Research article

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Analysing the chemistry in beauty blogs for curriculum innovation

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Cosmetics play an important role in our everyday lives. However, the variety of different products and brands appears confusing to consumers. Products vary from basic, indispensable, everyday items such as soaps, shower gels and shampoos, to decorative cosmetics and high-end skin creams with specific, “innovative” ingredients for every skin type imaginable. In recent years, beauty blogs have become a popular platform to seek information on cosmetic products. Such blogs often contain chemistry-based content, which is only rarely written or at least double-checked by someone with a scientific background. Often such blogs reach a readership of several million users per month. But which role do chemical aspects play in beauty blog texts? This paper describes a qualitative content analysis of 60 recent posts from six popular English-language beauty blogs. The texts were coded according to categories such as the number of chemistry-related terms, supporting information for such terms, positive and negative claims regarding chemical aspects, references to studies etc. Based on the distribution of the categories, three main types of blogs could be distinguished: The “scientific type”, the “semi-scientific type” and “the non-scientific type”. By color-coding the different categories, a difference between these types can be easily depicted. The paper will discuss first findings and ideas on how to make use of corresponding analyses of beauty blogs for the teaching of chemistry.

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Introduction

Each day every one of us is confronted with an enormous amount of media messages, ranging from print-based newspaper articles to advertising or social media. The media landscape is evolving and changing in an incredibly fast pace. In the last decade, especially social media platforms have gained massive popularity. Statistics show that the number of social media users worldwide has increased from roughly a billion in 2010 to 2.6 billion in 2018 (eMarketer, 2018). Especially young people are heavy social media users. For instance, recent surveys among American teenagers showed that 76 % of the 13–17 year olds use social media sites daily (Lenhart, 2015). Blogs, which are also considered to be a type of social media, have become a widespread communication platform for both sharing as well as retrieving information in the last 30 years. A blog (derived from “Weblog”) is commonly defined as a webpage that is constantly modified by one or several people (“blogger”) and where the entries (“posts”) are displayed in a reverse chronological order (Herring, Scheidt, Wright, & Bonus, 2005). It was estimated that by 2017 there were over 440 million blogs on the web (mediakix.com, 2017). Forty-seven percent of US internet users in the age group between 18 and 29 read blogs on a regular basis (Statista Survey, 2018), even though other social media platforms such as Instagram gained popularity in recent years. Everyone can start a blog on a free-of-charge platform such as WordPress, Tumblr or Livejournal. While the first blogs started as online diaries in the mid-nineties (Herring et al., 2005), today we can find blogs on almost any topic imaginable: news blogs, food blogs, lifestyle blogs or beauty blogs, just to name a few. Many of the popular blogs reach a readership of several million unique visitors per month.

As in any type of media, scientific information in general and chemistry-based information in particular can also often be found in blogs. This information can be spread by anyone and it is often not possible to distinguish the credibility of it or whether the blogger has any kind of scientific background. The current paper supports the idea that students need to gain the abilities to deal with science-based information in blogs. However, as a first step it is crucial to investigate which kind of scientific information young people are confronted with when reading blogs. For this purpose we chose so-called beauty blogs where information on various cosmetic products can be found, from make-up-tutorials to reviews on specific ingredients of such products. Although

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the recent hype about beauty blogs has been declining during the last years, 58 % of female respondents of a recent survey in the US claimed to be reading averagely three beauty blogs regularly (Statista Survey, 2017). Twenty-four percent of young German women between 18 and 29 claimed to be seeking information on cosmetic products mainly in beauty blogs (Statista & QVC, 2018). Therefore, we can assume that blogs can serve as a basis for consumer behavior in general, trigger purchasing decisions in particular and also shape the view of young people about the role and, moreover, the nature of science. To avoid manipulation and misinformation, a first step could be a general analysis of blogs that has the potential to help the students gain a perception about different blog types and the way scientific content is used in them. But how can blog posts be analyzed efficiently? This paper presents a qualitative content analysis of 60 recent blog posts regarding science-based claims and attempts to derive first possible ways of implementing the findings in the science classroom.

Theoretical framework

Looking at the complex media landscape of today it becomes clear that participating in our modern society requires specific skills for dealing with the media offers surrounding us daily (Buckingham, 2003). Because the role of mass media in society was quickly increasing over 70 years ago already, media literacy was first addressed internationally in 1946 by UNESCO as part of fundamental education for everyone (Holmes, 1947). It quickly becomes clear that science is a ubiquitous and recurring topic in nearly all the different media types. There are science-based news reports on TV, on the radio, and on the Internet, for instance regarding issues such as climate change or new forms of energy supply and mobility. Internet users discuss scientific issues concerning cosmetic products in on-line forums or on social media platforms. Magazine articles promote new diets which are “developed under scientific supervision”. There are also advertisements for dietary supplements which in many cases try to make their claims more credible by underlying them with scientific (or pseudo-scientific) facts. Countless more examples of the omnipresence of science in the media can be found.

Developing capabilities to cope with information related to science in the media is indispensable, if young people wish to become scientifically and media literate citizens.

In the sense of a Bildung-oriented understanding of science education (Sjöström, Frerichs, Zuin, & Eilks, 2017), science lessons should seek to promote the development of skills on order to prepare younger generations to become responsible citizens (Hofstein, Eilks, & Bybee, 2011; Holbrook & Rannikmäe, 2007; Levinson, 2010). The implementation of media into the science classroom also has the potential to make chemistry learning more meaningful to learners and more personally and societally relevant (Stuckey, Hofstein, Mamlok-Naaman, & Eilks, 2013). Different definitions of the notion of media literacy can be traced in the literature. Two main dimensions of media literacy were outlined by the UNESCO (2006): “reading” and “writing” media. On the one hand students need to understand the different forms of communication used in the media. On the other they have to be able to create their own media. These dimensions are widely accepted (Buckingham, 2003). The European Commission (2018) defines media literacy as the ability to access media, understand them, and critically judge media content, including the creation of one’s own media products. According to Scheibe and Rogow (2012), the common definition of media literacy is described as individuals having a number of capabilities which enable them to navigate their way through a media-dominated environment. They, as well as other media educators (Hobbs, 2003), explicitly name four dimensions that define the concept of media literacy: accessing, analyzing, evaluating and creating media.

It is necessary to develop skills to critically access and evaluate science in the media for societally-oriented scientific literacy (Eilks, Nielsen, & Hofstein, 2014). Merging scientific literacy and media literacy in school science should form part of citizenship education in the modern age that can be named “scientific media literacy” (Chang Rundgren & Rundgren, 2014) or “scientific media education” (Reid & Norris, 2016). Scientific media literacy is a concept that encompasses a huge amount of different goals, skills and possible classroom activities connected to the learning of science and forms a justification for more intense media education in the science classroom.

Incorporating general media education into the science classroom is an important issue. However, research on science education and the media has been mainly focusing on news media for a long time (McClune & Jarman, 2012), although there seems to be a shift towards digital media in general and social media in particular (Wohleb, Skinner, & Witte, 2014; Lundgren & Crippen, 2019). Research into classroom practices has also revealed (e.g. Klosterman, Sadler, & Brown, 2012; Ginosar & Tal, 2018) that science teachers mainly use traditional, print-based media in their lessons. At the same time they tend to focus on a very limited number of goals, quite often failing to put enough emphasis on both critical media-awareness and media creation. In our view, new pedagogies should cover a broader range of media and contain more specific and well-formulated learning goals. For instance, in order to broaden the focus, Belova and Eilks (2015) introduced ideas on how to

implement advertising in the science classroom. In this paper we aim to present some initial ideas on how to enlarge the focus of science media education even more by learning *about* blogs in the science classroom.

Research on social media in the science classroom in general and blogs in particular is scarce.

Reid and Norris (2016) recently outlined certain research areas for the next decade in scientific media education, for example the design of standardized assessment tests for media literacy. They do not explicitly focus on social media, but point out the importance of teaching the students to be able to judge “representations of science on the Internet” (p. 159) in order not to be confused by misinformation. We believe that teachers should be aware which types of information students are confronted with online in order to help them to make this part of their teaching.

In a recent paper, Tseng (2018) outlined the importance for more opportunities to critique science-based information online after an intervention where a group of students was confronted with flawed science-based information. She showed that students who accepted the claims lacked showed low capabilities in scientific reasoning.

A book recently published in the USA (Information Resources Management Association, 2018 entitled “Social Media in Education: Breakthroughs in Research and Practice” mostly focuses on using social media as a learning tool (for instance for collaborative learning) in the non-science subjects such as language education. It includes a chapter on practicing scientific argumentation through social media (Craig-Hare, Rowland, Ault, & Ellis, 2018) which also mainly focuses on social media as communication platforms and emphasizes that students must be prepared to engage in science-based online interactions in a proficient way. Nevertheless, the authors point out the need for the students to understand the mechanisms of scientific argumentation online.

In general, there have been recent suggestions for a more thorough implementation of social media platforms such as Facebook (Blonder & Rap, 2017), Instagram (Affeldt & Eilks, 2018) or Internet forums (Dittmar & Eilks, 2016) in the lower secondary science classroom. Still, a status quo of the ways of communication on such platforms has not been on the research agenda in the science education context so far.

Just like the above-mentioned publications, papers that have recently been published on the inclusion on blogs in science teaching and learning mainly focus on learning *with* blogs and not *about* them. Moreover, the research that is available has been conducted mainly in higher education contexts (Kandroudi, Bratitsis, & Lambropoulos, 2014). For instance, Zinger and Sinclair (2013) encouraged health science students in a community college in the USA to create their own health blogs in order to increase their engagement and achievement. Dos and Demir (2013) analyzed undergraduate students’ blogs where they had to reflect on the contents of a specific course in order to gain insights into their learning strategies and reflective practices. Studies that are available in the primary and secondary education contexts show similar foci (Angelaina & Jimoyiannis, 2011; Saltan & Divarci, 2017) – the content of existing blogs is not being taken into account. This paper aims at starting to bridge some of the above mentioned gaps by giving insights into the scientific content of popular beauty blogs in order to describe ways to learn *about* blogs in lower secondary education.

Sampling and method

To select the sample of blogs we used the website blogmetrics.org, which features a ranking tool called BlogRank. This tool uses over 20 different factors to rank a blog, such as monthly visitors, link to page ratio or reviews on other social sites. One of the features of BlogRank is that factors that can be manipulated have less impact of the ranking of the blog. Another advantage is that one can search for specific topics, in our case for beauty blogs. From the top ten beauty blogs listed on this website we excluded the ones only focusing on reviews of decorative cosmetics and/or paid advertising which led to six remaining blogs. The blogs are listed in Table 1 together with the number of visits in November 2018 (data according to semrush.com, retrieved on December 7th, 2018) as well as a short description of the blog type and the target audience (when provided by the blogger). The selection of blogs was conducted in April 2018; since then, some of the blogs slightly changed their focus, became less or more active and therefore lost or gained readers. This and the various criteria applied to rank a blog explains the very different numbers of visits ranging from about 24,000 up to almost two million. Only one of the bloggers has a scientific background.

From previous research on science in advertising (Belova & Eilks, 2015) we knew that in the context of cosmetics scientific information in general and chemistry-based information in particular appeared mostly when talking about ingredients. Therefore, a search within the blogs for the keyword “ingredients” was performed both in the headings of the posts as well as the posts themselves and the keywords which are commonly attached to each post. From the search results, the first ten posts were transferred into a uniform format and analyzed. To illustrate the types of posts that were selected, Table 2 shows one headline from each of the blogs.

Table 1: Sample of blogs.

Blog name	Visits in November 2018	Blogger	Blog description
hudabeauty.com	969,100	Huda Kattan, Make-up-Artist, no scientific background	Focuses mainly on decorative cosmetics (blogger has own make up line), aims explicitly at women over 25
vivawoman.net	96,700	Sesame (pseudonym), no scientific background	Blogs about natural and self-made cosmetics, the target group are women from 18 up
mybeautybunny.com	23,700	Jen Matthews, no scientific background	Aims at both women and men who are interested in animal friendly products
labmuffin.com	139,700	Michelle, PhD in chemistry	For anyone who wants to understand the science between cosmetic products, focuses mainly on skincare
makeupandbeautyblog.com	129,600	Karen, no scientific background	The focus lies on high-end decorative cosmetics and make up tutorials, mainly for women over 25
temptalia.com	1,900,000	Christine Mielke, no scientific background	An extensive collection of swatches of decorative cosmetics and tutorials, but also many product reviews. For different age groups

Table 2: Exemplary headlines from the blogs.

Blog name	Headline
hudabeauty.com	This Is Where Your Skincare Ingredients Really Come From
vivawoman.net	Chemical Ingredients Can Cause Skin Damage
mybeautybunny.com	Ingredients to Avoid in Sunscreen
labmuffin.com	Surfactants Are Everywhere, aka Stop Being Terrified of Chemicals
makeupandbeautyblog.com	Troublesome Beauty Ingredients and How to Test for Skin Allergies
temptalia.com	Ten Skin Care Ingredients to Keep You Looking Young

These examples already show that blogs have opposite views on chemistry as a domain. Some bloggers connotate chemistry negatively, while especially the blogger with a chemical background constantly tries to promote a positive image of chemistry.

Analysis of the resulting texts was carried out using common content analysis (Hsieh & Shannon, 2005). The categories were developed inductively along the material. After reading the text, as a first step all science-based terms and information were underlined. As a next step, the bits of information were clustered. Here, the focus was not on the scientific content itself, but on the actual amount of scientific terms, the way they were presented and whether the science-based information was supported by any additional sources or references. A deeper analysis of the actual content of the blogs could be a next step of the evaluation. Two rounds of coding resulted in the category system which is presented in Table 3. Each category received a color-code so blog posts could be visually compared to each other afterwards. Our aim was to develop a simple and not overly time consuming tool to visualise the fact that blog posts are very different when it comes to the presentation of scientific content, although they may not seem to differ significantly at first glance.

First, we coded the scientific terms used in the blog posts and checked whether or not they were explained somewhere in the post. General references to research and concrete sources (where at least the names of the research team and/or the affiliation needed to be mentioned) were coded separately. We included references to the media landscape and marketing mechanisms (e.g. *“the marketing packaging encourages using a small amount mixed into a different product”*) as a separate category to gain insights on how critically the blog is dealing with the presentation of cosmetic products in the media. Probably the most important category was the description of ingredients. Based on the analysis of argumentation in media messages (Craig-Hare et al., 2018) we paid special attention to coherent justifications for judging a specific ingredient/compound positively or negatively. The category “Hyperbole” mirrors a more rhetorical device which can frequently be found in blogs, namely the exaggerated depiction of mostly positive properties of a certain product and/or ingredient (*“magically smooth-*

ing”, “baking soda rocks my socks”, “antibacterial powerhouse”). Finally, the average number of words per post was also calculated.

Table 3: Overview of the categories.

Category	Quote
Scientific term (not explained)	“[...] and it is often used to because of its high refractive index.”
Scientific term (explained)	“Dimethicone is a type of silicone that has a durable, rubber-like texture and is often used in primers, creams, and serums to give an insanely smooth after feeling.”
Reference to a study	“Clinical studies show improvement [...]”
Reference to science/research in general	“Research is showing that [...]”
Reference to advertising/media	“[...] think about how much of that premium price goes to the marketing department.”
Source (study)	“BV Nusgens et al., Stimulation of collagen biosynthesis by topically applied vitamin C (open access), Eur J Dermatol 2002, 12, 32-34.”
Source (other blog)	“Susan of True Beauty says [...]”
Ingredient described negatively with justification	“Here’s the actual legitimate issue with propylene and butylene glycol: in high concentrations, they can be irritating, and very rarely they can cause allergic reactions.”
Ingredient described negatively without justification	“Parabens should be generally avoided.”
Ingredient described positively with justification	“Vitamin C on its own is a potent antioxidant that soaks up free radicals and prevents the oxidative damage that results from UV light and other environmental stressors, as well as normal biological processes.”
Ingredient described positively without justification	“[...] and includes good for ya things like shea butter and avocado oil!”
Hyperbole	“I like to keep certain no-no ingredients in mind [...]”

Results and discussion

The analysis of the blog posts using the described category system showed a broad spectrum of foci and led to the conclusion that there are different types of beauty blogs when it comes to the presentation of scientific information. A visual comparison of selected pages from different blogs already shows major differences (Figure 1).

Figure 1: Comparison of color-coded pages from mybeautybunny.com (left) and labmuffin.com (right).

It can be seen that in the left blog post generally fewer categories (fewer colours) are present. The text contains many unexplained scientific terms and no concrete references to studies, although it describes ingredients positively with justifications. The blogger does mention "recent studies", but without providing a source. For a reader it is not possible to trace where these justifications were derived from. On the other hand, the text on the right does provide (partially open access) sources to support the claims. There is a balance between positively and negatively described ingredients – this is visible due to the presence of an approximately equal number of corresponding color codes. Most of the scientific terms are explained to the readers.

As already mentioned, different bloggers have different views on the role of chemistry as a domain when evaluating cosmetic products. For instance, mybeautybunny.com, who tends to promote natural cosmetics, states in the context of sunscreen: "Most chemical active ingredients (i.e. oxybenzone, avobenzone, octinoxate) have been shown to be hormone disruptors and potential skin allergens" – without providing any references to support this claim. This goes in line with other research findings on the role of science in popular media such as television. For instance, Nisbet et al. (2002) have indicated that television very often presents a negative image of science and scientists. On the other hand, Michelle from Labmuffin.com encourages her readers not to be terrified of chemicals and to seek additional scientific information themselves:

"But unfortunately we don't all have the time to be completely informed on every aspect of all the products we use in our day-to-day lives. A more practical approach? Learn the basics, and then ask all the questions. [...] Ask your friendly local scientist, who will probably relish the opportunity to wax lyrical to an enthusiastic audience. Ask multiple scientists and watch them battle to help you understand. [...] Then compare the answers, and see which ones fit together to give a plausible explanation."

To get an overview of the distribution of the categories we summed up the results from each one for each of the blogs (Table 4).

These numbers clearly show the varying amount of science-based content and shows the differences between the only blog run by a scientist in comparison to the other ones. Labmuffin.com uses 92 scientific terms that are not explained. Thus, basic scientific knowledge can be regarded as a prerequisite to fully understand the claims made in this particular blog but also in blogs that use a huge amount of unexplained terms. On the other hand, 72 terms are explained – by far more than in any other blog. The blogger cites 42 studies and there is a clear balance between positively and negatively depicted ingredients. Vivavoman.net confronts the reader with 114 not explained terms versus only two where an explanation can be found. Generally, bloggers seem to use unexplained scientific terms to point out positive properties of a product or ingredient ("such creams are full of antioxidants") – the same mechanisms advertising uses to sell a product (Belova, Chang Rundgren, & Eilks, 2015).

Table 4: Total numbers of codes per category.

	hudabeauty .com	vivawoman .net	mybeauty bunny.com	labmuffin .com	makeupand beauty- blog.com	temptalia .com
Scientific term (not explained)	84	114	106	92	60	84
Scientific term (explained)	20	2	12	72	8	26
Reference to a study	0	0	6	12	0	4
Reference to science/research in general	2	8	8	20	0	12
Reference to advertising/media	2	4	4	10	4	2
Source (study)	0	2	0	42	2	0
Source (other blog)	2	2	6	14	0	10
Ingredient described negatively with justification	2	10	12	36	21	166
Ingredient described negatively without justification	2	26	12	2	4	58
Ingredient described positively with justification	36	18	48	36	2	56
Ingredient described positively without justification	2	0	8	0	0	12
Hyperbole	18	6	2	2	16	16

References and study results are used and presented in different ways. Some bloggers do not back up their claims at all and hardly anyone cites actual research papers, which does not seem to bother thousands or even millions of readers. It can even be differentiated between two diametrically opposed perspectives on writing a post – egocentric (“*from my experience*”) vs. scientific (“*scientists say*”).

Based on the described results we propose to divide beauty blogs into three categories based on the role scientific information plays in them (Table 5). To make a statement whether chemistry as a domain is depicted positively, neutrally or negatively, we took a deeper look on the exact wording the bloggers used when talking about chemical aspects. When negative wording (“*avoid synthetic chemicals*”) was prevalent, we characterized this as being a negative depiction of chemistry, while positive wording (“*stop being terrified of chemicals*”) led to a positive characterization. Due to the very small sample these types can only be regarded as a general orientation but can serve as a basis for future research.

Table 5: Types of beauty blogs.

The scientific type	The semi-scientific type	The non-scientific type
Balance between explained and not explained scientific terms	More scientific terms are not explained than explained	Majority of scientific terms not explained
Chemistry depicted positively	Chemistry depicted neutrally	Chemistry depicted negatively
Properties of ingredients justified by concrete references to studies	Properties of ingredients justified by references to research in general (often without sources)	Properties of ingredients not justified
Critical reflection of media claims supported by research findings	Critical reflection of media claims not supported by research findings	Critical reflection of media claims almost absent; not supported by research findings
Long posts (over 1000 words)	Medium posts (between 1000 and 500 words)	Short posts (less than 500 words)

Conclusions and implications

As outlined in this paper, social media in general and blogs in particular are ubiquitous in the daily lives of the students and therefore “it is futile to try to stop their influence at the classroom door” (Chao, Parker, & Fontana, 2011, p. 324). Our research showed that beauty blogs contain a large amount of science-based information which is often not sufficiently explained and/or not supported by any empirical evidence. The developed category system can be easily used to evaluate other blog posts and distinguish different types of blogs. By color coding the different categories it was possible to compare the posts visually and to draw conclusions on the role of scientific information in a particular blog.

But how can we make use of these findings in the science classroom? In the context of advertising, Belova et al. (2015) suggested for potential roles a media type can play in science education. First, media messages, in our context blog excerpts, can be used as a motivational introduction to a certain topic. For instance, when talking about polar and non-polar compounds teachers can use the heading “surfactants are everywhere” from labmuffin.com. Second, blog posts can be used to contextualize science-related tasks such as experiments or calculations. A blog post on different types of mechanical peelings could contextualize experiments on the effect of peelings. For the next two roles the insights into the scientific content of blogs gained through our analysis are highly relevant. The third role is the promotion of critical thinking through reflection of the role of science-related information in blog posts. Students can for example reflect on the way bloggers are dealing with scientific terms and figure out possible reasons. They can also evaluate positive or negative representations of science in general and chemistry in particular. The fourth role goes beyond this and aims at promoting a meta-cognition of the mechanisms behind the interplay of science and social media. Here, possible questions for discussion might be: How is the scientific information used in blogs selected? In which way are blogs used as a communication platform between the blogger and the readers and which role does science-based argumentation play? Which effect does science-based information have on myself as a consumer – am I receptive for “hypes” induced by blogs? Do I find numerous references to studies to be convincing or overwhelming? Students can be encouraged to write blog posts themselves and evaluate them with the help of the categories developed in this paper. They can even try to develop categories themselves. We argue that the latter roles can make blogs more relevant for developing scientific media literacy at a general level. It is of great importance to emphasize that our developed categories and the outlined blog types do not necessarily lead to a characterization of blogs being good or bad – this is always a matter of goals one is pursuing and the type of information one is looking for. Still, our way of analyzing can show that scientific information is used differently and can be also misused to (for instance) make a blog post seem more credible. It can be discussed in the classroom whether it would be better if all the beauty blogs would correspond to the scientific type. All in all, our categories can be considered as criteria to (first of all) recognize the chemistry-based aspects (as with a kind of filter or magnifier) and then determine whether the present text is scientifically acceptable and meets certain standards. For this, the learners do not necessarily have to have previous knowledge – it is about the pure presence and the presentation of scientific content. Of course, then you can use the found aspects as a learning opportunity to contextualize content knowledge and promote other skills.

This article suggests that teaching through and learning about blogs in the science classroom of the future can be a potentially fruitful issue in science education. This includes bettering science’s contribution to the development of scientific media literacy in the next generation of learners as a prerequisite for their role as critical consumers and at the same time contributing to the increase of the perception of relevance of science learning. It is now crucial to develop teaching materials which can help teachers to move beyond the news media and consider using blogs in the science classroom. Available teachings strategies, pedagogies and examples are quite limited so far. In terms of educational policy, learning about mass media in general and social media in particular need to be more systematically incorporated into modern science education. This is a clear task for science education curriculum development and accompanying research on its effects.

It is also of great importance to start from the students’ side asking which types of social media or which types of blogs they find relevant and which factors contribute to their consumer decisions. As mentioned in the introduction, especially Instagram (a more visual and less text-based social network) has gained popularity in recent years. More and more bloggers transfer their emphasis from the actual blog to Instagram. Educators should keep an eye on the social media habits of their students. Effectively, it is not that important through which platform scientific information is spread as long as we have clear criteria to evaluate it.

With regard to the implementation of such measures into classroom practices, it seems advisable to include both learning with and about social media in science education. This includes integrating learning about corresponding pedagogies and teaching examples into university programs for pre-service science teacher education and into in-service, continuous professional development programs. There is need for further development of suitable pedagogies and illustrative examples. It also needs evidence-based curriculum development that leads to credible teaching scenarios that can serve as exemplary patterns and useful illustrations.

In terms of empirical research, there is a need for more evidence, both on the prerequisites for as well as on the effects of including social media in science classes. This includes factors as taking into consideration learners' knowledge gains, higher-order cognitive and communication skills development, meta-cognition, or attitudes towards science. As we already mentioned, a generally deeper content analysis of blog posts could be fruitful next research step. Also, more research into teachers' beliefs and attitudes concerning the use of social media in the field of science education is needed. Research should reveal whether teachers are sufficiently aware about ways of communication in social media, whether their curricular knowledge is sufficiently developed and flexible to recognize teaching and learning chances, or what kind of pedagogical repertoire is available among the teachers to develop effective teaching and learning activities based on social media.

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