

Mojca Štraus, Neja Markelj

Attainment of Baseline and Highest Levels of Literacy Among Slovene Students According to PISA Study Results¹

Abstract: The recent PISA results published in December 2010 opened up a debate on Slovene students' proficiency in reading, and mathematical and scientific literacy. The study showed that the 15-year-old Slovene children had lower than average reading scores in comparison to their counterparts in the OECD and the EU. In this paper, data from 2006 and 2009 are used to identify the percentage of 15-year-old Slovene students in the first grade of upper-secondary education in Slovenia who are proficient at the highest levels of literacy as well as the percentage of students not reaching the baseline levels. As expected, the highest levels of proficiency were attained mostly by students on academic programs and a very small percentage of students on professional programs. Attainment of baseline proficiency was a problem at least in one area for a quarter of the students on professional programs, three quarters of students on the middle level vocational programs, and for almost all students on the lower level vocational programs. Moreover, in the lower vocational programs, more than 60 % of students failed to attain baseline proficiencies in any of the three areas.

Keywords: PISA, literacy levels, upper secondary programs, gender

UDC: 37.091.279.7:373.5

Scientific review paper

*Mojca Štraus, Ph.D., Education Research Institute, Gerbičeva 62, SI-1000 Ljubljana, Slovenia;
e-mail: neja.markelj@pei.si*

*Neja Markelj, Ph.D., Education Research Institute, Gerbičeva 62, SI-1000 Ljubljana, Slovenia;
e-mail: neja.markelj@pei.si*

Introduction

One of the consequences of technological development in the last few decades is that in order for young people to become successful adults, they need to attain or develop new knowledge and skills. The understanding that youngsters do not attain knowledge and skills only at school or through schoolwork has been emphasized. In this regard, a conceptual transition in the perception of knowledge in international studies is observed, from evaluating the knowledge and understanding of topics in the curricula (e.g., the TIMSS study), to evaluating the understanding of basic principles and processes and the use of knowledge and skills in various every-day situations (e.g., the PISA study) (cf. *Assessing Scientific ...* 2006; Cotič et al. 2010; *Definition and Selection ...* 2005; Markelj 2010). In the PISA study, conducted by the OECD, literacy is not understood simply as being able to read and write (*Measuring Student Knowledge ...* 2000) and also not as a quality that an individual possesses or not, but as a quality that is developed in varying degrees and whose increase can be assessed and measured from low to high literacy (Salganik 2001).

Inadequate literacy is, on a social level, generally perceived as an obstacle to social and economic development, and warnings about the significance of literacy for personal development and the success of society are highlighted in the findings of international studies on inadequate literacy (Grosman 2010, p. 17; cf. *The High Cost ...* 2010). Hanushek and Woessmann find that international studies that include data on the quality of the learning achievements of a population reveal much larger skill deficits in developing countries than in developed countries than generally derived from the number of youngsters enrolled in education programs and the number of years a certain population spends attaining education (Hanushek and Woessmann 2008, p. 607). Of course, it is not only important to reach baseline proficiency, it is also important to attain the highest levels. While

¹ Preparation of this article was a part of the activities of the project "Evaluation and assurance of the quality in education and training – Evaluation of the education on the basis of the internationally recognized methodologies", that is cofinanced by the European Social Fund of the European Union and the Ministry of Education and Sports of the Republic of Slovenia.

the baseline level of literacy is perceived as important for successful acceptance and use of new technologies, a highly developed literacy is crucial for creating new knowledge, technologies and innovations, and this is especially important for countries wishing to lead the way in technological development (Top of the Class ... 2009, p. 18).

Of course we cannot expect a 15-year-old to have mastered everything he or she will need as an adult, since attaining literacy is a lifelong process (Measuring Student Knowledge ... 2000). However, it makes sense to expect some baseline knowledge and skills in areas such as reading, mathematics and science, in order to increase knowledge in these areas and help students use this knowledge in situations outside the context of the school curriculum (cf. Assessing Scientific ... 2006; PISA 2009 Assessment ... 2009). It is reasonable to expect that knowledge and skills are not only attained in school or in other forms of formal education, but are also attained outside the school environment through contacts within family, peers and society in general. However, the education system certainly remains the primary mechanism with which we try to improve the level of literacy in youngsters through setting goals, standards and approaches to teaching. In this regard, the results of literacy studies, such as PISA, can in a particular segment be viewed as achievements that are significantly co-determined by the education system.

There are many different perceptions of educational achievements, which derive from different perceptions of the aims and goals of education systems. Various skills and knowledge are often presented as achievements, the understanding of which changes constantly – from traditional to constructivist perceptions of knowledge (Uljenš 1997). Education systems have always strived to form other qualities in students: from learning habits, motivation, attitude, moral and ethical principles to the development of personality (e.g. Gogala 1966; Poljak 1991; Strmčnik 2001; Šilih 1961). There has been an understanding in recent expert literature of achievements as a partial integration of knowledge with all, or at least some, of the aforementioned characteristics of an individual under the common term of competence (e.g., Lafontaine 2004; Markelj 2010; Medveš 2004; Peschar 2004; Rychen 2004; Rychen and Salganik 2003; Salganik 2001).

The transfer of emphasis from knowledge to competence is evident when we compare the assessment designs and operationalization of the significance of educational achievements in the TIMSS and PISA studies. The TIMSS 2007 frameworks (Mullis et al. 2005, pp. 4-5) emphasize the connection with previous studies, the first of which was FIMS (First International Mathematics Study) (Husén 1967). In TIMSS, the curriculum in its broader sense represents the basic conceptual framework to help us decide how opportunities for education are related to other factors and how students take advantage of these opportunities. TIMSS achievement tests are therefore formed in close connection with the national curricula of the participating countries. On the other hand, the PISA study's focus is not on the assessment of attainment of the national curricula goals but the knowledge and skills that 15-year-olds need for the future and attempts to collect data on how youngsters use this knowledge and skills (Assessing Scientific ... 2006, p. 7). Evaluations of knowledge and skills are supposed show the ability of youngsters

to continue permanent learning, how they use the knowledge acquired in school in a non-school environment, and evaluate their competency to make decisions. Therefore, data collection for the PISA study is not limited by the national curricula of the participating countries and the term literacy is used for the evaluated knowledge and skills.

The definition of the research problem and research questions

The recent publication of the PISA 2009 study results, which point to significantly lower results in reading literacy of 15-year-old Slovene students compared with 15-year-olds from other countries (OECD PISA ... 2010), opened a debate in various daily newspapers (e.g., Ivelja 2010; Žist 2010; Žolnir and Kramžar 2010). While the average achievements of 15-year-old Slovene students in the areas of mathematical and scientific literacy were above the average of the OECD in 2006 as well as in 2009, and achievements in the area of reading literacy in 2006 were above the average of the OECD in 2006. In 2009, when reading literacy was more thoroughly evaluated with two thirds of items being reading literacy items, achievements were below the average of the OECD (PISA 2006 ... 2007, PISA 2009 Results ... 2010). The results in 2009 are the consequence of lower achievements compared with results in 2006 in items that were present in both reading literacy achievement tests, as well as lower achievements of 15-year-old Slovene students in comparison with peers from other countries in a higher number of new items in 2009 (PISA 2006 Database ... 2007; PISA 2009 Database ... 2010).

Therefore, it makes sense to pay additional attention to the achievements of Slovene students, especially in the area of reading literacy. In this article, reading literacy is treated in connection with mathematical and scientific literacy. For a more thorough understanding of attaining the baseline and highest levels of literacy in Slovenia, it is important to research the interconnectedness of reading literacy with mathematical and scientific literacy for at least two reasons. Firstly, although the role of language in scientific literacy is assessed on understanding science questions, creating and attaining new science knowledge, making explanations and evidence based decision making is often not explicitly emphasized, the correlation between scientific literacy and mathematical and reading literacy is evident (Yore et al. 2007). Similarly, M. Cotič, Felda and A. Žakelj state that without a highly developed reading literacy, students find it impossible, or very hard, to demonstrate their mathematic abilities (Cotič et al. 2010, p. 278). Similar results can be found in the PISA study, when in 2009, for example, the correlation between reading and mathematical literacy in the achievements of 15-year-old Slovene students was 0.84, and the correlation between reading and scientific literacy and mathematical and scientific literacy was 0.88 (PISA 2009 Database ... 2010). Secondly, basic national achievement results in the PISA 2009 study show that 15-year-old Slovene students who are high-achievers in reading literacy are also highly mathematically and scientifically literate (OECD PISA ... 2010, p. 39).

In general, the question of the definition and ways of attaining high levels of literacy in upper-secondary education programs in Slovenia has no direct or simple answer and the PISA study has received some criticism (BonderupDohn 2007; Murphy 2010; Topping et al. 2003). However, due to the international attention it received, the PISA study presents an important starting point for researching the achievements of students and for searching for ways of improving the quality of the education system. PISA is the only study in Slovenia that enables international comparability of the population entering the Slovene upper-secondary education system and gymnasias programs, since the vast majority (approximately 90%) of 15-year-olds in Slovenia are enrolled in the first grade of upper-secondary education programs. At the same time, the study covers three domains of literacy, so that we can investigate their interconnectedness in detail.

The data on attaining baseline and highest levels of literacy among 15-year-old Slovene students in the PISA study at the national level, and in comparison with other countries, can be found in international and national reports (PISA 2006 ... 2007a; PISA 2009 Results ... 2010; OECD PISA ... 2010). In this article, we will analyze the data in more detail according to various upper-secondary education programs in Slovenia. We are interested in the percentage of 15-year-old students who attained the highest levels of reading, scientific and mathematical literacy, individually or in several domains simultaneously, and the percentage of 15-year-old students who did not reach the baseline proficiency levels in those domains. We shall investigate the following research questions:

1. Attaining the highest levels: What percentage of 15-year-old Slovene students in the first grade of upper-secondary education programs attain the highest levels of reading, mathematical and scientific literacy in the PISA 2006 and PISA 2009 studies? Are there significant gender differences?
2. Attaining baseline levels: What percentage of 15-year-old Slovene students in the first grade of upper-secondary education programs did not attain the baseline levels of reading, mathematical and scientific literacy in the PISA 2006 and PISA 2009 studies? Are there significant gender differences?

One consequence of the different characteristics and goals of upper-secondary education programs is that there are different expectations about attaining the levels of student literacy in those programs. It is reasonable to expect that students of gymnasias programs will attain the highest levels in a bigger proportion than students enrolled in other programs. It is also reasonable to expect that a higher proportion of students enrolled in vocational programs will not reach the baseline levels of literacy, compared with students enrolled in other education programs, according to the PISA study. In the process of transition from elementary to upper-secondary education, students enroll into programs primarily on the basis of their own choice. We can assume that these choices are made within a complex system of background factors, that includes, for example, students' grades in elementary school, their home background, their attitudes to individual subjects and to school work in general, and other similar factors. Therefore it makes sense to look at

the expectations of attaining baseline and the highest levels of literacy in light of the data from both PISA assessment studies in which Slovenia participated, PISA 2006 and PISA 2009.

The results of the analysis of reading, scientific and mathematical literacy of 15-year-old Slovene students at the beginning of upper-secondary education can offer an important basis for planning pedagogical approaches to their further education. The results of the analysis certainly do not solve all the intricate problems of literacy development, however, they do offer a framework, which helps us investigate the population entering Slovene upper-secondary education programs. It is perhaps important to emphasize that the achievements of 15-year-old Slovene students on the achievement scale in the PISA study do not reflect the (un)successfulness of pedagogical work of the upper-secondary programs that those 15-year-olds attend, as much as they reflect the (un)successfulness of their former formal or non-formal education, together with other factors that are connected with the development of literacy.

Description of data and methods of work

To analyze the attainment of baseline and highest levels of literacy among 15-year-old Slovene students we will use the database in the international PISA studies from 2006 and 2009, when Slovenia also participated in the studies. The execution of PISA studies adheres to strict international technical standards that the PISA international center monitors with various quality assurance mechanisms, such as an independent verification of translation, the high level of sample response, on-site international monitoring of assessment and item-bias analysis. The preparation procedures and the scope of validity of the PISA study data are described in detail in international documents such as the report of the project "Definition and Selection of Competencies" (Definition and Selection ... 2005), the Technical Report (PISA 2006 Technical ... 2009) and the Assessment Frameworks (Assessing Scientific ... 2006).

International technical standards specify that the sample of 15-year-olds in each country needs to be representative of the total population of 15-year-olds included in education, regardless of their grade or education program. The Slovene samples of 15-year-old students in PISA 2006 and 2009 comply with these standards, which is evident from the fact that the achievements of the Slovene students are included in the international reports (PISA 2006 ... 2007a, PISA 2009 Results ... 2010). Because the majority of 15-year-old students in Slovenia attend upper-secondary education programs that differ in design and objectives, the sample was designed to be representative within subgroups of 15-year-old students in the individual education programs. Students who attend the first grade of upper-secondary programs and are not 15-years-old are not included in the PISA study (the percentage of such students is relatively low, e.g., 9.4% in 2006). On the other hand, 15-year-old students who either still attend elementary-school programs, programs for youths or programs for adults are also included in the

study. Those two groups of 15-year-olds are relatively small (in 2006 they together represented 3.7% of the population of 15-year-olds) and are not representative of the total population of students in elementary school programs for youths and adults, and are therefore not part of a more detailed analysis presented in this article. Analysis and results in this article therefore only refer to 15-year-olds attending the first grade of upper-secondary programs.

Characteristics of the sample

Upper-secondary education programs in Slovenia are structured into several programs (Seznam javno veljavnih ... 2009). However, in this article we only look at a narrow selection of these programs, namely those into which 15-year-olds are enrolled: lower vocational programs (NPI), secondary vocational programs (SPI), secondary technical and professional programs (STSI), professional gymnasias programs (STROK GIM) and general and classical gymnasias programs (GIM). After the exclusion of those students from the sample who did not fit the described criteria, 6,224 students were included in the data analysis of the PISA 2006 study (45.7% female students and 54.3% male students), out of which 21.4% of students attended general and classical gymnasias programs, 12.6% attended professional gymnasias programs, 35.7% attended secondary technical and professional programs, 26.9% attended secondary vocational programs and 3.3% attended lower vocational programs. There were 5,799 students who were included in the PISA 2009 study (45.5% female students and 54.5% male students), out of which 23.4% of students attended general and classical gymnasias programs, 11.5% attended professional gymnasias programs, 38.4% attended secondary technical and professional programs, 24.0% attended secondary vocational programs and 2.7% attended lower vocational programs.

Statistical analysis

The article focuses on the characteristics of attaining the baseline (Level 2) and highest levels (Levels 5 and 6) of proficiency on the scales of reading, mathematics and scientific proficiency in the PISA study among 15-year-old Slovene students. For an easy overview, we present the results of the proficiency scales of the PISA study in three categories: a low achievement is an achievement below the baseline level (Level 2) of literacy, a high achievement is Levels 5 or 6, and the remaining achievements are termed average achievements.

To analyze the data, we used the SPSS application and a special module, "Replicates" that enabled the calculation of statistical parameters and their population estimates with the analysis of plausible values.

Results²

In this section, we present results of the achievement analysis of 15-year-old Slovene students enrolled in the first grade of upper-secondary education programs according to individual education programs for all three domains of literacy. Table 1 presents the percentages of students in the three categories of achievements (low, average and high) and the individual intersections of the three literacy domains.

On the basis of both PISA studies (2006 and 2009), we conclude that more than half of Slovene upper-secondary program students attain average results in all three domains combined (58.1% in 2006 and 55.2% in 2009; Table 1). The highest levels of literacy in at least one domain were attained by 17.2% of students in 2006 and 16.4% in 2009. The highest levels in reading literacy were attained by between 4 and 5% of students (4.8% in 2006 and 4.2% in 2009), in mathematic literacy by between 12 and 14% of students (12.6% in 2006 and 14.0% in 2009), and in scientific literacy by between 9 and 13% of students (12.4% in 2006 and 9.8% in 2009).³ It is evident that between the two assessments, the percentages did not significantly change in reading literacy, whereas in mathematical and scientific literacy, one can notice a statistically significant decrease in the percentage of students attaining the highest levels.

On the other hand, approximately one sixth of 15-year-old Slovene students did not attain the baseline levels of reading, mathematical and scientific literacy and the best results can be found in the domain of scientific literacy (16.0% of students in 2006 and 21.4% in 2009 in reading literacy, 17.1% in 2006 and 20.0% in 2009 in mathematical literacy, and 13.1% in 2006 and 15.0% in 2009 in scientific literacy). Approximately a quarter of students (24.6% in 2006 and 28.4% in 2009) had problems attaining the baseline level in at least one domain.

There was a statistically significant increase from 2006 to 2009 of 15-year-olds who did not attain the baseline level in all three literacy domains, with the biggest increase in reading literacy, a smaller increase in mathematical literacy and the smallest increase in scientific literacy. However, these increases did not reflect in the average achievements of 15-year-old Slovene students between 2006 and 2009. In the average assessment achievements in mathematical literacy in 2006 and 2009 respectively, there is no statistically significant difference, however, in scientific literacy the average achievement was 7 score points lower than the average assessment achievement in 2006, and the reading literacy assessment achievement was 11 points lower (OECD PISA ... 2010).

² In the section, we present statistically significant results based on a representative sample of 15-year-old students enrolled in the first grade of upper-secondary programs. To make the text shorter, we do not state standard errors and we do not emphasize that the differences are statistically significant. Details of analysis of statistical significance are available from the authors.

³ Those values relate to the overall percentages of students according to individual assessment domains regardless of their achievement in other domains; e.g., the reader can get the percentage of students attaining the highest levels in mathematic literacy by adding the percentages in *only MATH*, *MATH and REA*, *MATH and SCI* and *all three domains*. Minor deviations to the total values from Table 1 are due to rounding.

In attaining the highest levels of literacy, there are some unusual reading literacy achievement results among the three literacy domains. While the percentages of students who attain the highest levels in mathematical and scientific literacy are quite similar (between 10 and 14%), the percentage in reading literacy is considerably lower (approximately 4%). This discrepancy is further evident when the percentages of students according to overlapping domains are compared (Table 1). High assessment scores in all three domains simultaneously were achieved by approximately 3% of students (2.9% in 2006 and 3.1% in 2009). Among the remaining domains, the highest common percentage of students with high achievement results can be found in mathematics and science (5.4% in 2006 and 4.7% in 2009), which is roughly similar to the percentage of students with high achievement results in mathematical literacy only (4.1% in 2006 and 5.6% in 2009). We can conclude that the cross-sectional percentages of mathematical and scientific literacies combined with reading literacy, as well as the percentage of students successful in reading literacy only, are significantly lower, which may point to the possibility that students' reading literacy falls behind when compared to the other two domains. This can also be substantiated by comparing the percentages of students attaining the highest levels of reading literacy in the OECD, where the percentages are also small, but somewhat higher than in Slovenia (OECD PISA ... 2010, p. 39).

	LOW ACHIEVEMENT (does not attain Level 2)							AVERAGE ACHIE- VEMENT in all three domains	HIGH ACHIEVEMENT (attains at least Level 5)						
	all three domains	MATH and SCI	SCI and REA	MATH and REA	only SCI	only REA	only MATH		only SCI	only REA	only MATH	MATH and REA	SCI and REA	MATH and SCI	all three domains
2006	7.6	2.4	1.9	2.1	1.2	4.4	5.0	58.1	2.9	0.6	4.1	0.2	1.1	5.4	2.9
2009	10.5	1.5	2.0	3.5	1.0	5.4	4.5	55.2	1.8	0.4	5.6	0.5	0.2	4.7	3.1

Table 1: Percentages of students attaining the highest and lowest levels according to intersections of reading, mathematical and scientific literacy in PISA 2006 and PISA 2009.

Data on attaining the baseline levels in Table 1 show that most students with low scores have problems in all three domains simultaneously, followed by those students who did not attain the baseline level in mathematical literacy only or in reading literacy only. The fact that one tenth of students enrolled in the first grade of upper-secondary education did not reach the baseline levels of literacy in any of the three domains in the 2009 study, is surely worthy of attention. We can claim that these students show deficient levels of literacy and will probably have problems continuing their education successfully.

Students enroll in the first year of an education program according to their achievements in elementary education programs and we can therefore expect students of different programs to attain, on average, different scores in the three literacy domains in the PISA study. The assessment results of this study confirmed these expectations, as students in general and classical gymnasia programs, on average, attained statistically significantly higher achievements than students in

professional gymnasias programs, and students in professional gymnasias programs attained statistically significantly higher results than students in technical and professional upper-secondary programs; the latter attained statistically significantly higher results than the students of secondary vocational programs, and the students of secondary vocational programs attained statistically significantly higher results than the students of lower vocational programs. We present these results in more detail further on in this article.

Although the majority of students enrolled in general and classical gymnasias programs (57.0% in 2006 and 59.7% in 2009) attained average levels in all three domains simultaneously, more than one third of students attained the highest level in at least one domain (41.8% in 2006 and 37.6% in 2009) and there were few students who did not reach the baseline level in at least one area (1.1% in 2006 and 2.7% in 2009). The situation in professional gymnasias programs was similar: more than three quarters of students attained average levels in all three domains simultaneously (77.6% in 2006 and 75.1% in 2009), slightly less than one sixth of students attained the highest levels in at least one literacy domain (15.6% in 2006 and 15.1 % in 2009), and a small percentage of students did not attain the baseline level in at least one domain (6.9% in 2006 and 9.8% in 2009).

However, these relationships were reversed in the 4-year technical and professional programs, secondary vocational and lower vocational programs – the percentages of students who did not attain the baseline levels of literacy in at least one domain was very high in these programs. Just a few percent of students in the 4-year technical and professional programs (3.0% in 2006 and 3.9% in 2009) attained the highest levels in at least one literacy domain, while most students (70.2% in 2006 and 61.5% in 2009) attained average levels in all three domains and more than a quarter of students (26.8% in 2006 and 34.6% in 2009) did not attain the baseline level in at least one domain. There were hardly any students in secondary vocational programs who attained the highest levels (0.2% in 2006 and 0.1% in 2009), a quarter or fewer students (27.8% in 2006 and 19.1% in 2009) attained average levels in all three domains, and approximately three quarters of students did not reach the baseline level in at least one domain (72.1% in 2006 and 80.6% in 2009). This ratio is even lower in lower vocational programs, where very few students reached the baseline levels in all three domains simultaneously (2.0 % in 2006 and 3.9 % in 2009). Therefore, more than 90% of students enrolled in these programs have problems reaching the baseline level.

Attaining the highest levels of literacy in the upper-secondary programs

Figure 1 presents in detail the percentages of students in general, classical and professional gymnasias programs who attained the highest levels in at least one domain of literacy. We can see that students enrolled in general and classical gymnasias programs attained the highest levels of literacy in an individual literacy or a combination of two or all three domains of literacy in 2006 as well as in 2009 in a higher percentage than students enrolled in professional gymnasias programs. However, it is true of both programs of general and classical gymnasias and

programs of professional gymnasia that a higher percentage of students attained the highest levels in mathematical literacy or in a combination of mathematical and scientific literacies, rather than in other domains (approximately one tenth of students of professional gymnasia programs and approximately one quarter of students of general and classical gymnasia programs). It is quite the opposite in the reading literacy domain, where the percentage of students who attained the highest levels (individually or in a combination with another domain) is especially low (less than 5% in general and classical gymnasia programs and about 1% in professional programs).

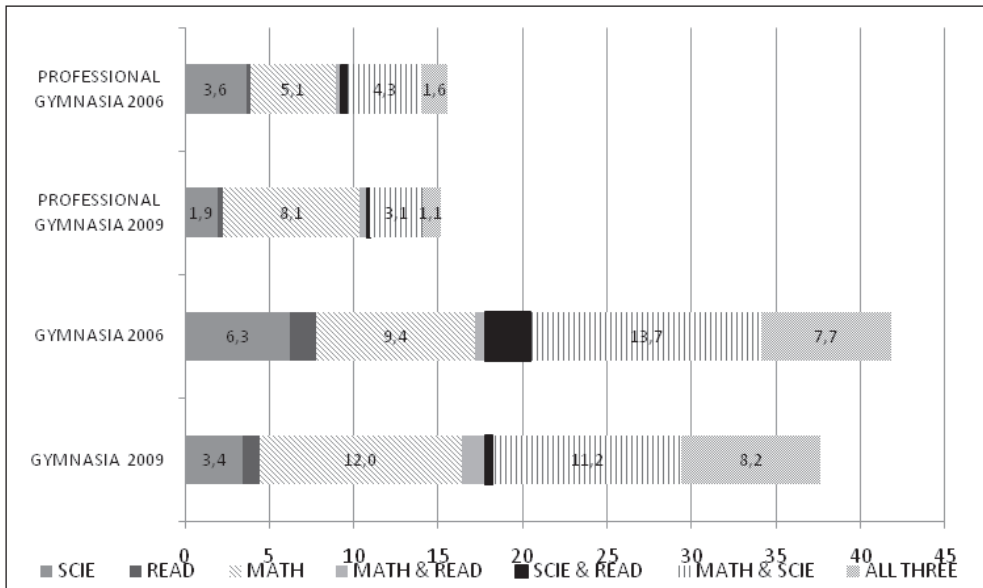


Figure 1: The percentages of students in general and classical gymnasia programs and students of professional gymnasia programs who achieved the highest levels in reading, mathematical and scientific literacy in PISA 2006 and PISA 2009 with gender comparisons.

The profile of attaining the highest levels does not only differ between gymnasia programs, but also between genders. Approximately half the male students in general and classical gymnasia programs attained the highest levels of literacy in at least one domain (51.1% in 2006 and 45.2% in 2009) and only approximately one third of female students attained the same (31.1% in 2006 and 32.5% in 2009). A higher percentage of female students than male students regularly attained the highest levels in all three domains simultaneously (8.0% of female students compared with 6.7% of male students in 2006 and 10.0% of female students compared with 5.5% of male students in 2009), whereas a higher percentage of male students than female students regularly attained the highest levels in mathematical literacy only (13.6% of male students compared with 7.0% of female students in 2006 and 18.6% of male students in 2009 compared with

8.4% of female students), and mathematical and scientific literacy assessment combined (22.7% of male students in 2006 compared with 8.6% of female students and 17.3% of male students in 2009 compared with 6.2% of female students). From this we can deduct that male students outperform female students in mathematical literacy (45.3% of male students in 2006 compared with 24.6% of female students and 42.3% of male students compared with 26.3% of female students) and scientific literacy (26.1% of female students in 2006 compared with 36.7% of male students and 19% of female students in 2009 compared with 25.8% of male students), whereas female students outperformed male students in reading literacy (15% of female students in 2006 compared with 7.5% of male students and 14.7% of female students in 2009 compared with 5.4% of male students). The differences are statistically significant.

Approximately, a fifth of male students in professional gymnasias programs attained the highest levels in at least one literacy domain (23.4% in 2006 and 19.9% in 2009) while a mere tenth of female students in professional gymnasias programs attained the highest levels in at least one literacy domain (7.9% in 2006 and 10.1% in 2009). The highest percentage of male students attained the highest levels in mathematical literacy (8.1% in 2006 and 11.8% in 2009), in 2006 also in combination with mathematics and science (7.5%). Whereas a smaller percentage of female students than male students attained the highest levels, some female students did attain them in mathematics individually (2.2% in 2006 and 4.1% in 2009) and in 2006, in scientific literacy individually (4.6%). Also, in professional gymnasias programs, male students outperformed female students in mathematical literacy (18.6% of male students in 2006 compared with 4% of female students, and 16.7% of male students in 2009 compared with 8.9% female students) and in scientific literacy (6.1% of female students in 2006 compared with 15.3% of male students, and 5.4% of female students in 2009 compared with 8.3% of male students). The differences between genders in scientific literacy were not statistically significant in 2009. On the other hand, the differences between the genders were small in reading literacy and were not statistically significant in 2006 (2.7% of female students in 2006 compared with 2.8% of male students), whereas in 2009 they were 2.7% of female students compared with 0.1 % of male students.

The basic results of the PISA 2006 and PISA 2009 studies show that there are gender differences at the national level in average achievements; female students outperformed male students in reading literacy (female students attained 54 score points more than male students in 2006 and 55 score points more in 2009) and in scientific literacy, female students attained 8 score points more in 2006 and 14 score points more in 2009, while there was no significant gender difference in mathematical literacy (PISA 2006 ... 2007b, PISA 2009 Results ... 2010). A more detailed analysis of the PISA 2006 study showed that gender differences at the national level are not reflected evenly in individual upper-secondary education programs, since the advantage of female students in reading literacy decreased within programs and male students actually outperformed female students in scientific literacy (Štraus 2009). One explanation for these seemingly contradictory results, is the difference in percentages of female and male students in various

education programs and the fact that more successful male students than female students decided to enroll in education programs other than the programs of general and classical gymnasias programs (ibid., p. 60). Similarly, in the analysis presented here, gender differences at the national level show different results. In reading literacy, the gender differences in the percentages of students attaining the highest levels are small and inconsistent, and in mathematical and scientific literacies, male students of both gymnasias programs outperform female students in attaining the highest levels.

Attaining baseline levels of literacy in the upper-secondary education programs

In this section we present details of the results of baseline literacy achievements of 15-year-old Slovene students enrolled in the first grade of upper-secondary programs from the database of the PISA 2006 and PISA 2009 studies. As we have already mentioned, students enrolled in both gymnasias programs, in a great majority, attained at least baseline levels in all three domains of literacy. Therefore we shall, in the continuation, present results only of vocational and technical and professional programs, where attaining baseline levels of literacy is less expected.

In Figure 2 we present the relationships between the percentages of students enrolled in technical and professional upper-secondary programs, secondary vocational programs and lower vocational programs who did not attain the baseline level of literacy in at least one domain of literacy. We can see that the percentages of students who did not attain the baseline levels of literacy in all three domains are significantly different according to the program. Whereas in technical and professional programs, this percentage is still lower than one tenth (4.1% in 2006 and 7.7% in 2009), it significantly increases to approximately a third in secondary vocational programs (30.4% in 2006 and 43.5% in 2009). However, the percentage is even more worrying in lower vocational programs, where as many as between 60 and 70% of students enrolled in these programs did not attain baseline levels in any of the assessed domains (63.1% in 2006 and 70.1% in 2009). We also find that students enrolled into programs of secondary vocational and lower vocational upper-secondary education had problems especially in reading literacy and a combination of reading literacy with other domains. Even if we take into account the more favorable results from 2006 and 2009, we can see that in the domain of reading literacy (individually or combined with another domain), more than 90% of students of lower vocational programs (96.1% in 2006 or 94.4% in 2009) did not attain the baseline levels. The results are also worrying in the remaining two domains, since three quarters of the students and more did not attain the baseline levels in scientific literacy (80.1% of students in 2006 and 87.8% of students in 2009) and in mathematical literacy (70.7% in 2006 and 73.0% in 2009). The results of students of secondary vocational schools are also a cause for concern, since more than half of the students did not attain the baseline levels of reading literacy (53.8% in 2006 and 72.6% in 2009), and approximately half in mathematical (54% in 2006 and 62.4% in 2009) and in scientific literacy (44.8% in 2006 and

52.1% in 2009). The presented results are worrying because the baseline levels in all three domains of literacy present the stage of literacy development that an individual requires to comprehend significant activities in their private and social lives and that he/she needs to function well in every-day situations. The percentages of students not attaining the baseline level of literacy are somewhat lower among students of technical and professional upper-secondary programs, however, they are still dissatisfactory: 13.7% of students in 2006 and 22.6% in 2009 did not attain the baseline levels of reading literacy, 16.9% of students in 2006 and 22.3% in 2009 in mathematical literacy, and 10.9% of students in 2006 and 14.2% in 2009 in scientific literacy.

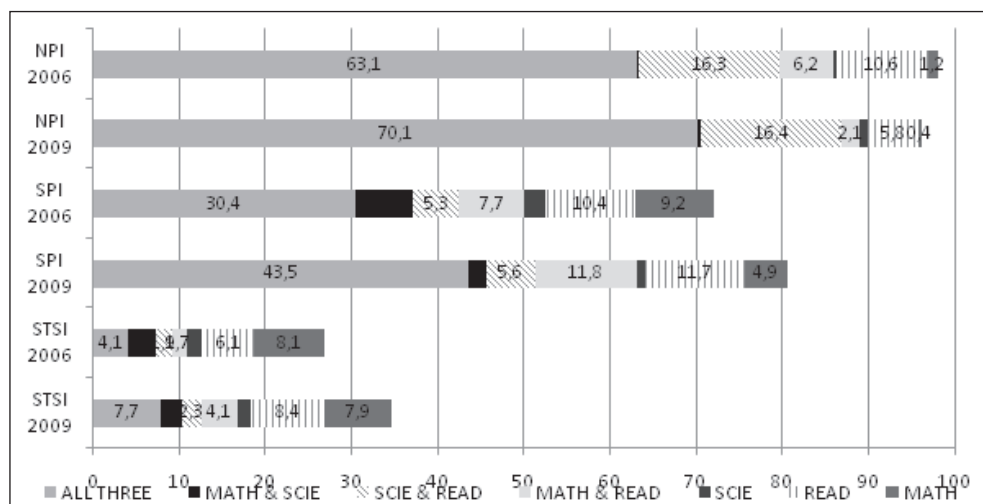


Figure 2: The percentages of students of technical and professional upper-secondary programs (STSI), secondary vocational programs (SPI) and lower vocational programs (NPI) who did not attain baseline levels in reading, mathematical and scientific literacy in PISA 2006 and PISA 2009 with a gender comparison.

Gender differences are evident in all three upper-secondary programs. The percentages of male and female students in lower vocational schools who did not attain the baseline level in at least one domain of literacy are similar, however, there are gender differences within individual domains and their combinations. Three quarters of female students in lower vocational schools compared with slightly less than two thirds of male students did not attain the baseline levels in all three domains simultaneously (77.0% of female students compared with 59.3% of male students in 2006 and 86.6% of female students compared with 65.2% of male students in 2009). Another difference is the higher percentage of female students compared with male students who did not attain the baseline level in mathematical assessment (5.1% of female students compared with 0.1% of male students in 2006, and only 1.9% of female students compared with 0% of male students in 2009). Meanwhile, a higher percentage of male students in lower

vocational programs did not reach baseline levels in the domain of reading literacy (12.1% of male students compared with 4.7% of female students in 2006 and 7.5% of male students compared with 0% of female students in 2009), in the combination of reading literacy with scientific literacy (18.3% of male students compared with 8.5% of female students in 2006, and 19.6% of male students compared with 5.6% of female students in 2009), and in combination with mathematical literacy only in 2006 (7.1% of male students compared with 2.5% of female students).

The percentage of male students (29.6% in 2006 and 44.0% in 2009) and female students (32.0% in 2006 and 42.3% in 2009) in secondary vocational programs who did not attain baseline levels in any of the three domains is, as expected, lower than in lower vocational schools, however, the percentages are still high. There is also a gender difference in attaining the baseline levels in individual domains in secondary vocational schools. Female students mainly perform poorer in assessments of mathematical literacy and male students perform poorer in assessments of reading literacy. If we are more precise, a higher percentage of female students compared with male students did not attain the baseline levels in mathematical literacy assessments (16.5% of female students compared with 5.4% of male students in 2006 and 13.0% of female students compared with 1.6% of male students in 2009) and in a combination of mathematical and scientific literacy assessments (15.7% of female students compared with 2.0% of male students in 2006 and 6.0% of female students compared with 0.5% of male students in 2009). A higher percentage of male students compared with female students did not attain the baseline level in the reading literacy assessment (14.8% of male students compared with 2.2% female students in 2006 and 15.5% of male students compared with 2.4% of female students in 2009) and in the combination of reading and mathematical literacy (9.7% of male students compared with 3.9% of female students in 2006, and 13.0% of male students compared with 9.0% of female students in 2009) and scientific literacy (6.6% of male students compared with 2.9% of female students in 2006, and 7.1% of male students compared with 2.2% of female students in 2009).

The ratios in technical and professional programs are similar to those in secondary vocational programs. The percentage of male students (4.2% in 2006 and 8.0% in 2009) and female students (4.0% in 2006 and 4.7% in 2009) who did not attain the baseline levels in all three domains simultaneously is lower in lower and secondary vocational programs. The percentages according to gender are, in that program, similar. Gender differences according to individual domains do exist. A higher percentage of female students compared with male students did not attain the baseline levels in mathematical literacy (14.4% of female students compared with 2.9% of male students in 2006, and 13.7% of female students compared with 2.8% of male students in 2009) and in a combination of mathematical and scientific literacy (5.5% of female students compared with 1.0% of male students in 2006, and 4.7% of female students compared with 0.6% of male students in 2009). However, a higher percentage of male students compared with female students did not attain the baseline levels in reading literacy (10.4% of male students compared with 0.9% of female students in 2006, and 13.9% of male students compared with 2.1% of female students in 2009).

Gender differences at the national level are only partially reflected in gender differences in all three programs considered. In the domain of reading literacy, male students on a national level attained statistically significant lower average scores than female students. In secondary professional and vocational programs there are differences in a higher percentage of male students who did not attain the baseline levels. In mathematical literacy there are no statistically significant gender differences in average scores, however, there is a higher percentage of female students than male students in secondary professional and vocational programs who did not attain the baseline levels in this domain. In scientific literacy, there are some small, but statistically significant gender differences in average scores at the national level in favor of female students, however, in secondary professional and vocational programs, differences in not attaining the baseline levels in this domain are evident, but inconsistent.

Conclusion

The results of the most recent PISA study, published in December 2009, opened a debate on Slovene students attaining adequate levels of proficiency, especially in the reading literacy domain. The study showed lower than average reading scores of 15-year-old Slovene students in comparison with their counterparts in the OECD and the EU. Even though the results in the form of national averages contribute important information, they do not give detailed answers to the questions about the differences in assessment achievements of Slovene students compared with students from other countries or within the country. In order to establish those differences, we must analyze the data in the broader context of understanding the correlation between interrelated factors in the process of teaching and learning.

In this article, results of the analysis of the levels of reading, mathematical and scientific literacy of 15-year-old Slovene students at the beginning of upper-secondary education programs offer a framework of thinking about the population enrolling into these education programs and the possibilities of improving the pedagogical base and teaching approaches in their further educational process. We used the data from the PISA international studies from 2006 and 2009, where we found the data on 15-year-old Slovene students' literacy for all education programs combined, and then we analyzed the education programs individually. The results were mainly as expected, since it is understandable that the highest levels of literacy were generally attained by students of general and classical gymnasias programs and the baseline levels were generally not attained by students of vocational programs. However, some students of gymnasias programs did not attain the baseline level in at least one domain and the utmost attention should be paid to the data that show that in technical and professional programs, at least a quarter of students did not attain baseline levels, and the ratios are even less favorable in secondary vocational and lower vocational programs where very few students attained baseline levels of literacy in the assessed domains. In lower vocational

programs, for example, 60 to 70% of students did not attain baseline levels in any of the three assessed domains.

Gender differences become even more pronounced within individual education programs. Female students regularly attain the highest levels in all three domains of literacy combined, which probably reflects their significantly higher reading achievements, since male students of gymnasias programs regularly, and in a higher percentage than female students, attained the highest levels in mathematical literacy and in a combination of mathematical and scientific literacies. Even though the general advantage of female students over male students in the technical and professional programs and vocational programs is due to the fact that a higher percentage of female students attained baseline levels in reading literacy, generally more female students than male students in these programs did not attain baseline levels of mathematical literacy and a combination of mathematical and scientific literacies.

These findings certainly offer more questions than answers. There are questions about the functions and goals of upper-secondary programs in Slovenia, which stem from the initial discussion on education or thinking about the importance of general education and specific knowledge within the society and for an individual. The PISA study, with its lateral approach to data collection, does not offer immediate reasons for the presented results and little information on the mechanisms that would enable us to improve those results in a short period. However, a clear database, acquired with the help of meticulously-built mechanisms, which ensure international comparability and analysis of students' achievements and factors from the school and home environment, presents an important basis for data-based decision making for further educational processes.

Changing education systems to improve students' achievements is a difficult task. However, some cases show that it is not an impossible one. The OECD found that Poland, for example, when it restructured its education system and abolished upper-secondary education programs for students with lower education expectations, achieved a significant progress in the reading achievements of students between 2000 and 2003 (Strong Performers ... 2010, p. 230). The report also gives details on other examples of successful countries, such as Canada, Japan, Finland and Germany, in order to prepare the framework for an education reform, which started in 2010 in the United States of America entitled "Race to the Top".

In an article on providing adequate levels of various forms of literacy of Slovene pupils, students and people in general, M. Grosman stresses findings on the crucial significance of language aptitude on a person's literacy, where a higher level of literacy and various forms of literacy can only be achieved with more closely controlled and more careful language usage and language awareness (Grosman 2010, p. 22). Further on, the author writes that a person must be aware of the possibilities of language choice, know the language system and be capable of using various strategies and follow contextual factors, in order to use language successfully (ibid, p. 23). Gaber and L. Marjanovič Umek studied the results of the "Progress in International Reading Literacy Study 2006" (PIRLS 2006) and discovered that the inclusion of children into kindergartens has a positive correlation

with the achievement of children in reading literacy (Gaber and Marjanovič Umek 2009, p. 136). L. Marjanovič Umek also writes that the latest concepts and models of literacy and the findings of many studies where authors confirmed that children with highly developed speech competency achieve high results in assessments of emerging literacy, and that emerging literacy is a good prediction for literacy in time of schooling, show that it is scientifically founded that emerging literacy (and speech) should be encouraged in Slovene kindergartens, and we should teach first grade elementary school pupils to read and write using differentiated teaching, which requires setting initial standards of literacy and the corresponding implementation in the whole of the first triennium (Marjanovič Umek 2010).

An analysis done by S. Pečjak, N. Bucik, M. Peštaj, A. Podlesek and T. Pirc of gender differences in the factors of reading literacy or reading comprehension at the end of elementary school that are important for achieving higher levels of literacy in Slovene pupils and students (Pečjak et al. 2010). The authors discovered that these factors have some common features, such as variables of vocabulary and meta-cognitive awareness, and at the same time that motivational variables are more important for male pupils and students than for female pupils or students when trying to understand a text (ibid., p. 94). Taking into account the models of reading literacy, they infer pedagogical applications to increase the reading preparedness of boys. M. Cotič, Felda and A. Žakelj discovered that with adequate teaching and learning we can develop mathematical literacy and enable children to solve realistic problems and use mathematics in every-day situations (Cotič et al. 2010, p. 277). The authors also state that teaching mathematics at a science lesson, especially at a physics lesson, differs from teaching mathematics at a mathematics lesson, and that mathematics and science are usually not connected in the minds of pupils, upper-secondary students, university students or teachers (ibid., p. 278). This fact might help us find ways to improve the levels of literacy in Slovene pupils and upper secondary students.

References

- Assessing Scientific, Reading and Mathematical Literacy: A Framework for PISA 2006.* (2006). Paris: OECD Publishing.
- Bonderup Dohn, N. (2007). Knowledge and Skills for PISA – Assessing the Assessment. *Journal of Philosophy of Education*, 41, Issue 1, pp. 1–16.
- Cotič, M., Felda, D. and Žakelj, A. (2010). Razvijanje matematične pismenosti na razredni stopnji. *Sodobna pedagogika*, 61, Issue 1, pp. 264–282.
- Definition and Selection of Key Competencies. Executive Summary.* (2005). Retrieved from: <http://www.deseco.admin.ch/bfs/deseco/en/index/02.parsys.43469.downloadList.2296.DownloadFile.tmp/2005.dskcexecutivesummary.en.pdf> (Accessed on 25. 7. 2009).
- Gaber, S. and Marjanovič Umek, L. (2009). *Študije (primerjalne) neenakosti. Znanstveno poročilo Pedagoškega inštituta*. Ljubljana: Pedagoški inštitut. Retrieved from: [http://www.pei.si/UserFilesUpload/file/zalozba/ZnanstvenaPorocila/21_09_studije\(primerjalne\)neenakosti.pdf](http://www.pei.si/UserFilesUpload/file/zalozba/ZnanstvenaPorocila/21_09_studije(primerjalne)neenakosti.pdf) (Accessed on 20. 1. 2011).

- Gogala, S. (1996). *Obča metodika*. Ljubljana: Državna založba Slovenije.
- Grosman, M. (2010). Kakšne pismenosti potrebujemo za 21. stoletje. *Sodobna pedagogika*, 61, Issue 1, pp. 16–27.
- Hanushek, E. A. and Woessmann, L. (2008). The role of cognitive skills in economic development. *Journal of economic literature*, 46, Issue 3, pp. 607–668. Retrieved from: http://edpro.stanford.edu/hanushek/admin/pages/files/uploads/Hanushek_Woessmann_2008_JEL_46.pdf (Accessed on 25. 1. 2011).
- Husén, T. (ed.). (1967). *International study of achievement in mathematics: a comparison of twelve countries* (Vols. I and II). New York: Wiley.
- Ivelja, R. (2010). *Raziskava znanja PISA 2009: Na vrhu Šanghaj in Finska, Slovenci v sredini*. Retrieved from: http://www.dnevnik.si/tiskane_izdaje/dnevnik/1042408681 (Accessed on 8. 12. 2010).
- Lafontaine, D. (2004). From comprehension to literacy: Thirty years of reading assessment. In: J. H. Moskowitz and M. Stephens (eds.). *Comparing learning outcomes: international assessment and education policy*. London: Routledge Falmer, pp. 24–45. Retrieved from: http://books.google.com/books?id=2W_UUzm3iggC&source=gbs_navlinks_s (Accessed on 18. 6. 2009).
- Marjanovič Umek, L. (2010). Govorna kompetentnost malčkov in otrok kot napovednik zgodnje in kasnejše pismenosti. *Sodobna pedagogika*, 61, Issue 1, pp. 28–45.
- Markelj, N. (2010). *Zasnovanost mednarodnih raziskav znanja z vidika teorij učenja*. Doktorska disertacija. Ljubljana: Univerza v Ljubljani, Filozofska fakulteta.
- Measuring Student Knowledge and Skills: The PISA 2000 Assessment of Reading, Mathematical and Scientific Literacy*. (2000). Paris: OECD Publishing.
- Medveš, Z. (2004). Kompetence – razmislek o razvoju koncepta splošne izobrazbe. In: *Zbornik prispevkov mednarodnega posveta o splošni izobrazbi*. Ljubljana: Zavod RS za šolstvo, pp. 9–14.
- Mullis, I. V. S., Martin, M. O., Ruddock, G. J., O'Sullivan, C. Y., Arora, A. and Erberber, E. (2005). *TIMSS 2007 Assessment Frameworks*. Chestnut Hill: TIMSS & PIRLS International Study Center, Boston College.
- Murphy, S. (2010). The Pull of PISA: Uncertainty, Influence, and Ignorance. *Interamerican Journal of Education for Democracy*, 3, Issue 1, pp. 28–44. Retrieved from: <http://scholarworks.iu.edu/journals/index.php/ried/article/viewFile/616/712> (Accessed on 20. 1. 2011).
- OECD PISA 2009 Prvi rezultati*. (2010). Retrieved from: http://www.pei.si/UserFilesUpload/file/raziskovalna_dejavnost/PISA/PISA2009/PISA2009_prviRezultati.pdf (Accessed on 8. 12. 2010).
- Pečjak, S., Bucik, N., Peštaj, M., Podlesek, A. and Pirc, T. (2010). Bralna pismenost ob koncu osnovne šole – ali fantje berejo drugače kot dekleta? *Sodobna pedagogika*, 61, Issue 1, pp. 86–102.
- Peschar, J. L. (2004). Cross-curricular competencies: developments in a new area of education outcome indicators. In: J. H. Moskowitz and M. Stephens (eds.). *Comparing learning outcomes: international assessment and education policy*. London: Routledge Falmer, pp. 59–80. Retrieved from: http://books.google.com/books?id=2W_UUzm3iggC&source=gbs_navlinks_s (Accessed on 18. 6. 2009).
- PISA 2006 – Science Competencies for Tomorrow's World. Vol 1: Analysis*. (2007a). Paris: OECD.

- PISA 2006 – Science Competencies for Tomorrow's World. Vol 2: Data.* (2007b). Paris: OECD.
- PISA 2006 Database.* (2007). Retrieved from: <http://pisa2006.acer.edu.au/index.php> (Accessed on 10. 12. 2007).
- PISA 2006 Technical Report.* (2009). Paris: OECD.
- PISA 2009 Assessment Framework. Key competencies in reading, mathematics and science.* (2009). Paris: OECD Publishing.
- PISA 2009 Database.* (2010). Retrieved from: <http://pisa2009.acer.edu.au> (Accessed on 10. 12. 2010).
- PISA 2009 Results: What students know and can do. Vol 1.* (2010). Paris: OECD.
- Poljak, V. (1991). *Didaktika*. Zagreb: Školska knjiga.
- Rychen, D. S. (2004). Key competencies for all: an overarching conceptual frame of reference. In: D. S. Rychen and A. Tiana (eds.). *Developing key competencies in education: Some lessons from international and national experience*. Paris: UNESCO, pp. 5–34.
- Rychen, D. S. and Salganik, L. H. (eds.). (2003). *Key competencies for a successful life and well-functioning society*. Göttingen: Hogrefe & Huber Publishers.
- Salganik, L. S. (2001). Competencies for life: A conceptual and empirical challenge. In: D. S. Rychen and L. S. Salganik (eds.). *Defining and selecting key competencies*. Bern: Hogrefe & Huber, pp. 17–32.
- Seznam javno veljavnih izobraževalnih programov za pridobitev srednješolske izobrazbe (stanje v šolskem letu 2009/2010).* (2009). Retrieved from: http://portal.mss.edus.si/msswww/programi2009/programi/javno_veljavni_prg/seznam_javno_veljavnih_programov.htm (Accessed on 3. 12. 2009).
- Strmčnik, F. (2001). *Didaktika. Osrednje didaktične teme*. Ljubljana: Razprave Filozofske fakultete.
- Strong Performers and Successful Reformers in Education: Lessons from PISA for the United States.* (2010). Retrieved from: <http://dx.doi.org/10.1787/9789264096660-en> (Accessed on 20. 1. 2011).
- Šilih, G. (1961). *Očrt splošne didaktike*. Ljubljana: Državna založba Slovenije.
- Štraus, M. (2009). So dijakinje uspešnejše od dijakov? Razlike med spoloma v bralni, matematični in naravoslovni pismenosti iz raziskave PISA 2006 na začetku srednjestopenjskega izobraževanja. *Sodobna pedagogika*, 60, Issue 5, pp. 60–85.
- The high cost of low educational performance.* (2010). Paris: OECD Publishing. Retrieved from: <http://www.pisa.oecd.org/dataoecd/11/28/44417824.pdf> (Accessed on 12. 5. 2010).
- Top of the class. High performers in science in PISA 2006.* (2009). Paris: OECD Publishing.
- Topping, K., Valtin, R., Roller, C., Brozo, W. and Lourdes Dionisio, M. (2003). *Policy and practice implications of the Program for International Student Assessment (PISA) 2000. Report for the International Reading Association. PISA Task Force*. Retrieved from: http://www.reading.org/Libraries/Reports_and_Standards/pisa.sflb.ashx (Accessed on 20. 1. 2011).
- Uljens, M. (1997). *School didactics and learning. A school didactic model framing an analysis of pedagogical implications of learning theory*. Hove: Psychology Press, Ltd.
- Yore, L. D., Pimm, D. and Tuan H.-L. (2007). The literacy component of mathematical and scientific literacy. *International Journal of Science and Mathematics Education*, 5, Issue 4, pp. 559–589.

- Žist, F. (2010). *Bodo učenci vedno manj bralno pismeni?* Retrieved from: <http://web01.vecer.com/portali/vecer/v1/default.asp?kaj=3&id=2010120805599518> (Accessed on 8. 12. 2010).
- Žolnir, N. and Kramžar, B. (2010). *Bralna pismenost učencev vsako leto slabša.* Retrieved from: <http://www.delo.si/clanek/131820> (Accessed on 8. 12. 2010).