

Science goes to school: A new model for introduction of modern biology teaching strategies to Slovene schools

Znanost gre v šolo: nov pristop k uvajanju sodobnih metod poučevanja bioloških vsebin v slovenske šole

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Abstract: In the framework of the project *Science Goes to School*, we developed and tested a new model for introduction of modern biology teaching strategies to Slovene schools. The project focused around a close university-school partnership, bringing together the expertise of scientists from the University of Ljubljana and the experiences of teachers from 22 Slovene secondary schools (grades 9-12, age of students 15-19). The project comprised three phases. During the introductory workshop, project scientists and partner teachers identified curriculum topics with an acute lack of good-quality teaching materials. During the second phase, university scientists developed new practical activities for students and prepared comprehensive teaching materials. Each new activity was tested in partner schools, with a scientist acting as a visiting teacher. Partner teachers were present in the class during testing and were hence trained in the authentic environment of their own classrooms. Both teachers and students contributed their comments and suggestions for improvement of new activities. The visiting scientist also acted as a role model motivating the students to consider science careers. During the third phase, the new teaching materials were published in a handbook for teachers and on the internet. In addition, the new activities were presented to a wider community of teachers and school laboratory assistants during a training workshop. The project was favourably received among the teachers, the project scientists and the students in partner schools. To efficiently improve biology education in Slovene schools, such activities require long-term, stable funding from national sources.

Keywords: science education, biology, teaching, effective learning, university-school partnership

Izveček: V okviru projekta *Znanost gre v šolo* smo razvili in preizkusili nov pristop k uvajanju sodobnih metod poučevanja bioloških vsebin v slovenske šole. V središču projekta je bilo tesno partnerstvo univerze in šol, s katerim smo povezali strokovno znanje znanstvenikov z Univerze v Ljubljani in izkušnje učiteljev z 22 partnerskih srednjih šol. Projekt je obsegal tri faze. Med uvodno delavnico so znanstveniki in partnerski učitelji opredelili vsebine v učnem načrtu, pri katerih močno primanjkuje kakovostnih učnih gradiv. Med drugo fazo so znanstveniki razvijali nove praktične aktivnosti za pouk biologije in pripravili izčrpna učna gradiva. Vsako novo aktivnost smo preizkusili v partnerskih šolah, pri čemer je eden od znanstvenikov obiskal šolo kot gostujoči učitelj. Med testiranjem so bili partnerski učitelji prisotni v razredu in so se tako strokovno usposabljali v avtentičnem okolju lastnih učilnic. Tako učitelji kot dijaki so prispevali pripombe in predloge za izboljšanje novih aktivnosti. Gostujoči znanstvenik je bil hkrati vzornik pri spodbujanju dijakov, da bi se odločili za naravoslovne študije. Med tretjo fazo projekta smo nova učna gradiva objavili v priročniku za učitelje in na spletnih straneh. Poleg tega smo organizirali zaključno delavnico za učitelje, na kateri se je širši krog učiteljev in šolskih laborantov usposabljal za izvedbo novih aktivnosti. Projekt so z navdušenjem podprli učitelji, sodelujoči znanstveniki in dijaki s partnerskih

šol. Za učinkovito izboljšanje kakovosti biološkega izobraževanja v slovenskih šolah bi morali tovrstne dejavnosti dolgoročno in stabilno financirati iz nacionalnih virov.

Ključne besede: naravoslovno izobraževanje, biologija, poučevanje, učinkovito učenje, partnerstvo univerz in šol

Introduction

Recently, biology became the most rapidly developing natural science. In addition, topics such as biodiversity, global warming, invasive species, genetically modified organisms, stem cells and gene therapy have gained a high social importance. Consequently, a modern citizen needs biological knowledge to cope with everyday problems, such as understanding the news in the media and deciding about health issues. For young people, the main source of up-to-date biological knowledge is their biology teacher.

In the context of the increasing importance of biological literacy for personal and social decision-making, biology teachers face the challenge of updating the teaching content and changing their practices from teaching factual knowledge to conveying conceptual understanding of living systems. However, biology teachers have a high teaching load and have to cover a wide range of biology topics. They also lack time and expertise to convert important scientific discoveries into classroom activities.

For the teacher to cope with emerging new biology topics and the increasingly interdisciplinary and systemic approach to teaching biology, he/she needs an excellent education and continuous in-service training (Moore 2003, 2007). In many schools, teaching lags far behind new scientific findings. Many countries have reported problems with overloaded and outdated curricula, outdated textbooks, insufficient »real« practical work, the perception of biology as a »soft« scientific subject, inappropriate pedagogy, lack of teacher and student enthusiasm and lack of continuous teacher training (Moore 2007, Tunnicliffe and Ueckert 2007).

Introduction of new approaches to teaching science as an exciting and dynamic topic is a long-term process (Mervis 2002, Vilhar 2007). It comprises development of new curricula and changes in teacher education, and has to be supported with new textbooks and teaching materials. One of the problems is development of scientific thinking in

science class. Presently, the philosophy of science is often wrongly presented as a collection of recipes for experiments (Mervis 2002, Bonner 2004, National Research Council 2002, 2005, Moore 2007). Empirical evidence shows that active learning works (Michael 2006), motivating students to become active learners and problem solvers (Lujan and DiCarlo 2006). As stated in the review with a meaningful title *Too much teaching, not enough learning: What is the solution*, extensive curricular changes are required to achieve effective learning (Lujan and DiCarlo 2006).

Modernisation of science teaching in schools has to be supported by active involvement of university scientists. Scientists are competent to select and suggest new science topics and help to develop new approaches to teaching biology in schools, conveying the true spirit of science (Bhattacharjee 2005, Moore 2007). However, these new ideas need to be adequately fitted into the curriculum, since learning will only occur after teaching if students are given enough time to process the new information and connect it to their previous knowledge and conceptions (Tunnicliffe and Ueckert 2007). To achieve this, expertise of scientists has to be complemented with experience of teachers, who know well the capabilities of their students and real-life situations in the classroom (McDiarmid et al. 1989, Tanner et al. 2003).

The above mentioned problems are also present in Slovene schools. In the past, biology teachers frequently complained about the lack of systematic support from scientists. Students also felt that changes are needed in secondary school biology. More than 71% of students thought that the curriculum should be more connected to everyday life, 66% would like to have more experiments and 59% more excursions (field work) during biology lessons (Gabršček et al. 2005; see Tab. 1).

The project *Science Goes to School* connected scientists, teachers and students from secondary schools with the aim to improve science teaching. We tested a new model for introduction of modern teaching strategies to our secondary schools. The project was a university-school partnership

based on experiences of similar projects in other countries (e.g. Mervis 2002, Tanner et al. 2003), but taking into account the specific circumstances in Slovene schools and universities.

Methods

Survey of teachers' perceptions of problems in biology education

In order to investigate teachers' perceptions of the major problems in biology education, we prepared a questionnaire for teachers in general secondary schools. The questionnaire was handed out to teachers who participated at a training seminar in January 2006. Participation in the survey was voluntary. 35 out of 78 participants returned a filled-in questionnaire.

The project Science Goes to School

The idea for the project *Science Goes to School* was based on previous similar projects in other countries (e.g. Mervis 2002, Tanner et al. 2003), in particular the program Graduate STEM Fellows in K-12 Education in the USA (National Science Foundation 2010). This program supports fellowships and training for graduate students in science, technology, engineering, and mathematics (STEM). We adapted the project

activities to specific circumstances in Slovenia, as explained in the Results. The project duration was 1.5 years (project budget: 62 600 €).

The project activities were evaluated using questionnaires. The first questionnaire was handed out to biology teachers participating at the introductory workshop in May 2006. 18 out of 20 teachers returned a filled-in questionnaire. The second questionnaire was handed out to 72 participants at the training workshop for teachers (53 biology teachers and 19 school laboratory assistants) in September 2007. 46 teachers and 13 laboratory assistants returned a filled-in questionnaire.

Statistical methods

Standard statistical methods were used to analyse questionnaires. Data were analysed with the software package Prism 5 for Windows (Graph Pad Software). Average values are expressed as mean \pm standard error of the mean.

Results

Teachers' perceptions of problems in biology education

The questionnaire for teachers about the main problems in biology education, which we

Table 1: Perception of biology teachers and students about the main problems of biology education in secondary school. Teachers' perceptions were evaluated in January 2006 on the basis of a questionnaire. The open-ended question was: List three main problems in biology education. Answers were grouped to categories. Data about students' opinions are from Gaberšček et al. 2005.

Tabela 1: Mnenja učiteljev biologije in bivših dijakov o problemih na področju biološkega izobraževanja v srednji šoli. Mnenja učiteljev so iz vprašalnika, ki so ga gimnazijski učitelji izpolnili januarja 2006. Vprašanje odprtega tipa je bilo: Napišite tri ključne probleme na področju biološkega izobraževanja. Odgovori so razvrščeni v kategorije. Podatki o mnenju bivših dijakov so iz Gaberšček in sod. 2005.

Problem	Fraction of teachers (%)	Fraction of students (%)
	N = 35	N = 862
curriculum	71	71
in-service teacher training	69	---
laboratory and field work	51	62
teaching materials (in Slovene)	46	---
textbooks and workbooks	40	19
general circumstances at school	37	---

Table 2: **Expectations of biology teachers about activities of university scientists in the field of biological education.** Teachers' perceptions were evaluated in January 2006 on the basis of a questionnaire. The open-ended question was: *What are your expectations from the Department of Biology [Biotechnical Faculty, University of Ljubljana] in this field?* Answers were grouped to categories.

Tabela 2: **Pričakovanja učiteljev biologije o aktivnostih matične stroke na področju biološkega izobraževanja.** Mnenja učiteljev so iz vprašalnika, ki so ga gimnazijski učitelji izpolnili januarja 2006. Prikazana je analiza odgovorov učiteljev biologije na vprašanje odprtega tipa: *Kakšna so vaša pričakovanja od Oddelka za biologijo na tem področju?* Odgovori so razvrščeni v kategorije.

Activity	Fraction of teachers (%) N = 35
introduction of novelties to school	77
in-service teacher training	71
collaboration with teachers	71
participation in development of curricula	29
increased impact in wider society	29

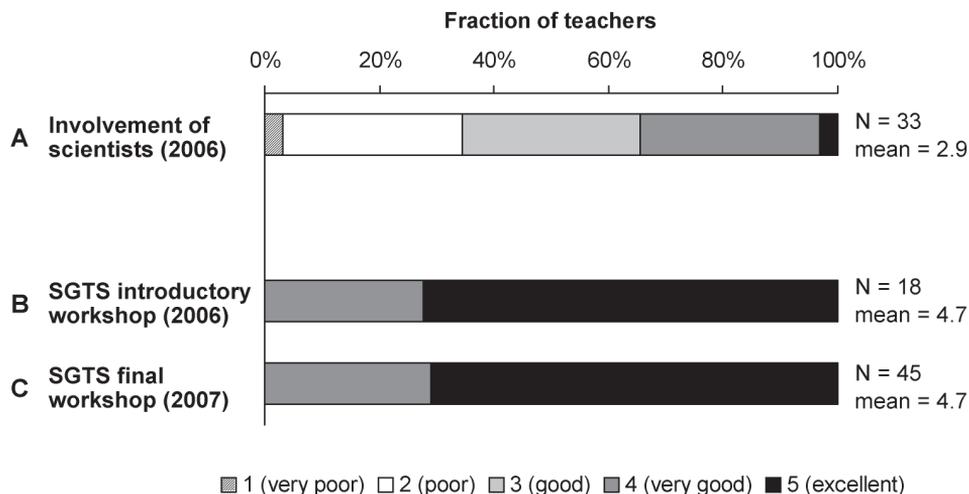


Figure 1: **Teachers' evaluation of activities in the field of biological education.** Teachers used "school" grades from 1 (very poor) to 5 (excellent) to evaluate activities. **A** - Involvement of scientists (2006): questionnaire handed out at a workshop for biology teachers in secondary school in January 2006 (question: *Use school grades from 1 to 5 to evaluate current activities of the Department of Biology [Biotechnical Faculty, University of Ljubljana] in the field of biology education.*) **B** - SGTS introductory workshop (2007): questionnaire handed out at the introductory workshop of the project Science Goes to School in May 2006 (question: *Use school grades from 1 to 5 to evaluate today's workshop.*). **C** - SGTS final workshop (2007): questionnaire handed out at the final workshop of the project Science Goes to School in September 2007 (question: *Use school grades from 1 to 5 to evaluate today's workshop.*).

Slika 1: **Mnenje učiteljev o dejavnostih na področju biološkega izobraževanja.** Učitelji so dejavnosti ocenjevali s "šolskimi" ocenami od 1 do 5. **A** - Involvement of scientists (2006): anketa izvedena na seminarju za gimnazijske učitelje biologije januarja 2006 (vprašanje: *Ocenite s šolsko oceno od 1 (nezadostno) do 5 (odlično) trenutno delovanje Oddelka za biologijo na področju biološkega izobraževanja.*) **B** - SGTS introductory workshop (2007): anketa izvedena na uvodni delavnici projekta Znanost gre v šolo maja 2006 (vprašanje: *S šolsko oceno od 1 do 5 ocenite delo na današnji delavnici.*) **C** - SGTS final workshop (2007): anketa izvedena na zaključni delavnici projekta Znanost gre v šolo septembra 2007 (vprašanje: *S šolsko oceno od 1 do 5 ocenite današnji seminar.*).

prepared in January 2006, contained open-ended questions. Teachers' answers were sorted into categories. The most frequently mentioned problems were related to inappropriate and outdated curriculum, lack of good-quality teacher training seminars and workshops, problems with laboratory and field work and lack of good-quality teaching materials in Slovene language (Tab. 1).

We also investigated what teachers expected from university scientists working in the field of biology. Teachers most frequently listed support in relation to introduction of novelties to school, involvement in in-service teacher training activities and general collaboration with teachers (Tab. 2). Teachers were also asked to evaluate past activities of university scientists in the field of biology education using the scale of school grades from 1 (very poor) to 5 (excellent). The average grade was 2.9 ± 0.2 (Fig. 1A).

The project Science Goes to School

The project *Science Goes to School* specifically aimed to address three problems that teachers identified as the main problems in biology education: lack of appropriate teacher training, lack of new materials for practical activities of students and lack of teaching materials in Slovene language (Tab. 1). The project was based on an intense partnership between university and schools, aiming to overcome the previous discontent of teachers with insufficient involvement of university scientists in biology teaching in schools (Tab. 2, Fig. 1A). In particular, project scientists helped teachers introduce novelties to school and offered additional teacher training. The project collaborators included scientists from the Department of Biology, Biotechnical Faculty, University of Ljubljana and partner teachers from 22 secondary schools (grades 9-12, age of students 15-19).

The project activities comprised three phases (Fig.2). During the one-day introductory workshop, four project scientists and 20 partner teachers participated in brainstorming sessions, aiming to identify the topics in the secondary-school biology curriculum for which there was an acute lack of useful teaching materials. Possible teaching strategies for these topics were also discussed. We decided to use new approaches to

teaching biology that support effective teaching for long-lasting knowledge, such as experiment-based learning and educational games (Lujan and DiCarlo 2006). Teachers evaluated the introductory workshop with an average grade 4.7 ± 0.1 (Fig. 1B).

During the second phase, university scientists developed new activities and tested them in partner schools. The new practical activities for students were based on our own ideas or modified from materials developed by other authors (Vilhar et al. 2007). Development of materials included testing of experiments in laboratories and writing supporting materials for teachers and students. We paid special attention to possible errors that students could do during execution of the practical activity at school and possible unexpected results of experiments. We also reviewed relevant textbooks for secondary schools in Slovene language and exposed the main sources of misconceptions and problems with understanding of selected topics.

We tested all new activities in partner schools. One of the project scientists came to the classroom during regular biology lessons and taught the subject using newly developed methods. The partner teacher was present in the classroom and was thus trained in the authentic environment of his/her own classroom. We collected the opinions about the new practical activity from the teachers and the students and used their ideas and comments to improve the teaching material. Partner teachers and students in visited schools thus actively contributed to the quality of newly developed practical activity. The improved version of the practical activity was tested again in another school. In some cases, new practical activities were tested prior to the first visit to school with first-year university students of biology and pre-service biology teachers, who volunteered to participate in the project.

Within the framework of the project, we developed and tested eight new activities, which can be directly used for teaching biology in Slovene secondary schools (Vilhar et al. 2007):

- Diffusion and osmosis (experiment-based learning with educational role-playing game and a computer simulation; Strgulc Krajšek and Vilhar 2010)
- Describing and naming in biology (discovery-

- based learning)
- Determination keys (discovery-based learning)
- How to grow fern gametophytes? (discovery-based learning)
- Respiration (experiment-based learning using computer-linked measurement instruments)
- Muscle fatigue (experiment-based learning using computer-linked measurement instruments)
- The plant game (educational computer game)
- Bio impro-league (educational card game).

The prepared teaching materials include references to the relevant curriculum topics, duration of the activity, theoretical background for teachers, detailed instructions for preparing and teaching the activity, worksheets for students with solutions and comments for teachers (including the expected results of experiments), links to websites with additional materials, lists of books and other relevant literature, safety warnings, explanations about common misconceptions and how to overcome them, and some interesting stories linked to the topic that teachers can use to motivate the students. We paid special attention to include references to the history of science in the teaching activities (e.g. Strgulc Krajšek and Vilhar 2010), thus emphasising the importance of the largely neglected aspect of science education, namely explaining to students the nature of science.

During the third phase, at the end of the project, we made the new teaching activities available to a wider community of teachers. We published the teaching materials in a handbook for teachers (Vilhar et al. 2007), which was sent to all secondary schools. Supporting material was published on the project website (<http://znanost-gre-v-solo.biologija.org/>). While some supporting material is publicly available, specific comments for teachers are accessible with a password for registered teachers. The worksheets for students were published in a format that allows teachers to modify the text and thus adapt the teaching materials to conform to their teaching strategies and the time they allocate to each activity.

We also organised a one-day training workshop for teachers and school laboratory assistants, where project scientists and partner teach-

ers acted together as instructors. Participants (53 teachers and 19 school laboratory assistants) were divided into groups, so that each participant was trained in three of the new activities. The seminar was closed with a general discussion of all participants and scientists, where impressions, questions and comments about the new activities were shared.

Participants evaluated the quality of the training workshop with a questionnaire. Teachers evaluated the workshop with an average grade 4.7 ± 0.1 (Fig. 1C). They thought that the model for introduction of novelties to schools used in our project was very appropriate (average grade 4.8 ± 0.1 ; Fig. 3A). They also evaluated five of the eight new activities. The average grades ranged from 4.3 to 4.8 (Fig. 3B-F). For the five evaluated activities, the fraction of teachers who thought that they would use the new activity in school was 95% to 100%. Teachers also expressed a strong support for follow-up projects similar to the project *Science Goes to School* (average grade 4.91 ± 0.04 ; Fig. 3G).

Discussion

Our survey conducted in January 2006 clearly showed that teachers need and expect support from university scientists (Tab. 2; Fig. 1A). Prior to the project *Science Goes to School*, there was no close collaboration between scientists and teachers with the goal to develop new biology teaching strategies and introduce them to Slovene schools. While partner teachers were somewhat sceptical at the very beginning of the project *Science Goes to School*, the close university-school partnership later led to enthusiasm among partner teachers and project scientists (Figs. 1B, 1C) and sparked valuable exchange of ideas and experiences. The cooperation of teachers and scientists thus turned out to be beneficial for both partners. Laursen et al. (2007), who worked in the USA with K-12 students and their teachers, came to similar conclusions.

The teachers liked the comprehensive approach in the new teaching materials of the project *Science Goes to School*, with extensive theoretical background, explanation of common misconceptions, comments on possible mistakes

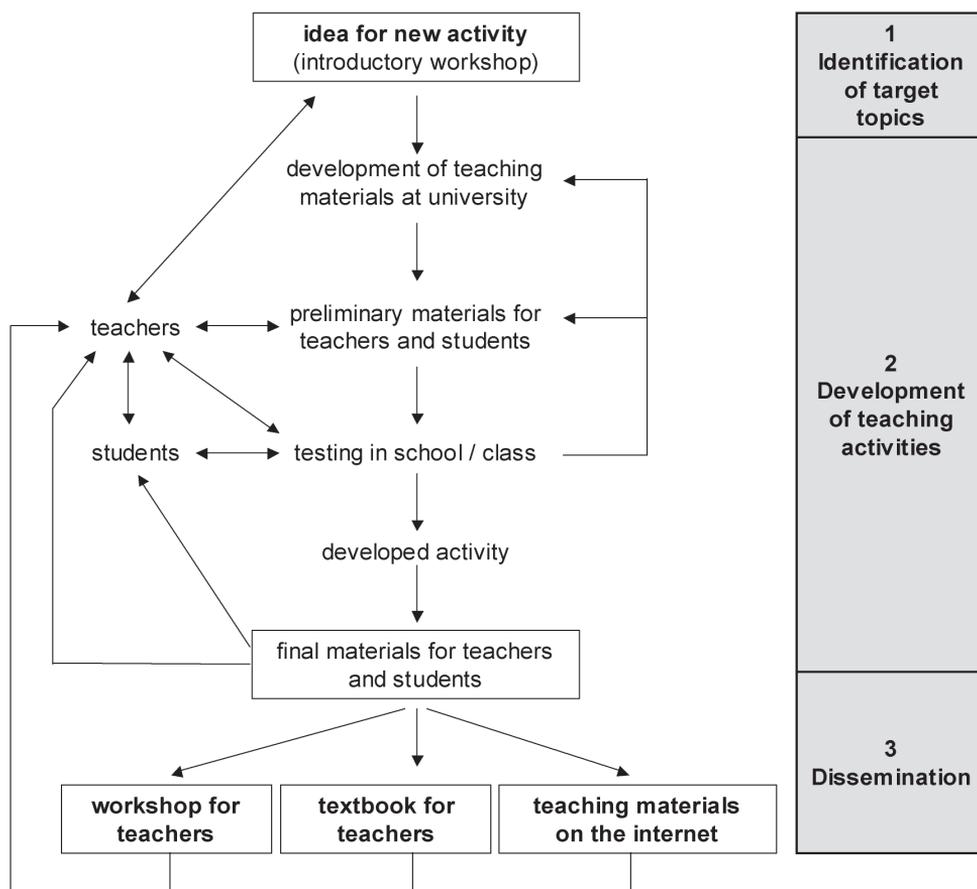


Figure 2: **Outline of activities of the project *Science Goes to School*.** See the main text for details.

Slika 2: **Pregled aktivnosti v okviru projekta *Znanost gre v šolo*.** Pri razvoju novih učnih gradiv za praktične aktivnosti so sodelovali univerzitetni znanstveniki, učitelji in dijaki s partnerskih šol.

that students can make in class and references to the history of science. The active involvement of university scientists reassured the teachers that the new teaching materials were of good quality and contained correct scientific information. The teachers appreciated the fact that the new practical activities for students were focused around specific teaching goals (subject content knowledge) and were thus a constructive part of the overall learning process in biology class. Their support for the outcomes of the project is reflected in their answers to questionnaires (Figs. 1B, 1C, 3). In addition, inclusion of school laboratory assistants in project training activities

was perceived as important for improvement of biology education (analysis of questionnaires not shown).

We paid special attention to tightly link the new activities to curriculum topics, and to instruct the teachers to give their students adequate guidance. Results of previous empirical investigations show that learning on the basis of students' own previous experiences alone is less efficient than teaching methods which include proper guidance of the students during the learning process (Klahr and Nigram 2004, Mayer 2004, Novak and Cañas 2006, Kirshner et al. 2006, Sweller et al. 2007). If students have no prior conceptual understand-

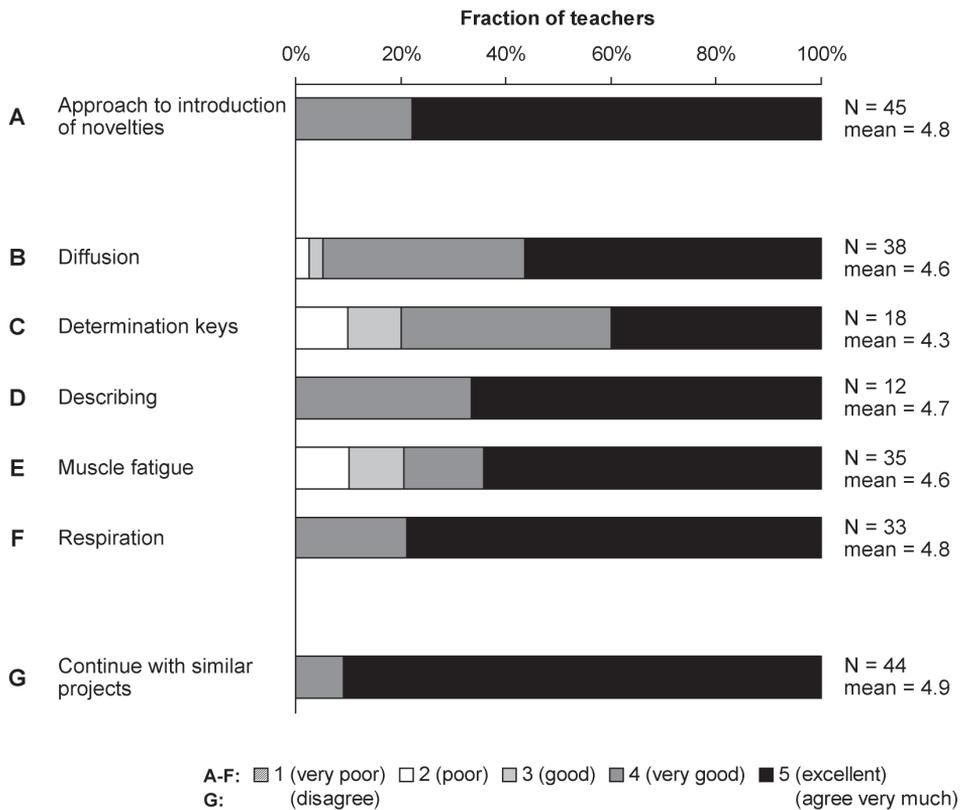


Figure 3: **Teachers' evaluation of the training workshop of the project *Science Goes to School*.** The questionnaire was handed out at the final training workshop for teachers in the framework of the project *Science Goes to School* in September 2007. The grading system is shown in the legend. **A** – question: *Do you find the approach to development of new activities which we used in the project Science Goes to School appropriate?* **B-F** – general evaluation of the new school activity using school grading system from 1 to 5. **F** – question: *Do you think it is reasonable to continue with activities similar to the project Science Goes to School?*

Slika 3: **Mnenje učiteljev o zaključni delavnici za učitelje na projektu *Znanost gre v šolo*.** Anketa je bila izvedena na zaključni delavnici za učitelje v okviru projekta *Znanost gre v šolo* septembra 2007. Način ocenjevanja je prikazan v legendi: **A do F** – “šolske ocene” od 1 do 5; **G** – 1 – sploh ne, 5 – zelo. **A** – *Ali se vam zdi način razvoja aktivnosti, ki smo ga uporabili v projektu Znanost gre v šolo, primeren?* **B do F** – Splošna ocena nove vaje: “šolska” ocena od 1 do 5. **G** – vprašanje: *Ali se vam zdi smiselno nadaljevanje s programi, podobnimi projektu Znanost gre v šolo?*

ing of a natural phenomenon that they are investigating, they often acquire no new conceptual knowledge during their practical activities (Novak and Cañas 2006). Likewise, development of skills such as learning to learn and searching for relevant information cannot replace the need for understanding science concepts, in particular not in the 21st century, when science knowledge

needs to be upgradeable (Sweller et al. 2007). In this respect, the experiences in Norway are particularly interesting. After a curricular reform that focused on acquiring skills through various activities and neglected subject content knowledge, the achievements of students in mathematics and science, evaluated in international studies PISA and TIMSS, dropped considerably

(Institute for Teacher Education and School Development 2006). These examples demonstrate that science teaching should focus around understanding of science concepts, with a balanced use of different teaching methods

A particular feature of the project *Science Goes to School* was a “science ambassador” – a scientist who visited schools during regular biology lessons. While the main goal of these visits was testing of new activities and teacher training, the visiting scientist also served as a role model to increase students’ interest in science and motivate them to consider science careers. The students in partner schools responded with enthusiasm. Examples of their comments in questionnaires are: *I wish we had more such lessons, this way we learn more; I liked the lesson, it was fun and instructive; Come back again; Keep delivering such lessons in the future* (see students’ comments in Strgulc Krajšek and Vilhar 2010). These experiences support previous observations that active learning works (Abrahams and Millar 2008) and that universities can promote change towards more efficient science teaching (Tanner et al. 2003). Different models of scientists visiting schools have been used in other countries, with encouraging results (e.g. Peplow 2004, Beck et al. 2006, Brodie 2006, Laursen 2007).

The project *Science Goes to School* was a pilot project, introducing and testing a new model for development of teaching materials and for teacher training in Slovenia. While the target subject of the project was biology, the same model is applicable for introduction of novelties in other science subjects (science, physics and chemistry). The strong support from the teachers (Fig. 3G) clearly shows that such activities should be continued on a regular basis. However, these activities are only financed in Slovenia on a short-term basis (in particular with financial support from the EU), which greatly diminishes the long-term impact on improvement of biology education. Notably, centres for biology teacher training with full-time staff exist in many EU countries, but there is no such centre in Slovenia. In 2009, The European Network of Academies on Science Education stated that the use of limited EU seed funds must be followed up by substantial investments nationally,

from ministries of education, Academies of Sciences, research institutions and industry (ALLEA 2009). The long-term strategy for improvement of science education in Slovenia should follow these guidelines.

Conclusions

- Biology teachers need and expect support from university scientists.
- The new approach to university-school partnership developed and tested during the project *Science Goes to School* was favourably received among the teachers, the project scientists and the students in partner schools.
- Long-term funding, in particular from the national sources, is needed for such activities to have a long-lasting effect on improvement of biology education in Slovenia.

Povzetek

Ob hitrem napredku bioznanosti ter naraščajočem pomenu biološkega znanja za osebne in družbene odločitve se precej spreminjajo tudi pristopi k biološkemu izobraževanju. Pri posodobitvi pouka učitelji biologije potrebujejo strokovno podporo in ustrezno strokovno izpopolnjevanje (tab. 1), pri čemer pričakujejo tudi pomoč znanstvenikov z univerz (tab. 2, sl. 1A).

V okviru projekta *Znanost gre v šolo* smo razvili in preizkusili nov pristop k uvajanju sodobnih metod poučevanja bioloških vsebin v slovenske šole. V središču projekta je bilo tesno partnerstvo univerze in šol, s katerim smo povežali strokovno znanje znanstvenikov z Univerze v Ljubljani in izkušnje učiteljev z 22 partnerskih srednjih šol. Zamisel za projekt smo oblikovali na temelju podobnih projektov v drugih državah (Mervis 2002, Tanner in sod. 2003, National Science Foundation 2010), pri čemer smo projektne dejavnosti prilagodili specifičnim razmeram na slovenskih šolah in univerzah. Projekt je trajal leto in pol (vrednost projekta: 62 600 €).

Projekt je obsegal tri faze (sl. 2). Med uvodno delavnico so znanstveniki in partnerski učitelji opredelili vsebine v učnem načrtu, pri katerih močno primanjkuje kakovostnih učnih gradiv,

ter razpravljali o možnih didaktičnih pristopih k poučevanju teh tem.

Med drugo fazo projekta so znanstveniki razvijali nove praktične aktivnosti za pouk biologije in pripravili izčrpana učna gradiva. Vsako novo aktivnost smo preizkusili v partnerskih šolah, pri čemer je eden od znanstvenikov obiskal šolo kot gostujoči učitelj. Med testiranjem so bili partnerski učitelji prisotni v razredu in so se tako strokovno usposabljali v avtentičnem okolju lastnih učilnic. Tako učitelji kot dijaki so prispevali pripombe in predloge za izboljšanje novih aktivnosti. Gostujoči znanstvenik je bil hkrati »znanstveni ambasador« - vzornik pri spodbujanju zanimanja dijakov za naravoslovne znanosti in naravoslovne študije.

V okviru projekta smo pripravili gradiva za osem novih praktičnih aktivnosti (Vilhar in sod. 2007). Učna gradiva vsebujejo navedbo ustreznih tem in ciljev v učnem načrtu, trajanje aktivnosti, teoretično razlago za učitelje, navodila za pripravo in izvedbo aktivnosti, delovne liste za dijake z rešitvami in komentarji za učitelje (vključno s pričakovanimi rezultati poskusov), povezave na spletne strani z dodatnimi gradivi, seznam strokovne literature, varnostna opozorila, razlago o pogostih napačnih predstavah ter zanimivosti, s katerimi lahko učitelj motivira učence. V učna gradiva smo vključevali tudi zgodbe iz zgodovine znanosti, s katerimi lahko dijakom predstavimo naravo znanosti.

Med tretjo fazo projekta smo nova učna

gradiva objavili v priročniku za učitelje (Vilhar in sod. 2007) in na spletnih straneh (<http://znanost-gre-v-solo.biologija.org/>). Organizirali smo tudi zaključno delavnico za učitelje, na kateri se je širši krog učiteljev in šolskih laborantov usposabljal za izvedbo novih aktivnosti. Projekt so z navdušenjem podprli učitelji (sl. 1B, 1C, 3), sodelujoči znanstveniki in dijaki s partnerskih šol.

Projekt Znanost gre v šolo je bil pilotski projekt, s katerim smo v slovenski prostor uvedli nov model za razvoj učnih gradiv in usposabljanje učiteljev. Čeprav je projekt obravnaval poučevanje biologije, je enak model uporaben tudi za posodobitev drugih naravoslovnih predmetov (naravoslovja, kemije in fizike). Za učinkovito izboljšanje kakovosti biološkega izobraževanja v slovenskih šolah bi morali tovrstne dejavnosti dolgoročno in stabilno financirati iz nacionalnih virov (ALLEA 2009).

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