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## **Mobilised Chemistry. That is: May the Smartphone Become an Effective Tool of Teaching Chemistry?**

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It is a common scene for teenagers to be totally indulged in their smartphones in various places either alone or sitting in groups. However, we would all be flabbergasted to observe to same in the classroom. Not in the least would we assume that serious work is being carried out there. The smartphone, on the other hand, is yet another element of our digital environment.

### *'Z children'*

Education, growing up and motivating the so-called 'Z generation' is another challenge teachers and more typically higher educators are facing. 'Z generation' involves those who were born between 1995 and 2010. Their most incongruous characteristic features include they are the children of the oldest mothers, born into the smallest families, they are the smallest generation as far as the number of members is concerned, with the longest predictable life span and they are the best 'global generation' or a generation linked to the Net. Their general features include good intellectual level, fairly developed problem solving skills, an excellent technical sense, highly developed practical skills, a good ability to share attention as well as abstraction (Pais, 2013).

It may be concluded from the above mentioned facts, that a digital educational environment seems to be natural for them since 'Z children' are digital natives, but beyond this they expect the application of modern contents and new methods, furthermore the development of important competencies. For them there are much more effective ways of obtaining information available, the primary goal of the teacher and of course education is the critical handling and productive application of these pieces of information.

During the course of realising these aims the use of the smartphone is more than obvious, since it is an ordinary tool of practically each Z child which is a hardware available inside and outside school continually, conveniently and renders itself possible to be applied for various purposes.

None of the educators can deny the fact that computer literacy is an essential necessity in employment nowadays as well as in life in general on the other hand, smartphones have not yet been accepted and allowed to be used as legal tool up to this point in spite of the positive tendency observable in recent years.

That was the reason why there was a pilot survey during the academic year 2013-2014 involving 614 students and 12 teachers in 8 schools, whose aim was to investigate the educational application on smartphones. The survey focused on grades 8-11 and during its preparatory stage concentrated on the potential of integrating the device into the education of four subjects (Literature, Chemistry, Geography and Biology) with one special field such as QR codes and extended virtual reality, freely accessible mobile applications usable in the education of specific subjects, apps based on geolocation and mobile apps individually developed, educationally-aimed optimised on one mobile tool (A mobiltechnológiával..., s.d.).

## *Research background*

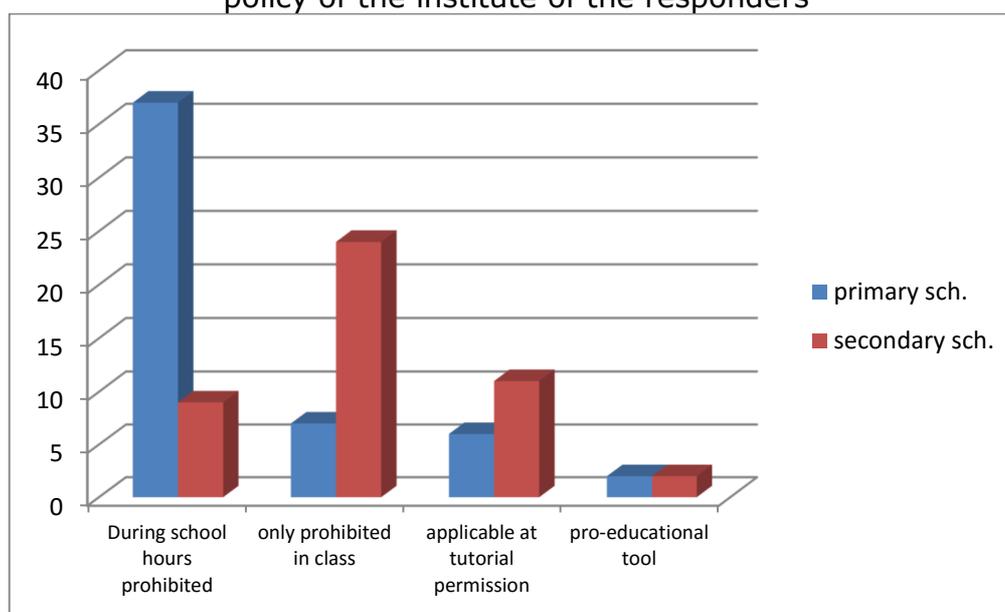
Similar pilot surveys have been carried out with the aim of finding out the habits of applying mobile phones with students then teachers in Chemistry lessons and attitudes connected to it in the form of questionnaires. The questions were concentrated on habits of mobile phone use and their knowledge concerning specifically chemistry linked applications of 31 students attending grades 9-10 taking part in talent managing camp from various parts of the country organised by the Association of Hungarian Chemists. The survey proved to undoubtedly support the observation based on everyday educational practice according to which students are keen on using their phones at school, furthermore during lessons as well and in more than one case they also emphasised the need for applying it even for the purpose of education (Farkasné-Ökrös & Murányi, 2015).

In possession of these experiences a new target has been selected: teachers of Chemistry have been interrogated about their knowledge of M-learning habits and opinion. 98 active Chemistry teachers have filled our questionnaire (see appendix). 46 of them work at secondary schools, 52 at primary schools, so the sample number may be declared to be adequate to draw certain conclusions and to the foundation of further research and the rate of representation of different educational levels is especially satisfactory.

## Results, conclusions

After the level of education, teachers were asked about the regulations of their institute's policy referring to the use of mobile phones (Figure 1). With the exception of one participant, all of them were aware of the content exactly. It might be concluded from the chart that the policy of primary schools appears to be stricter concerning this issue: the use of mobile phones is forbidden during the whole of the school day, while in the case of secondary school it is 'only' banned during the lesson. It is far from being promising from the aspect of our topic that only 4% of the institutions survey considers mobile phones as educational tools supporting the process of teaching and only one fifth of them provides opportunity to use them during the lesson with the supervision of the teacher and with their permission. It is clear, however, from further answers that this ban is a far cry from being that rigorous, it seems likely, that the majority of institutes falls into the category of 'applicable with the consent of the teacher', it is just that the school's policy failed to follow inevitable transformation.

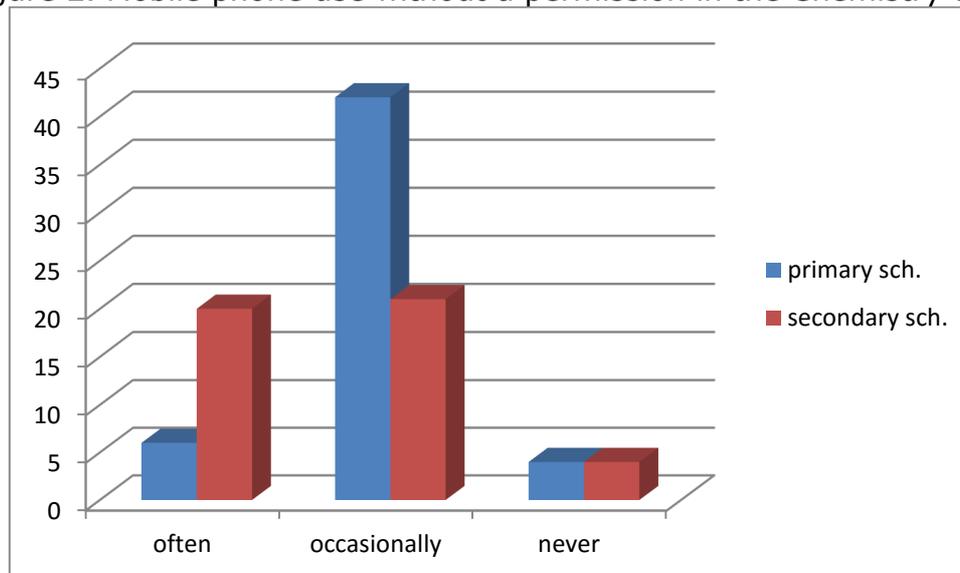
Figure 1. Regulations referring to the use of mobile phones of the applicable policy of the institute of the responders



Source: Own research

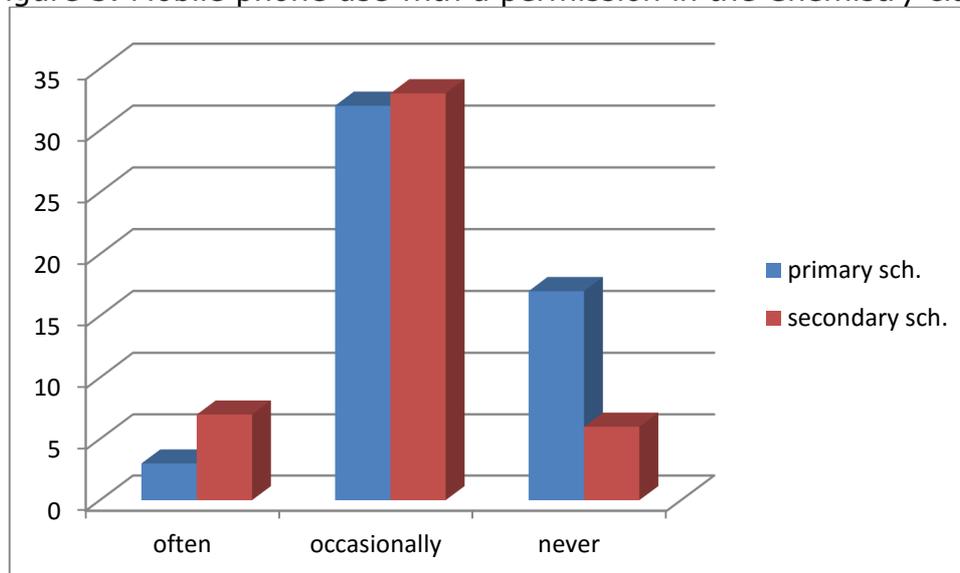
Questions 3 and 4 were aimed at finding out how often students use their mobile phones during the lessons of the colleagues (Figure 2, 3).

Figure 2. Mobile phone use without a permission in the Chemistry class



Source: Own research

Figure 3. Mobile phone use with a permission in the Chemistry class



Source: Own research

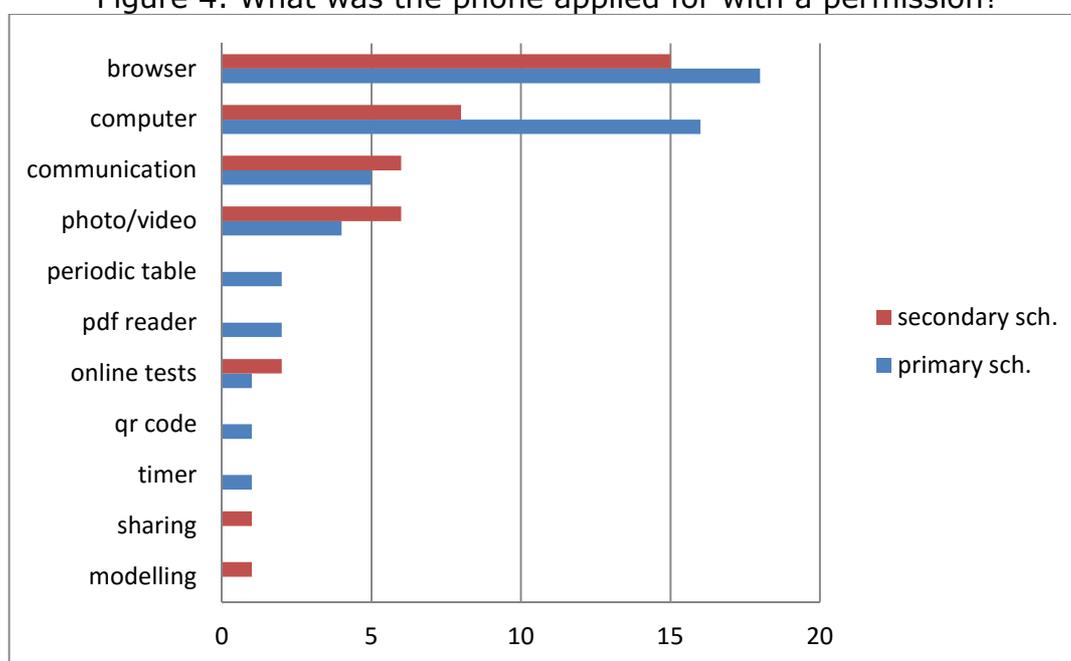
It may be concluded that it is very hard for the students to resign from using their favourite 'toys' even though it is forbidden, since the vast majority of the colleagues answered they did, during class, furthermore one fourth of them said it was a frequent phenomenon ('crime'). It is also char that secondary students are braver to break the rules. Only ten per cent of teachers answered they permitted the use of cell phones in their lessons frequently. However, one third of them have already allowed to occasional use for various reasons.

According to the results obtained so far it might be concluded that regular educational application of smartphones has not really been legitimised so far. Let us examined what reasons teachers permitted the use of cell phones (Figure 4). The most frequent (45%) reasons was for

searching the Net for additional information, interesting facts in individual or group work. It is not surprising at all since most teachers and students are likely to use their gadgets mainly for this purpose anyway. Cell phones as hardware only represents a significant step ahead if the classroom is not equipped with an adequate number of PCs in the case of this type of application; this happens relatively often, or if there is satisfactory WIFI system within the school, which is unfortunately happens less typically. It provides an opportunity for the critical application of information, a practice for finding safe resources, apart from individual work, cooperation within a group and ITC development. Application as a PC won't promote our 'issue' but it is a good example of how advantageous it is to have the phone always within easy reach. 'Communication' refers to cases when the student must be available during the lesson for a specific reason such as due to a family commitment. So this is not connected to education in any way, however mobile phones are suitable for revolutionising group work, beyond keeping in touch, common handling of documents and databases, coordinating extracurricular activities, providing the facility for the teacher to try out the new role of the 'tutor'.

As compared to our expectations there is a slight rate of utilising the potential of mobiles to use documenting opportunities, hopefully not because there is nothing worth recording. There was only one responder who made mention of recording and sharing a photo or a video. Hardly are there any instances of applications such as QR code, modelling molecule, Periodic Table and the same is true for online tests.

Figure 4. What was the phone applied for with a permission?



Source: Own research

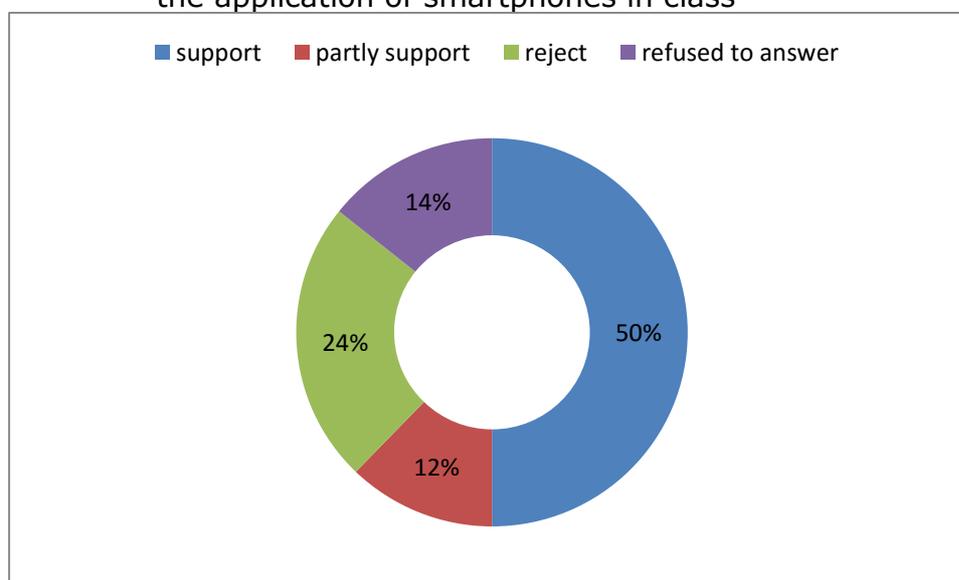
On the basis of what can be seen above, it might be concluded that the responders are not really active in the field of m-learning, especially not as far the variety of applications.

The next question referred to what applications connected to Chemistry the colleagues are aware of 55% of secondary teachers wouldn't answer this question; further 8% did not specify mobile apps but Web pages. The most well-known apps included Periodic Tables (7 responders), Molecule modellers (3 responders) special calculators (2 responders). 58% was the rate of non-responders within teachers working for primary schools, further 7% failed to specify an app. The vast majority mentioned the Periodic Table here, too and the second place belonged to modeller applications (5 responders). There have almost been exactly the same proportions, in spite of it, however, it must be mentioned that in the latter category a wider range of apps proved to be known by mobile users such as equation director, online test etc. There were only two responders who stated not possessing a smartphone.

The next question was how they think smartphones could be applied in education. 70% of responders provided an assessable answer. Most of them still see the potential in the Net, others mention voting system, evaluation, quiz show as opportunities. From other aspects, quite a few responder projects facilities of methodology just to mention but a few as headlines: motivation, games, teamwork, cooperative tasks, individual development, differentiated activities.

Finally the general opinion of colleagues was invited about the application of smartphones at school. Figure 5 illustrates of the attitude of responders.

Figure 5. The attitude of responders towards the application of smartphones in class



Source: Own research

## Summary

Taking the results of the surveys into consideration, the following statements can be made:

- Regular application of smartphones in class is not supported by either the legal or the infrastructural background by either the moment at the vast majority of schools.
- The dominant proportion of teacher of Chemistry asked are aware of few potential uses, there is a very low percentage of those applying a mobile phone regularly as educational tool.
- The majority of responders sees a potential in m-learning from the aspect of methodology, however many of them called attention to its hardships, too.
- None of the responders view smartphones as potential measuring (experimental) tools.
- M-learning's gaining ground in Chemistry lessons is supported by the majority of responders.
- There will be a demand for Web sites presenting and displaying useful applications and methodological aids in the near future.

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## **Appendix**

### Questionnaire

1. What type of school do you teach at?
2. What way does your school policy handle the use of mobile phones?
  - a. it is banned during the school day
  - b. it is only banned during the lesson
  - c. it is possible to use them with the teacher's permission during the lesson
  - d. it supports as a tool monitoring learning
  - e. I do not know
  - f. I will not answer
3. Have students ever used their phones during the lesson without your consent?
  - a. often
  - b. occasionally
  - c. never
4. Has it ever happened that they have applied it with your permission?
  - a. often
  - b. occasionally
  - c. never
5. What purpose have they used it for with a permission?
6. What applications connected Chemistry do you know?
7. What ways can you think of mobile phones could be applied in education?
8. What is your attitude towards applying smartphones in the lessons?