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Physics in the *Soros Educational Journal*

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Implementation of the International Soros Science Education Programme (ISSEP) has become one of the most notable events in the recent history of education in Russia. The programme directly involved tens of thousands of people ranging in age from schoolchildren to elderly professors. Even more people turned out to be associated with the programme through participation in olympiads and competitions or attendance at public lectures given by Soros Professors. A major component of the larger ISSEP strategy is the publication and distribution of the *Soros Educational Journal* which enables hundreds of thousands of readers (in the first place, students, schoolchildren and their teachers) to update their knowledge in the fast-moving fields of modern science. The physics section of this journal is the focus of the forthcoming discussion, which is the primary objective of the present review.

The International Soros Science and Education Programme in the basic sciences was initiated in February 1994. The *Soros Educational Journal* was started at the end of 1995 when the first issue was published. Very soon (in fact, almost from the very beginning) the journal established its well-designed format of a top-quality popular science edition which has been continued till now. This was possible under the expert editorship of a roster of experienced professionals who managed to avoid a long transitional period due to the excellent organization of work.

In 1995 – 1998, the journal had a circulation of 40,000; it dropped to 30,000 in 1999. In this country, it is distributed free to schools having senior classes and to many libraries (in the first place, those affiliated with institutions of higher education). Recipients of Soros fellowships also receive the journal. Information about the journal (and ISSEP) is available on the Internet [1].

A total of 218 papers published in 42 issues of the journal between 1995 and 1999 (No. 5) were included in the present study. The mean paper length was roughly 7 pages. In other words, physical issues were dealt with on almost 1,500 pages providing rather a large body of material worthy of a comprehensive examination. A little more than half of the available papers (117 of the 218) that had appeared during the first and last years of the journal publication were selected for thorough analysis. Collectively, they make up what we believe to be a representative sample containing more than half of all papers published both in the early issues of the journal and the most recent ones.

There is little doubt that merits of the journal by far outweigh its demerits. Hence, numerous letters of readers testifying to the high value and usefulness of the journal. But the higher the estimate the greater urge for perfection and the more room for improvement. Therefore, the primary objective of this concise review is to highlight what can be regarded as drawbacks of the journal rather than to center on those qualities which allow the reviewer to enthusiastically recommend it for reading and returning to it often.

The majority of the authors are Soros Professors. Some papers are written by Soros Associate Professors. Potential contributors are yearly offered to propose a few titles from which the Expert Council select one or two of special relevance to the journal's policy. The likely authors are then requested to write and submit the full text of the paper.

It can be seen from Table 1 that the majority of authors are affiliated with research and higher education institutions in the two capitals, Moscow and St. Petersburg. This situation mirrors the geographic affiliation of the holders of scientific degrees in this country. Professors of the M V Lomonosov Moscow State University make up the dominant group of authors. It is however essential that scientists from provincial institutions of higher learning are fairly well represented among the authors of physics papers. One third of them are written by specialists working in different regions of Russia including the most remote ones.

Table 1. Geographic affiliations of the authors of all 218 physics papers published in the *Soros Educational Journal*.

Moscow, Moscow State University	Moscow, Physico-Technical Institute	Moscow, other institutions	St. Petersburg	Other regions
24%	12%	15%	17%	32%

The distribution of papers by physical disciplines is shown in Table 2. Some papers concern several disciplines. This explains why the sum total exceeds the actual number of papers being considered. It follows from the table that physics

Table 2. Paper distribution over physical disciplines (by 117 papers).

Discipline	Number of papers
Quantum physics	8
Radiation and atoms	31
Nuclear physics	10
Plasma physics	7
Theoretical physics (general theory of relativity, fractals, etc.)	11
Energetics and technology	18
Biophysics	4
Solid-state physics	37
Elementary particle physics	8
Superconductivity	1
Phase transformations	4
Astrophysics	15
Cosmic physics and the solar system	11
Celestial mechanics	1
Others	14

[1] www.issep.rssi.ru

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of solids is an especially popular subject for papers. At the same time, the relatively poor coverage of many fundamental aspects of physics and astronomy having paramount ideological significance and important implications for public education is noteworthy. This is first of all true of modern cosmology and related branches of physics as well as of up-to-date methods of theoretical physics (probably, because they are especially difficult to interpret for lay readers).

Perhaps, the Expert Council should identify a few topical issues especially important and interesting for the purposes of the journal and offer each potential author to choose one or more of them as the subject-matter of an article. In case there are several authors wishing to cover the same topic, a competition for the best paper should be conducted. The information about the outcome of the competition, if published in the journal, may by itself be interesting and instructive. An alternative competition aiming to select most interesting subjects from amongst those proposed by schoolchildren and their teachers would be equally helpful. Readers' opinion polling undertaken by the journal (see, for instance, No. 8, 1996) appears to be of limited value in this respect because the results are hardly representative of the schoolchildren's views on the issue under consideration. The Internet provides ample opportunity for conducting such a competition on a much broader scale. It is however difficult to realize since the overwhelming majority of general education schools in this country have no access to the Internet.

The *Soros Educational Journal* has been designed primarily to acquaint schoolteachers and schoolchildren at first hand with the most recent developments in science. However, the disadvantages of many physics papers submitted (and published) in the journal arise directly from the fact that the mode of presenting material in many papers is at variance with the abilities and interests of their main readers, schoolchildren and their teachers. Going to a brief discussion of these disadvantages, it needs to be emphasized that all papers are written by first-class specialists and it is hardly probable that any claims can be laid to the scientific level of publications.

The first disadvantage subject to discussion is the difficult terminology with which some papers abound. Their authors use very specific terms as if they were perfectly familiar to the readers whereas they are not, having never been ingredients of the general school curriculum or even textbooks for students of higher education institutions, unless they have a direct bearing on physics and related subjects. Those authors who deem it indispensable to use such terms would do better to simultaneously refer the readers to definitive textbooks for universities and higher institutes.

Another chief fault lies in the indiscriminate use of formulas. In the majority of cases, even simple formulas could have been spared being used, to say nothing about cumbersome ones which are not infrequently inserted in the texts.

Thirdly, many authors tend to illustrate their papers with plots and diagrams showing original findings and primary results of studies instead of informative pictures and self-explanatory sketches which are more in place in a popular science edition.

Fourthly, references identified from bibliographies of pertinent articles or other literature sources intended for narrow specialists (e.g., booklets of abstracts and proceedings of scientific conferences) appear to be equally out of place because these publications are virtually unavailable to many readers of the journal. It seems much more reasonable to refer to authoritative textbooks on the subject for schools and institutions of higher education. Reading them would bring interested schoolchildren having a gift for physics rapidly up to the point where they may gain a broader general overlook and find a route into the realm of 'serious science' (the truth of this statement is verified by many good examples from the past experience). Moreover, a set of references may serve as a 'guide' to the search for and selection of works offering new insights into the subject of interest to be further used as mandatory aids by the readers who have to navigate through the plethora of information that has been and continues to be published on the problem. Also, such a list would be eminently useful for schoolteachers enabling them to recommend to their most able pupils thought-provoking books identified as relevant to the topic for in-depth study prior to entering institutions of higher learning. A list of physics resources available on the Internet would be equally helpful (see, however, a note to the point above).

The last but not the least failing of the papers published in the *Soros Educational Journal* is the manner of presenting material which is sometimes apt to discourage schoolchildren (and even their teachers) from reading them. Many of these papers are none other than a state-of-the-art review of the scientific literature in a narrative form or an introduction to such a review actually designed to be presented at a professional meeting. On the one hand, the 'scientific' style and the format of such works (containing Abstract, Introduction, Conclusions and other formal divisions) familiarize the reader with the organization of a scientific paper and its stylistic patterns. On the other hand, however, emphatically 'dry' texts can wholly disappoint schoolchildren and alienate them from the journal. Even many schoolteachers, a little bit forgetful of the lessons in concepts and methods of 'greater physics' given to them in the past, may be perplexed by certain very specific passages. Doubtless, Soros Teachers encounter little difficulty when faced with such 'extravagances', but their numerous colleagues have far less knowledge and experience.

As a rule, the content of the papers has little to do with the science curriculum of general education schools. Certainly, no author can be expected to write a supplement to the school course or strictly follow the curriculum and intersperse allusions to implied links with it throughout the text. But it is equally unwarranted to totally disregard the requirements of the official school programme because it constitutes the sole basis for many potential readers on which to familiarize themselves with the essentials of physics.

Our opinion on this issue seems to be shared by many readers whose letters were published in the *Soros Educational Journal*, No. 8, 1996. Although almost half of the teachers enrolled in the questionnaire gave high praise to the scientific level of the journal, the other half did not respond at all. About 15% of those who completed the questionnaire described the papers in general as being difficult for them and their pupils to understand. Forty percent of the respondents in this group were teachers of physics and another 40% teachers of mathematics. It can be inferred from the results of the questionnaire that there is still much to be done to make the materials published in the journal more interesting and understandable to schoolteachers and schoolchildren, for all its current success and the fact that no revolutionary changes are needed to preserve its traditionally high scientific level.

What has been said above about both the strengths and what we described as the weaknesses of the *Soros Educational Journal* (at least of its physics section) distinguishes it from other popular science periodicals. There is hardly a single analogue of the *Soros Educational Journal*, probably with the sole exception of *Science*. In principle, its strict scientific style could be regarded as an important benefit had not the journal been originally oriented towards the mass reader including great numbers of schoolchildren. As it is, only the most gifted of them seem to be able to use it to the best of themselves. Indeed, the main audience to which the journal now applies appears to consist of students in higher institutes studying physics and related disciplines as well as teachers working in these institutes and in schools providing general education. In a word, the journal fills a niche of its own and constitutes a valuable addition to the library of popular science periodicals (alas, rather a poor one).

We have tried to identify major groups of readers to whom papers published in the journal may be both interesting and easy to understand. Of course, we are aware that our conclusions must of necessity be subjective because an unambiguous solution of this task is hardly possible, at least in such a succinct review as this.

We classified potential readers into the following 5 groups:

(1) scientists whose area of research differs from that treated in a given paper;

(2) senior and post-graduate students receiving education in a branch of knowledge on which the paper is concentrated;

(3) junior students who intend a career in the study of physics or related disciplines and are given a course on general physics for institutions of higher education;

(4) teachers of physics in general education schools;

(5) upper-grade pupils studying physics (grades 9 – 11).

Indeed, any potential reader of the journal can be referred to one of the five categories depending on his or her educational level, from incomplete secondary education to higher education in one of the physical disciplines. The sole exception are professional physicists whose scientific interests are directly related to the subject-matter of the paper. Naturally, these specialists will hardly read the *Soros Educational Journal* as a source of new information.

In order to estimate the usefulness of individual papers in terms of interest and intelligibility to the readers of each group, they were conventionally graded on a 5-point scale ranging from 2 (lowest) to 5 (highest). Naturally, each group of potential readers needed to be judged using different criteria. They are not described here in greater detail because they underlie an essentially subjective assessment as has been mentioned in a previous paragraph. To meet the criteria chosen for group 5 comprising schoolchildren, the paper had to be interesting and understandable. The principal eligibility criterion for schoolteachers was a reliable and comprehensive coverage of the subject excluding any ambiguity which might interfere with the use of papers of interest during school and out-of-school hours. Professional physicists were supposed to value only highly informative papers. The criteria for post-graduate students included a wealth of new, completely updated information and those for undergraduates its compatibility with and the possibility of integrating it into the curriculum of their faculty. Certainly, these are only principal, nonlimiting criteria. The results are presented in Table 3.

Table 3. Usefulness of individual papers for various groups of readers (by 117 papers).

Groups of readers	Number of points				Mean score
	5	4	3	2	
Specialists in areas differing from those covered by the papers	4	63	50	0	3.6
Senior and post-graduate students educated in physics	1	9	37	70	2.5
Junior students	44	58	15	0	4.2
Schoolteachers	34	66	17	0	4.1
Schoolchildren	11	20	51	35	3.1

Some of these results were readily predictable, but others call for comments. It was evident prior to this study that professionals (even young ones) can hardly obtain the most current information they seek from the papers published in the *Soros Educational Journal* despite their high scientific level. Nor are they actually intended to address this sort of reader. It was equally obvious that the bulk of the papers are interesting and fairly well understandable to the majority of schoolteachers. A somewhat unexpected finding is that the papers turn out to be of greater value for junior students of higher learning institutions and scientists not active in the fields touched upon by the authors than for the schoolchildren for whom they were meant initially. Accordingly, we dare prophesy that these papers should be interesting to many readers of *Uspekhi Fizicheskikh Nauk*. In fact, we think that they will be the most interested readers of the *Soros Educational Journal*.

Thus, many papers are difficult to understand for schoolchildren, the main audience towards which the journal was originally directed. Indeed, a reader must be educated as a professional physicist or a specialist fairly well familiar with physical problems to be able to fully appreciate the value of many papers. We estimate that approximately one-third of the papers in the journal are either beyond the comprehension of the overwhelming majority of upper-grade schoolchildren or not interesting to them (the most able children exhibiting a special gift for physics are not included in this category). This inference is confirmed by our experience with teaching physics in modern secondary schools.

With their few faults and many virtues, the physics papers published in the *Soros Educational Journal* are full of consistently reliable fresh scientific information presented in an intelligible form (about 30% of them are really excellent specimens of popular science literature). It would be an unpardonable neglect not to adapt this information (or use it inefficiently) for educational purposes.

Schoolchildren and their teachers are not the sole audience for which the stated goal of the journal to promote the better knowledge of physics can be admirably accomplished. Materials of the journal can be successfully integrated into courses of general physics to improve the teaching of this discipline at universities and other institutions of higher education especially by using the journal's server which hosts an easy-access (via the Internet) database. We intentionally forbore the classification of high-school teachers of physics and related disciplines into a separate group of readers on the assumption that they can benefit from reading virtually any paper of relevance to their specific field which can be found in the journal.

Today, only few serious editions popularizing physics remain available for interested lay readers and nonexperts

(under 'serious' are meant those publications which both scientifically and stylistically meet the criteria for good popular science literature exemplified in this country by the well-known *Bibliotechka* "*Kvant*" (Set of Books on a "Quantum") or the PNTP series). This actually reduces to nothing previous efforts of professional scientists who have laid the foundation of popularization in various fields of knowledge by expert demonstration and critical evaluation of their latest advances and contemporary status. Suffice it to say, that many newly-published encyclopedias and reference-books fail to supply reliable, up-to-the-minute information on complex and intertwined subjects which they pretend to highlight merely because they are based on sources dating back to the 1970s and 1980s and have not been updated by specialists active in the respective sections of science and technology.

One of the major assets of the *Soros Educational Journal* is that it provides ample opportunity to fill a void in popular science literature. It has already published over 200 papers that capture practically all the essentials of the entire field of modern physics and astronomy (they will probably amount to 300 by the time this review is out and, hopefully, grow thereafter). Taken together, they provide a comprehensive coverage of recent developments in these branches of science and greatly contribute to their popularization among school-children. In this context, the *Soros Educational Journal* can be likened to a perennial (as opposed to annual) plant which yearly yields fruit.

As a new initiative, it is proposed that a volume of selected articles from the journal or a *School Encyclopedia of Physics* incorporating materials from these papers should be published in the framework of ISSEP. Realization of this initiative would have far-reaching beneficial repercussions.

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