitly state the promotion of gender equality including gender mainstreaming (bm:ukk 2000, 2004a). The curricula of the vocational schools also contain a passage considering “the education for equality between men and women” (bm:ukk 2011a:7).

To encourage girls to study an STEM subject, the federal Minister for Education, the Arts and Culture supports different funding like “FITsprungbrett” (fitwien 2010). The Public

Employment Service Austria (AMS) runs similar programs (cf. AMS 2013)

Within current teacher education curricula, gender specific issues are mentioned (“sensitivity for gender inequality”) and respective (sometimes optional) courses are offered. The new law relating to the teacher education (bm:ukk 2013b) and the development of new curricula offer a chance to implement such gender issues in more detail in the teachers’ professional development.

Addressing low achievement

Due to the results of PISA 2006, in Austria 16 percent of the students participated in the PISA tests are low achievers in science and 20 percent in mathematics (Bifie 2009:4.2). The stated percentages are similar to the OECD average. It gets visible, that in science there is no significant difference between the percentage of low achievers with regard to boys and girls. However, in mathematics 23 percent of the tested girls and 18 percent of the tested boys show a lower performance (Bifie 2009:4.3). Also it gets visible, that students from a migrant or low socio-economic background are over-represented among the low achievers (Bifie 2009:4.3). Furthermore, the level of education of the parents has an influence on the probability of their children to become an at-risk pupil (Bifie 2009:4.3).

TIMSS 2007 shows that nearly one third of the pupils in the fourth schooling year are low achievers in mathematics (Bifie 2010:1.1).

The latest data of the “Standardüberprüfung Mathematik, 8.Schulstufe” (2012) yielded a percentage of 17 of low achievers in mathematics (Bifie 2012a).

After the publication of the PISA results and the latest “Standardüberprüfung”, the federal Minister for Education, the Arts and Culture claims to develop strategies for tackling low achievement with regard to migrant or low socio-economic background (Bifie 2012b). A chance for structural changes is the development of new curricula within the new law concerning the teacher education (bm:ukk 2013b).

There are no known initiatives explicitly for tackling low achievement in science or in mathematics or explicit references to IBL.

Promoting entrepreneurship

There are no known studies which investigate the percentage of individuals who have the appropriate skills to start a business in Austria. The total early-stage Entrepreneurial Activity (TEA-rate) could be interpreted as related measure. The Austrian Economic Chambers publish each year this rate; in 2012 the percentage was 9.6 and therefore Austria was on the fifth position of the innovation-driven countries (FH Joanneum 2012:12).

In the vocational schools entrepreneurship education is already realized in different subjects (bm:ukk 2008). In order to promote entrepreneurship education, the federal Minister for Education, the Arts and Culture established the “Impulszentrum für Entrepreneurship-Education” (www.eesi-impulszentrum.at).

In the curricula of the “Kaufmännischen Schulen” entrepreneurship education is explicitly mentioned (bm:ukk 2004b).

There are no known initiatives to cover issues on entrepreneurship education in teachers’ professional development or references to IBL.

Comments by the NAB

There was no meeting of the NAB yet.

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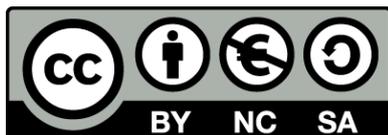
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Contact Information

Coordinator: University of Education Freiburg, Prof. Dr. Katja Maaß
Lead partner for this deliverable: Foundation for Research and Technology, Dr. Kathy Kikis-Papadakis
Website: www.mascil-project.eu



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