THE ROLE OF ASTRONOMY IN ROMANIAN EDUCATION

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Abstract
Despite the interest, curiosity and the enthusiasm of the large public for Astronomy as a scientific discipline, it is absent from the current Romanian curriculum. We present here the results of two surveys that involve parents and teachers and show the necessity, the relevance and the usefulness of including astronomy as a discipline in the curriculum, or at least astronomical related content. We emphasize the interdisciplinary character of Astronomy and suggest using Astronomy as a tool in motivating students towards science and in integrating the science curriculum. Astronomy is amazingly the oldest interdisciplinary approach to science and a most natural way of curriculum integration.

Keywords: curriculum, interdisciplinary approach, integrated teaching, scientific discipline

INTRODUCTION

Astronomy is regarded as the crown of sciences and that because any discipline that extends its knowledge beyond the Earth and into Space crosses the border into the discipline of Astronomy. Take Geography for example, once it looks at Earth as a rotating planet revolving around the Sun it is in the realm of Astronomy. In other words, Astronomy comes in many flavours, which originate in the many disciplines that seek answers in the realm of Astronomy. To continue with our example, the fundaments of Geography, more specifically the geographical coordinates are determined through astronomical observations, therefore the two disciplines – Geography and Astronomy – are fundamentally interlinked (Theohar, 1928).
In the “beyond Earth” context, Astronomy is the common theme for many disciplines and although we are tempted to believe that it relates only with exact sciences, in fact, towards Astronomy reach out also Philosophy, History, Literature, Music, and Fine Arts. Celestial bodies seem to be a common inspiration for all humanity (Pârvulescu, 1926; Theochar, 1928; Renée, 2012). I would dare say Astronomy is not only the oldest interdisciplinary approach to knowledge, but most importantly, it is a natural way of integrating the curriculum (Nicolescu, 2002; Nicolescu & Stavinschi, 2002).

**WHY IS ASTRONOMY USEFUL IN EDUCATION?**

Curiosity, fascination, enthusiasm are the three dimensions that define the astronomical experience for the public, especially for children, according to Osbourne and Collins (2000), who also describe Astronomy as the one topic that generated universal enthusiasm. According to Percy (2006), there are multiple reasons for which astronomy should be part of the curriculum and we will mention here only a few such as its practical applications and its philosophical and religious implications, its practical applications to timekeeping (essential to our daily lives), its quality to make use of advanced Mathematics and Physics and to push technology beyond known limitations. It can also be used to illustrate concepts of Physics that are otherwise difficult to understand, it reveals the Universe as vast, varied and beautiful and deals with our cosmic roots, attracting young people to science (Percy, 2006).

**STATE OF THE ART FOR ASTRONOMY TEACHING IN SCHOOLS**

Astronomy, although a scientific discipline in most curricula in the world, it is not studied as a mono-discipline until university, but rather studied at all levels as science themes, taking advantage in this way of its highly interdisciplinary character. At the university level, specializing in Astronomy can be achieved in science faculties, Maths or Physics faculties and, in Australia, even at the technical universities. China has the only Astronomy department in the world, with a tradition of over 50 years. However, the tragedy is that Astronomy in Romania is not a scientific discipline anymore and one cannot specialize at the university and postgraduate level in Astronomy.

In Romania, Astronomy was among the first subjects ever to be studied in our first universities. It was also a discipline studied in high school, from the 1920s up until 2000. However, there were always attempts of removing Astronomy from the curriculum and disowning it of its place among sciences as a number of articles in the 1920s show (Pârvulescu, 1926;
Theohar, 1928). Astronomy was studied by the science classes and at the pedagogical high schools and slowly became an optional course until it was totally removed from the curriculum (Sora, 2011). Today, Astronomy concepts are taught as science themes in primary school, as Geography content in secondary schools (5th grade) and in highschools (9th grade), and because of the large student interest, some schools have reintroduced it as an optional.

Roche et al. (2012) relates extensively about the challenges that are involved in teaching Astronomy in UK classrooms. Among the problems, they mention the British weather, the light pollution, the equipment, the staff’s expertise, experience and enthusiasm, the time limitations and the poor career information. Showing the practical aspects of Astronomy involves using dedicated equipment which, in Romania, not even the research facilities dispose of, dedicating special time to Astronomy labs, in the evening, when the celestial bodies can be seen (Percy, 2006), being willing to endure colder temperatures, etc. Students however are known to give up their comfort for the subjects that interest them and Astronomy is very high on their list.

METHOD

To assess the interest for astronomy in Romania, we collected data using the survey method. We designed two surveys, one destined to parents, one for teachers. Both surveys have five preliminary items collecting general information about the anonymous respondent, such as occupation, gender, education, work experience, etc. The other 15 items are the actual questions, 10 of them are common among both surveys. We used only closed items. The data were collected over a period of one month (4-31st of May 2018).

The data collected in these surveys were only partially used in this particular study, because, meanwhile, we have managed to make our surveys accessible to more participants and we have found out some interesting trends worthy of mentioning. For this purpose and to ensure the largest possible sample, we extracted the common questions in the parents’ survey and in the teachers’ survey. These questions are: whether Astronomy should be an independent science, whether Astronomy research is important, if they liked studying Astronomy in school, in which context they actually studied Astronomy, what was their self-evaluated Astronomy knowledge on five main themes, how important was Astronomy in our daily lives and, finally, how they would describe Astronomy teaching in Romania.

For our study, we used a comparative analysis between the two categories of respondents (23 teachers and 17 parents), 40 respondents in total. We also used an Excel type editor to produce the following figures. The participants are a group of 23 teachers, quite homogeneous regarding
their experience in education and their qualifications, also in their teaching medium (rural or urban). Most teachers in the group are primary school and kindergarten teachers. The group of 17 parents is also quite homogenous in the sense that both male and female parents have answered, from both rural and urban areas, having quite diverse jobs.

RESULTS AND DISCUSSION

In the interpretation of the answers to the first question, we show in percentages how many parents and teachers consider Astronomy an independent science and not a branch of another science such as Physics and Mathematics. This question comes in the context of the current Romanian curriculum, which does not regard Astronomy as a discipline of study, but as a branch of Mathematics or Physics. Among the 23 teacher respondents, 87% consider Astronomy an independent science and only 13% see it as a branch of Mathematics or Physics, whereas all 17 parent-respondents see Astronomy as an independent science.

Regarding the importance of astronomical research (Figure 1), equal shares of 43.5% of the teacher population find Astronomy research very important and important, while 13% consider it to have average importance. By comparison, only 23.5% of the parent-respondents find Astronomy research very important, and 70.6% find it important. Only 5.9% of the parents consider it of average importance. In other words, research in Astronomy is important to the population of teachers and parents, represented here by this sample, yet this importance is not reflected in the role Astronomy occupies in Romanian education.

![Fig. 1. Opinion regarding the importance of Astronomy research](image-url)
To illustrate respondents’ interest for Astronomy as a discipline of study (Figure 2), when asked whether they liked or they would have liked to study Astronomy in school, most teachers (43.5%) said they would have liked it very much, 26.1% that they would have liked it pretty much, 17.4% neither much, nor little and 13% did not know. Only 35% of the parents would have liked very much to study Astronomy in school, 41% of the parents answered the question with pretty much, 12% with neither much, nor little and 12% did not know. Around 70% of the respondents in each category answered positively to this question; therefore, we conclude that the interest for this discipline is very high for both teachers and parents.

![Fig. 2. To what degree the respondents liked or would have liked to study Astronomy](image)

When it comes to the context in which the respondents studied Astronomy and whether they actually studied it, Figure 3 shows that the great majority of the respondents did not study Astronomy in school. As shown in Figure 3, 10 out of 23 teachers never studied Astronomy, only five out of 23 teachers studied Astronomy in high school, none have a postgraduate training in teaching Astronomy, two studied Astronomy at the university and the others studied Astronomy individually. The parents’ situation is similar; three out of 17 studied Astronomy in high school, three at university, and one in a postgraduate course, while nine never studied Astronomy.

To be noted is the discrepancy between the high interest of the interviewed subjects and the poor response the Romanian school has had so far in satisfying this interest. Indeed Romania, as a country, and the Romanian research cannot absorb a great number of astronomers, but this does not
mean that the population’s interest and the curiosity for Astronomy should be discouraged so radically and the Astronomy as a discipline eliminated even from among the general knowledge content. The Astronomy content is in fact essential for a complete general knowledge background.

In this context, we then ask our respondents to evaluate their own Astronomy knowledge and the importance of Astronomy among sciences. The results are given in Table 1 and in Table 2, respectively. Most teachers, around 70%, have medium level knowledge on all proposed Astronomy themes, whereas only 50% of parents see themselves as having medium level knowledge. While teachers mostly have the same level across all proposed themes, parents admit they have more difficulties with some themes such as galaxies and origins of the universe. The theme that gives most confidence to both teachers and parents is the solar system.

In Table 2, we establish our respondents’ view of the importance of Astronomy. The majority of parents and teachers know that Astronomy is among the oldest sciences, it is a discipline that gives context to the place we occupy in the Universe, has applications in industry, aerospace sector, medicine and contributes significantly to the advancement of science,
technology and knowledge. Surprisingly, 41.2% of the parents compared to only 26.1% of teachers did not know how old Astronomy as a science was, although in our country Astronomy has a long history ever since the Dacians. Yet, the link between History and Astronomy was not as obvious for all respondents.

**Table 1.** Self-evaluated Astronomy knowledge on five main themes

<table>
<thead>
<tr>
<th>The degree to which you have Astronomy knowledge of:</th>
<th>Teachers</th>
<th>Parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stars</td>
<td>Very advanced (%)</td>
<td>Advanced (%)</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>8.7</td>
</tr>
<tr>
<td>Planets</td>
<td>0</td>
<td>8.7</td>
</tr>
<tr>
<td>The Solar System</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Galaxies</td>
<td>0</td>
<td>8.7</td>
</tr>
<tr>
<td>Origins of the Universe</td>
<td>0</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Having established the view on the importance of Astronomy, we return to education and ask our respondents to which degree they consider teaching Astronomy in school to be useful, necessary, relevant and able to develop transferable skills (Table 3). The great majority of those interviewed consider teaching astronomy in school as much necessary, useful and relevant. There are more teachers than parents using the words “very much necessary”, “very much useful” and “very much relevant”. Nevertheless, if we add up all percentages above the average, we find out that parents credit astronomy to be more useful, relevant, necessary and able to develop transferable skills than teachers do.

The great majority of the respondents find teaching Astronomy in school difficult in average and above average in ability to develop transferable skills. Table 3 illustrates comparatively along with the percentages also the average of the responses of the two different categories of respondents: the parents and the teachers. The averages were calculated as follows: we graded answers with 5 if the answer was very much, 4 if it was much, 3 if it was average, 2 if it was little and 1 if it was very little and then averaged the answers in each category, the average value being shown in the table.

This third table is a mathematical expression of the degree in which teaching Astronomy in school is considered useful, necessary, difficult, relevant and developing transferable skills. In this way, we see that parents’
and teachers’ opinion mostly coincide, all find (with differences of 0.2-0.3 between averages) teaching Astronomy in school to be useful and necessary. Discrepancies appear (0.9-0.13 between averages) when discussing the relevance and the ability of developing transferable skills, parents crediting Astronomy with these features to a higher degree than teachers do. Yet, the highest average difference of 0.71 comes into play when the respondents are asked to appreciate the difficulty of teaching Astronomy in school; parents find teaching Astronomy in school more difficult than teachers do.

**Table 2. Awareness of the relevance of Astronomy among sciences**

<table>
<thead>
<tr>
<th>Did you know that astronomy:</th>
<th>Teachers</th>
<th>Parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>I knew (%)</td>
<td>I did not know (%)</td>
<td>I knew (%)</td>
</tr>
<tr>
<td>is among the oldest sciences?</td>
<td>73.9</td>
<td>26.1</td>
</tr>
<tr>
<td>is a discipline that opens our eyes, giving context to the place we occupy in the Universe, which can change the way we look at the world?</td>
<td>82.6</td>
<td>17.4</td>
</tr>
<tr>
<td>has applications in industry, aerospace sector, medicine?</td>
<td>73.9</td>
<td>26.1</td>
</tr>
<tr>
<td>contributes significantly to the advancement of science, technology and knowledge?</td>
<td>91.3</td>
<td>8.7</td>
</tr>
</tbody>
</table>

**Table 3. Characterizing Astronomy teaching**

<table>
<thead>
<tr>
<th>The degree to which you consider teaching astronomy in school to be:</th>
<th>Teachers</th>
<th>Parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very much (%)</td>
<td>Much (%)</td>
<td>Medium (%)</td>
</tr>
<tr>
<td>useful</td>
<td>30.4</td>
<td>43.5</td>
</tr>
<tr>
<td>necessary</td>
<td>26.1</td>
<td>39.1</td>
</tr>
<tr>
<td>difficult</td>
<td>8.7</td>
<td>39.1</td>
</tr>
<tr>
<td>relevant</td>
<td>26.1</td>
<td>39.1</td>
</tr>
<tr>
<td>developing transferable skills</td>
<td>30.4</td>
<td>30.4</td>
</tr>
</tbody>
</table>
Our analysis shows a unity of opinion between two very different categories of respondents, parents and teachers, a unity of opinion, which suggests that enlarging the survey sample will not yield very different results than those published here.

CONCLUSIONS

In the Romanian curriculum, Astronomy lost its statute as a discipline overnight in an attempt of reducing the overloaded student schedules with no regard to the consequences. The lack of student interest for the old Astronomy textbook was interpreted as lack of interest for Astronomy itself and, instead of updating the scientific content and the textbook, we abandoned it all together. Indeed, in order for education to benefit from re-introducing Astronomy in the curriculum a cross-correlation of concepts among disciplines is necessary, as well as a master plan that organizes all fundamental concepts from all disciplines, fine tuning them with each other and with the psychological and pedagogical principles and an integrating vision of the curriculum. Our study shows that the disappearance of Astronomy from the curriculum has had important consequences at the curriculum level and is now posing some interesting challenges. We list below the conclusions of our study and discuss the curricular challenges each conclusion corresponds to.

1. Importance of Astronomy. Teachers and even parents are aware of the importance of Astronomy among sciences, hence our confidence in their appreciations regarding the necessity, relevance and usefulness of Astronomy in the Romanian curriculum. The great majority of the interviewed teachers considered Astronomy research important, which suggests that excluding Astronomy from the Romanian curriculum is not the teachers’ desire, but rather an error of curricular vision which fails to offer a complete general knowledge content on a national level.

2. Interest for Astronomy. Teachers as well as parents manifest a special interest for Astronomy as proved by the data collected so far through our surveys. This interest does not have a correspondent in the educational offer. Teaching Astronomy content in school is now up to the teacher, and the teacher receives no support or guidance in approaching such content. The teacher himself/herself has been deprived, with small exceptions, of a proper education in this discipline; therefore, he/she has difficulties responding to children’s interest for this type of content.

3. The identity of Astronomy as a discipline. Most interviewed teachers and parents see astronomy as an independent discipline of study
and not as a branch of Physics or Mathematics. This is an important result because, as representatives of the large public, the parents and teachers give back to Astronomy its statute of scientific discipline. In fact, the loss of this statute has led to important consequences at the curriculum level such as the exclusion from the curriculum of certain scientific content essential to our daily life. This scientific content, when the science it belonged to disappeared, was left to be covered by other disciplines such as Physics and Mathematics, at times even Geography. In practice, however, this scientific content became marginalized and even optional depending on the teachers’ preference, interests and training. Moreover, the fact that Astronomy content meant to be covered through an interdisciplinary approach within Mathematics or Physics is regarded by some as simple applications and this leads to unjust claims that state that Astronomy is an applied science and hence part of Mathematics or Physics. All because the interdisciplinary character of Astronomy is only partly understood. Astronomy not only operates with fundamental knowledge of Mathematics and Physics which many other sciences do, but also links concepts from within different sciences crossing the inter-discipline borders.

4. **Inequality at a national level regarding Astronomy content teaching.** During data analysis, I realized that out of 11 primary school teachers, nine of them teach Astronomy content. This does not mean that the children led by teachers who do not teach Astronomy content, do not want to learn such content, it simply means that we leave it up to a teacher to decide whether the student has or not access to an entire discipline. This is not fair, neither to the teacher, nor to the student and definitely not fair to the discipline itself. I would dare say that this sort of abuse from the educational system has led to denying the right to equal chances in education for all children, all because of lack of coherence on the national level regarding the way Astronomy content should be approached and included in the curriculum.

5. **Insufficient teacher training to ensure a proper approach toward Astronomy content in class.** Although there is interest from the students and there is support from both teachers and parents towards the study of Astronomy, the return of Astronomy to the curriculum poses the challenge of finding the teachers to teach it. We wonder whether the knowledge the teachers interviewed sustain they have on the five most common Astronomy themes is enough for them to approach Astronomy themes at class, in the context where translating the complexity of Astronomy to children is close to an art.

6. **Interdisciplinary approach covering Astronomy content loses its intensity and frequency as the student advances from primary school to middle school and high school.** Although the students’ capacity of understanding astronomical scientific content improves with age and with their abilities in Maths, Physics, Chemistry and in sciences in general, the access of students to such content is reduced as they advance from on cycle to the other. The preschool and primary school
teachers endeavour themselves to construct foundations for all disciplines, including Astronomy, yet these foundations are not enriched at times not even maintained at the superior educational levels. Moreover, the contrast between the integrating vision from primary school and the overspecialization from middle school and high school, confuses the students who do not yet have the ability to understand that both visions are necessary and complement one another in a complete education. Moreover, the error in curriculum which encourage overspecialization in the detriment of integration has led to a poor and incomplete general knowledge training on the national level, which further leads to teachers insufficiently trained to be able to teach interdisciplinary content at class.

In conclusion, Astronomy is one of the oldest sciences in Romania and in the world. Dacians were studying Astronomy, the very first universities in Romania had in their syllabus the discipline Astronomy, the first Ph.D. title given to a Romanian was given to Spiru Haret for a thesis in Astronomy. Despite our tradition, despite our students’ great achievements in international Astronomy competitions, despite the great interest of the large public in Astronomy, we have transformed this scientific discipline into a non-discipline.

Is the Romanian curriculum better without? Well, it is not. Whether we like it or not, Astronomy is important and interesting and is an independent discipline. Denying its statute can only increase inequalities among the children’s access to astronomical knowledge, decrease the number of researchers in this field, lead to incomplete general knowledge among the general public and soon will leave us without any trainers able to form new teachers capable of handling in class such content.

Indeed some of the astronomical content is so complex that it may be quite a challenge for a teacher to reduce and translate its complexity to a child’s understanding. Countries like U.K. have solved this problem by opening a dialogue between researchers and teachers, which gives teachers access to the cartoon images a researcher can imagine to help explain a certain process or phenomena. Even as an Astronomy student, I found that those cartoon images were most helpful in comprehending the complexity of a certain content. Researchers in Romania should be encouraged to popularize their work and their results; they should be welcomed into schools and allowed to contribute to the development of the future generations of researchers.

The Romanian curriculum could benefit by using Astronomy to solve two of the biggest educational challenges of the moment: to attract students towards science and by profiting from the interdisciplinary character of Astronomy to integrate the science curriculum. Will Romania rise to this challenge?
Acknowledgments

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