## ORIGINAL ARTICLE

# Bibliometrics versus altmetrics: Researchers' attitudes in Slovakia

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## ABSTRACT

**Objective**. The paper presents principal theoretical starting points and an overview of attitudes to altmetrics-based research evaluation among scientists of various disciplines in Slovakia, more specifically in comparison with traditional, bibliometric approaches.

**Design/Methodology/Approach**. We used a questionnaire and asked researchers from various disciplines about their knowledge of principle characteristics defining the altmetrics and about their attitudes towards the application of bibliometrics and altmetrics approaches in the processes of research evaluation. The questionnaire covered a wide range of issues, predominantly associated with interpretation and perception of the importance of alternative indicators, including the factors influencing the interpretation. In this analysis, we concentrate on those parts of research reflecting the willingness of respondents to accept alternative indicators as part of research/science assessment.

**Results/Discussion**. The attitude to the application of alternative indicators in research assessment is not significantly more negative among Slovak scientists if we compare it to other countries. The citations are still a respected indicator perceived as a tool for creating bonds within science. If they are perceived as obsolete or insufficient, it relates to the experience of researchers whose results are predominantly aimed at non-academic target group or if they are active in the research of social phenomena and problems. Due to pragmatic reasons connected with research financing, however, registering the citations is a generally accepted priority. Familiarity and practical experience with social media were identified as one of the factors influencing the interpretation of alternative indicators in the environment of both public and academic media.

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**Conclusions**. Traditional bibliometric methods, especially in the area of research evaluation, are still preferred over the altmetrics. The scientists realize that the kind of attention captured by the indicators based on social media is not comparable with the citation-based impact. Or, more precisely, that altmetrics reflects a different kind of impact whose correspondence with a traditional world of bibliographic citations remains to be explored.

**Originality/Value**. The article presents the results of original research carried out in the community of scientists in Slovakia, applying quantitative research methods. It contributes to the results of previous studies on the attitudes and acceptance of altmetrics in the research community, with a special focus on research assessment.

**Keywords**: Altmetric indicators, Bibliometrics, Research evaluation, Researchers' attitudes

## INTRODUCTION

In science, it is a generally accepted fact that both the quantity and quality of research outputs can be evaluated via publications (monographs, journal articles, collections of papers, conference proceedings, etc.) and feedback to these publications. Publications represent a principal component in science communication processes that enables to verify validity, reliability, and accuracy of research. At the same time, the publication is a fundamental building block of science guaranteeing the accumulation of knowledge and ensuring further development of social cognition. Information and communication technologies in their network modality started to introduce new patterns of spreading information by the end of the 20th century. It applies to all processes of communication in science, including the primary publications as well as all forms of references to them. On the contrary to the situation that was common some 60 years ago, when the creation of huge centralized databases was the principal tool for registration of publications and references, new technologies offer new instruments and new ways of monitoring references and the impact of publications. These tools are predominantly connected with social media and we usually call them "alternative". The primary benefit of these approaches and tools lies in their capacity to reflect and measure other types of the impact the research may have in the society, outside academia.

This article aims to present selected theoretical frames of altmetrics' development and use in the context of science evaluation. It summarizes very briefly the principal technological and social background of the discipline and its connections to the traditions of bibliometrics. It concentrates on the results of the survey carried out among scientists in Slovakia in which we attempted to find out about their attitudes to using altmetrics indicators in research/science assessment, specifically in comparison with traditional, bibliometric approaches.

### Background: from bibliometrics to altmetrics

There are various ways of understanding the impact of research within society. The impact can be defined as a perceptible and measurable shift or change in the area of theory and practice which can be of diverse intensity and force (Roemer & Borchardt, 2015), and can have distinct character and manifestation. Consequently, we can identify different types of impacts (Holmberg et al., 2019). In general, it can be designated as social or societal impact, although some authors prefer to distinguish between these two as well. Societal impact is usually understood as a kind of impact the science has on various levels and areas of society, while social impact reflects a more personal level of influence and affects people directly or indirectly (e.g., Vanclay et al., 2015). Technology, economy, culture, or health care are some of the most prominent examples of these areas of social/societal impact.

Bibliometric methods represent a traditional way of measuring success in the domain of research work, mainly due to their ability to express an impact within the academic/research community. Bibliometrics is based upon a principal assumption that citation is a positive reaction to a scientific product (Setti, 2013). If the number of citations of a document reflects its quality and importance, the citations are a suitable variable for a quantitative evaluation of research. Gutiérrez-Salcedo et al. (2018) recognize two principal application areas of bibliometrics. The first one is the performance analysis focused on the evaluation of science on various levels, such as individuals, institutions, countries, fields of science, etc. It is also called evaluative bibliometrics and it is largely based on the number of publications but also their quality measured via citations (Bornmann & Haunschild, 2017). The second area is the descriptive bibliometrics and it serves to depicture the structures of sciences and research, frequented topics, cooperation on the level of individuals, institutions, or countries, be it via the analysis of co-authorship or mapping of science. All these outputs and measurements are possible due to the existence of huge databases, mostly international, that systematically and on a long-term basis build the registers of the publications and their citations (such as the Web of Science, Scopus, and others).

Over the years, the exclusive use of bibliometric approaches for the evaluation of science became strongly criticized. The doubts were raised mostly about the question if the bibliometrics is universally applicable and suitable for both "soft" and "hard" sciences, or the works rooted in fundamental vs. applied research (Blockmans, Engwall & Weaire, 2014). These uncertainties were reflected in several international initiatives and programs, like the Declaration on Research Assessment (DORA) or Leiden Manifesto. Both documents underline such principles as combining qualitative and quantitative evaluation in science or respecting the peculiarities of publication and citation culture in individual branches and disciplines of science. Besides, there are other reasons behind this call for change – some say that it is necessary to consider a wider societal impact, out of academia, a quicker reflection of the impact that a scientific work might have, or different types of scientific products/media that are not considered in the traditional bibliometric realm. And here is where the altmetrics steps in.

Alternative indicators are based on the functionalities within web 2.0 applications like social media, which allow users to express feedback or attention towards a contribution to the media. They quantify the impact based on the use of the published content, not only with the help of the number of formal citations (Büttgen & Luprich, 2015). Technological instruments of altmetrics can be divided into two principal categories – tools providing data and tools providing services (aggregators) (Ondrišová, 2016; Erdt, 2016). Data sources are services, applications, or programs offering space for sharing and assessment of scientific products, most notably public social media (Facebook, Twitter) as well as academic (scientific) social media (Mendeley, ResearchGate, Academia.edu). Aggregators collect data from various sources and calculate/present a kind of composite altmetric value for a document (e.g., Altmetric.com, PlumX Metrics, PLoS-ALM, ImpactStory, or Snowball Metrics).

Within such a wide range of instruments, it is also possible to find a wide variety of individual indicators, some of which exist only on a particular platform. One of the most frequently cited approaches to their classification used by PlumX Metrics aggregator (PlumX, 2020) divides them into 5 principal categories: citations (in Scopus, for example), usage (views, video plays, clicks, downloads), captures (bookmarks, watchers, readers), mentions (blog posts, Wikipedia references, etc.) and social media (activity on Facebook and Twitter).

Variability of altmetric data represents the variability of social interaction with science and scientific products (publications, patents, software, datasets) in all steps of the research

process. One of the most frequently mentioned benefits of altmetrics is the focus on readers – a wide community of social media users like scientists, professionals, students, and the general public (Bornmann, 2014). Their possible usage of a scientific product is not as formal as a citation, but it can provide a picture of the societal interest in the topic, research, issues. Wouters, Zahedi & Costas (2019) talk about analyzing trends and identifying patterns of acceptance of scientific outputs. The speed of feedback to a scientific product via informal discussion is another advantage of altmetrics and it can affect the dynamics of research.

Altmetrics indicators and tools pose a challenge to the traditional system of quality evaluation of information resources, information, and science in general. Most of the researchers agree, though, that their purpose is not to replace traditional bibliometrics but to amend it (Sugimoto, 2015). Of course, many proponents of bibliometrics call attention to the drawbacks that the application of altmetrics in research evaluation can bring along. They are, for example, insufficient standardization of individual indicators across various platforms, but also the issues connected with social media in general – like dynamic and commercial nature of these media, users and their behavior, data and its stability and credibility (Haustein, Bowman & Costas, 2016).

Some researchers rightfully question the very substance of attention in social media, pointing to the fact that very often the tweets that mention scientific articles are just mechanical actions of forwarding the information (Robinson-Garcia et al., 2018). Some other studies suggest that many of the tweets may be sent by researchers themselves, which means that social media just opened a new channel for informal discussions among researchers (Sugimoto et al., 2017) – all of which can lead to a conclusion that the social media events may not express societal impact but rather reflect new forms of scholarly communication (Holmberg et al., 2019). In one of his latest articles, Thelwall (2020) underlines that alternative indicators must be dealt with very carefully and he sums up some common problems and mistakes that should be avoided in this process – among others he mentions the problems of using indicators that do not match the research goals, ignoring research field differences, or using alternative indicators in formal evaluations.

## Previous research in altmetrics

Publications in the domain of altmetrics very frequently focused on investigating the applicability and usability of alternative indicators in the area of science/research assessment and analysis. Yu (2017) identified two principal directions of research in altmetrics, measuring the correlation between traditional and alternative indicators (mostly quantitatively oriented) and exploring the context of altmetrics which involves, for example, user behavior, motivation, etc. (both quantitative and qualitative approaches). A detailed look into the publication production in this area allows us to identify several specific topics within these two big research domains.

Comparisons between alternative indicators and traditional bibliometric ones concentrate on looking for a (significant) correlation between the two, eventually how strong this correlation is (whether a given indicator is "a predictor of a citation") and how the reasons for the outcoming relation between traditional indicators and individual social media indicators (tweets on Twitter, sharing, mentions, and likes on Facebook, Mendeley reader, etc.) are being interpreted. Some researchers get even more specific and deal with the issues of dependence between citations and selected alternative indicators in various science areas, the impact of alternative indicators on the citing ratio in publications with open access, or what the highly cited publications and those with high values of the alternative score have in common.

Quantitative studies of correlation look for the answer to the question if alternative indicators can be considered as a relevant, objective, and reliable tool for scientific evaluation. Originally, in the early years of altmetrics development, the alternative indicators were deemed to be the markers of quality. This perception of alternative indicators, however, started to be questioned early in the first phase of research (Banshal et al., 2018). Dependence between citations and alternative indicators is influenced by several factors, such as the type of indicator, science area, and discipline or a type of document. In general, however, this correlation was not found to be statistically significant, even though it is still positive. Weaker correlation, according to some authors, does not mean that alternative indicators are not suitable to measure success in science, but they are indicators of a different kind than citations and their usefulness lies in the ability to quantify the interest and attention of a wider public (Alhoori & Furuta, 2014; D'Angelo & Di Russo, 2019).

On Facebook alone, there are various types of alternative indicators – likes, posts of the message itself, or shares of the message. Several studies reveal, however, that likes on Facebook are indicators with a lower correlation to traditional indicators because they can become the predictors of a citation only in certain disciplines, e.g. in social sciences (Ringelhan, Wollersheim & Welpe, 2015) – in comparison with Twitter which, according to several studies, is a more representative source for altmetrics due to a quicker outreach of scientific works shared on this medium (Xia et al., 2016), but also due to a higher correlation with citations (Haustein, Costas & Lariviére, 2015). On the other hand, the academic network Mendeley reflects a kind of impact that is closer to citations and which has been documented by their mutual significant correlation (Alhoori & Furuta, 2014; Mohammadi et al., 2014; Mohammadi & Thelwall, 2014; Bornmann, 2015; Maflahi & Thelwall, 2016; Amath, 2017; Zhang, 2019). It is interesting to note that Mohammadi and Thelwall (2014) found the highest level of correspondence in natural sciences and related areas, and the lowest level in humanities – according to their findings, bookmarking is a tool for discovering connections between various disciplines and revealing potential interdisciplinary relations and interactions, so it has a descriptor function.

Studies in the area of altmetrics context cover a wide range of issues, such as using social media in a science environment, sharing and using scientific publications on the platforms of social media, defining social media user groups in the context of science activities (types of users), their specific behavior (activity), interpretation of attention (impact), interpretation of the meaning of alternative indicators, factors affecting alternative indicators (factors affecting attention and the level of alternative score), etc. Considering its interdisciplinary coverage, the altmetrics touches closely upon the research areas connected with wider aspects of social media functioning, evaluation of science, information and citation behavior, and other areas – whereby all these topics tend to overlap in the research. Of course, one of the main aims of these various research is to find a convenient application for the alternative indicators in the processes of objective and complex evaluation of science. From this point of view, one of the most important outputs would be to find out to which degree the alternative indicators identify similar or diverse phenomena connected with the expression of impact/attention in comparison with traditional bibliometric approaches (Copiello & Bonifaci, 2018; Wang, Wang & Chen, 2019; Nuzzolese et al., 2019).

Some of the latest trends in the area of social media indicators research are based on the assumption that current altmetric indicators stem from traditional citation metrics and they are not very suitable for assessing societal impact. Instead, interaction approaches are getting a more prominent position in this new model stating that the assessment should focus on network analysis, mapping the contexts in which engagement among researchers and stakeholders takes place (Robinson-Garcia et al, 2018). From this point of view the altmetrics

is more and more frequently labeled as social media metrics, or even social media studies of science, a discipline that attempts to merge the altmetric and bibliometric perspectives via bringing together the interactions and network approaches (Díaz-Faes et al., 2019). A recent attempt to define a new typology of social media users was based on this methodology. It was built upon extensive research on Twitter and identified four constitutive user dimensions (science engagement, social media capital, social media activity, and science focus) based on users' activity related to social media and science (Díaz-Faes et al., 2019).

When it comes to the research concentrated specifically on the level of alternative indicators' acceptance in the academic community, two examples are worth mentioning. Južnič, Vilar and Bartol (2014) used a questionnaire survey among Slovenian scientists to study whether alternative indicators are an acceptable way for them to evaluate their research work, which social media they use, how familiar they are with the concept of altmetrics and that of alternative evaluation and what their attitude to selected alternative indicators is. It turned out that not a small number of respondents would be interested in the idea of alternative assessment of science, although they have never heard of altmetrics, while approximately only 20 % of respondents know what altmetrics is. The results also show that the indicator of downloading in journals is acceptable, or at least partially acceptable for most of the respondents. In this particular indicator, the researchers distinguished clearly between downloading an article from a journal portal or a repository. On the other hand, Slovenian scientists respect less the indicators of social media and statistics of ResearchGate and Mendeley reader, which is probably connected with a lower frequency of their usage. Scientists over 45 years of age generally do not favor the idea of using alternative indicators as a tool for assessment but the respondents from humanities are more inclined to using download statistics for this purpose.

Another research focused on the interpretation of the "attention" phenomenon in altmetrics and it was carried out by Holmberg and Vainio (2018). They used the questionnaire again and tried to map the opinions of Finnish scientists on what it means to get the attention on social media like Mendeley or Twitter. More precisely, the authors analyzed which factors could influence the attention the publications attract, what can this attention reveal about a potential social or scientific impact, and if the researchers actively monitor which type of attention (academic or public) their contribution receives. Twitter appears to be a platform where the attention is mostly dominated by factors like the emotional appeal of the topic, respected publication channel, topicality of the subject, timeliness and freshness of the topic, popularity.

In the case of Mendeley, the reasons for attention were, for example, important research results, recentness of a research method, researchers' reputation, interesting topic, but also, as in the case of Twitter, timeliness, and freshness of the topic. Mendeley appears to be a medium with a wider and more diversified scale of attention factors than Twitter. Most respondents see Mendeley as a tool reflecting scientific impact and research quality. Anyway, more than 63 % of those questioned believe that the visibility of a contribution on the web can boost the scientific or social influence of the research as well as a positive repercussion on the financing of research.

As the results of previous studies show, the altmetrics as a method of assessing academic performance is not broadly accepted. To a certain degree, it is due to the low level of familiarity with altmetrics among academicians. Partly it is also since it is not trivial to find relations and to understand the connection between citations and altmetrics indicators. Furthermore, from the beginning of the 21st century, a huge wave of monetization and call for economic efficiency in academic research all over the world induced a strict system of

financing based on performance factors giving priority to selected types of publications and, of course, to those that are highly cited. Under these conditions, a pragmatic, i.e., not overly positive approach towards altmetrics will probably prevail.

Scientists' perception of and attitude to the use of traditional or alternative indicators in the research evaluation can be affected by various factors. They can be of personal, cultural, societal, technological, economic, or disciplinary nature. All these specifics must be considered in the process of examining the possibility of integrating indicators into the evaluation of science. The motivation of our survey was to analyze the perception of traditional and alternative indicators by Slovak scientists and to identify specific features and differences between Slovak scientists and their colleagues from other European countries where this type of study was conducted.

## METHODOLOGY

In the preliminary phase of the research, an extensive literature review was carried out to get a grasp of the phenomenon of alternative indicators and to identify their potential interpretations as well as to map the circumstances that could reveal important connections between the respondent's context and his/her perception of indicators' meaning. In this phase, in-depth interviews were also conducted to optimize the questionnaire for the second stage of quantitative research.

The key dimensions were identified in the preliminary phase and they were quantitatively measured in the second phase. Therefore, the questionnaire was divided into 6 sections. Three sections map the respondent's context which includes the basic sociodemographic information about respondents (age, gender as well as the scientific area), his/her usage and preferences of public social media (Facebook and Twitter), and usage and preferences of academic social media (Mendeley, Academia.edu and ResearchGate). The following two sections of the questionnaire are focused on respondent's perception and interpretation of traditional and alternative indicators and their usage of public and academic social media in the context of science evaluation. The last part of the questionnaire is dedicated to the interpretation of alternative indicators from the respondents' point of view.

In total, the questionnaire consisted of 40 questions and it took an average respondent 36 minutes to complete it. The questionnaire was anonymous, sent out electronically via email to 2,973 email addresses, of which 273 returned as undeliverable. Data collection was carried out during October 2019 and it produced 232 questionnaires completed by 103 women and 129 men (figure 1) representing various institutions in Slovakia, predominantly universities and institutes of the academy of sciences. The scientific disciplines of respondents were grouped into 6 areas: natural, social, technical, medical, agricultural sciences, and humanities (figure 2).
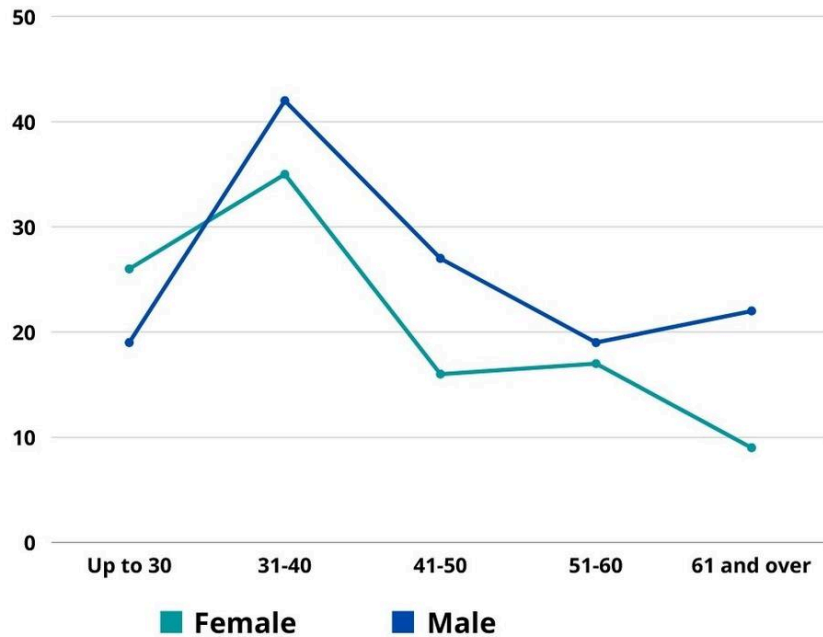
**Figure 1**. Respondents of the questionnaire by gender and age.

Although the questionnaire covered a wide range of issues connected with the topic of altmetrics, in this analysis we concentrate only on those parts of research reflecting the willingness of respondents to accept alternative indicators as part of research/science assessment. We were interested in:

- how the researchers perceive traditional bibliometric indicators and which aspect (quantity or quality of citations) is more important for them,

- if they consider traditional bibliometric indicators still sufficient and relevant for the assessment of science,

- if they are familiar with altmetrics and they can imagine and accept supplementing traditional science assessment indicators with alternative ones,

- which types of social media they use.

Based on this data we wanted to find out whether and to what degree researchers in Slovakia accept altmetrics as an indicator of societal/scientific impact and whether they accept it as a criterion in research assessment. We expected there would be differences in the attitudes of researchers from different science fields but also between those who have less and those who have more experience with social media from their previous activities.
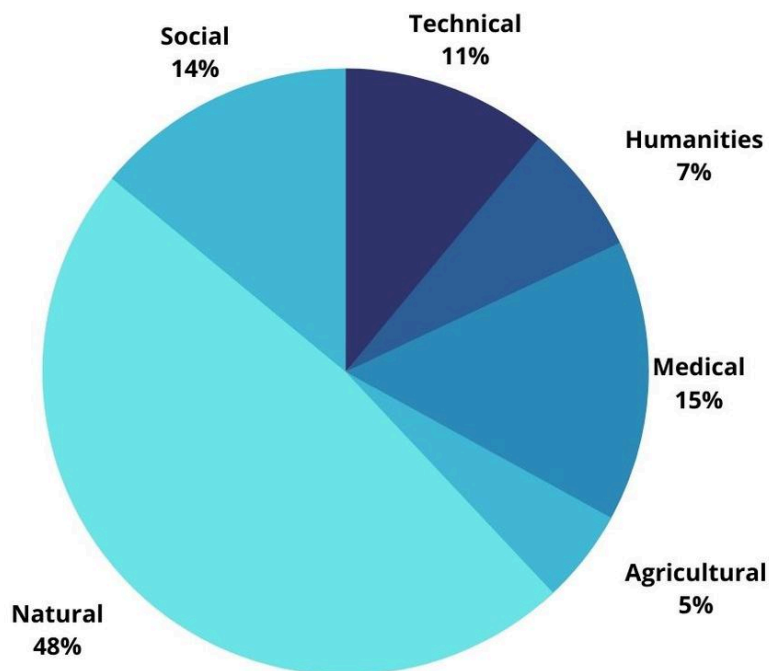
**Figure 2**. Respondents of the questionnaire by discipline.

## RESULTS

Researchers' perception of traditional bibliometric indicators may be a factor that could help us understand better their attitude towards alternative, supplementary indicators. We wanted to know which dimension of indicators' perception seems to be more important for the researchers – qualitative or quantitative (figure 3).
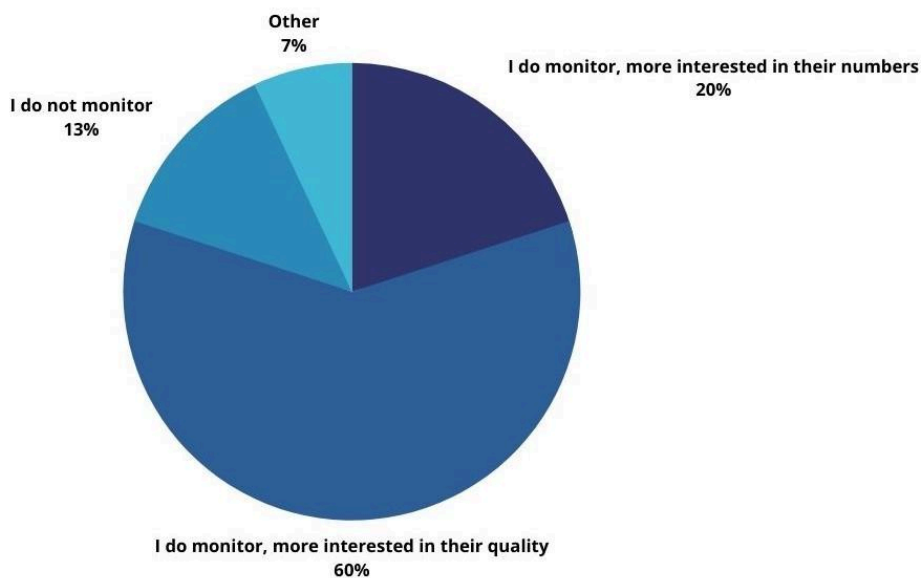


**Figure 3**. Monitoring citations.

Approximately 60 % of our respondents declare to be interested in the quality of citations that have been attributed to them/their work, while 20 % of the authors say the quantity is more important for them. Only 13 % claim they do not follow the citations at all. 15 subjects voted for the option "other" instead, but chose one of the previous 3 answers, adding some extra information to it.

The quality of citation is usually judged based on several types of information – it can be the quality of the citing author (his prestige), quality of the source document (journal, conference, publisher) where the reference was published. The quality of citation is also conditioned by the type of use of the source – how the results of the cited author are being applied and interpreted, in which part of the publication the citation can be found, and how it is used, e.g. as a short general notice in an introduction to the topic or the core part of the study referring to the results of the original publication – in this case, it can be also important if the citation is positive or negative. Moreover, trying to understand the interconnections of one's work being put into context helps some of the authors to find other people working on the same or similar topic, which can be useful to formulate a new research project within one's field or even in an endeavor to get an interdisciplinary outreach. As one of the authors put it, "many a time it is a very good source of information, even though sometimes out of the topic, it may be interesting to see how other people can interpret our results – quite often this interpretation is completely different from ours".

On the other hand, some authors concentrate more on the number of citations, but they do it mostly due to pragmatic reasons as they know it is a criterion that is used to determine their level of success in research and, consequently, their share of the financial reward for the institution. This has a direct connection to another aspect that appears quite frequently in the answers of the researchers – the fact that they feel obliged to keep track of their citations because it is their institution/employee who requires them to do so. Analysis of these numbers according to age groups reveals that every group of authors is more interested in the quality of citations but the subjects between 41 and 50 years of age pay proportionally slightly more attention to their quantity. We interpret this number as a sign of a pragmatic approach among older researchers who simply do what is expected from them. Although there can be other reasons for this behavior as well.

When it comes to the researchers' awareness of the existence of alternative indicators and their opinion on the relevance of traditional bibliometric indicators based on citations (figure 4), for approx. 43 % of respondents the traditional indicators are still sufficient and relevant, while 38 % of respondents see them as insufficient and obsolete.

If data is analyzed from the viewpoint of science disciplines, we can see two distinct camps in this matter. On one side there are natural (49 % of respondents from this area), technical (48 %) and agricultural sciences (45 %), where a bigger number of respondents support the idea that traditional indicators are still valid. On the other side, in medicine (47 % of respondents from this area), social sciences (48 %), and humanities (44 %) we can find more respondents leaning towards the opinion that traditional bibliometric indicators have already been overcome. Additional responses and comments from the researchers (other) indicate that there can be 3 possible groupings of the most frequent reasoning:

a. Dissatisfaction with the fact that the assessment of research/science is getting more important than actually doing good, quality research. The transformation of scientific work into a "publishing marathon" is criticized by many experts stating that it harms the real mission of science. In their article, Saenen and Borrell-Damian (2019) also claim that we live in an era when the efforts to make a progress in science are replaced by a goal of

quick publication production.

b.  Dissatisfaction with the fact that the particularities of different branches of science are not considered in publishing assessment and even less so within the citation culture – the numbers do not always express the quality of work but rather how many researchers are active in the specific area. In this context, Motal (2017) writes about pushing aside the problems and issues of the society which require a longer period for their solution, or even about fending off the whole branches of science (e.g., humanities) whose primary aim is often to start a discussion with an open ending.

c.  Traditional indicators were considered relevant but not sufficient. The respondents often mentioned the need to supplement traditional indicators with new ways of reflecting societal impact, application of published knowledge in real life. This applies even to technical disciplines where – as some of our experts feel –, doing exclusively the basic research is "outdated".
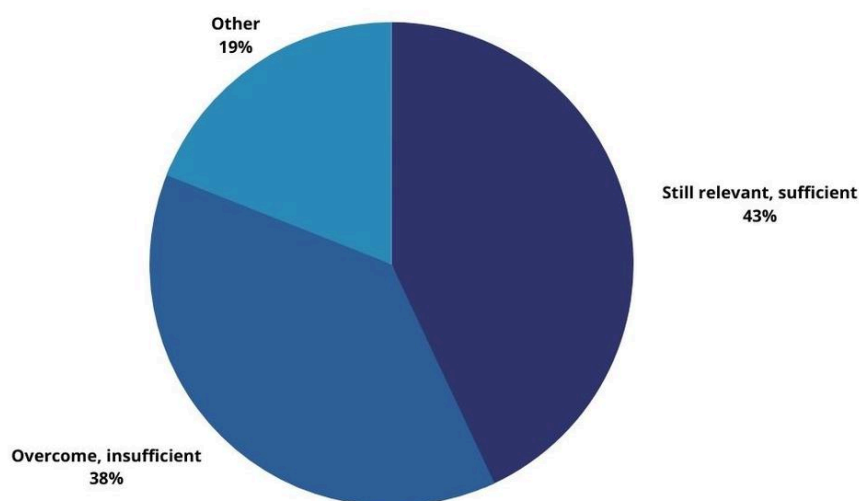


**Figure 4**. The relevance of traditional indicators of research assessment.

When looked upon from the angle of researchers' age (figure 5), only in two age groups there is a prevailing opinion (although just slightly) that traditional indicators are insufficient as a tool for research evaluation and that they should be enriched with other, alternative measures. These groups are the youngest researchers (up to 30 years of age) and those aged 51–60. There seems to be no clear and unambiguous explanation to this and the reason for this position should be sought somewhere else – maybe in the general attitude of researchers towards social media.
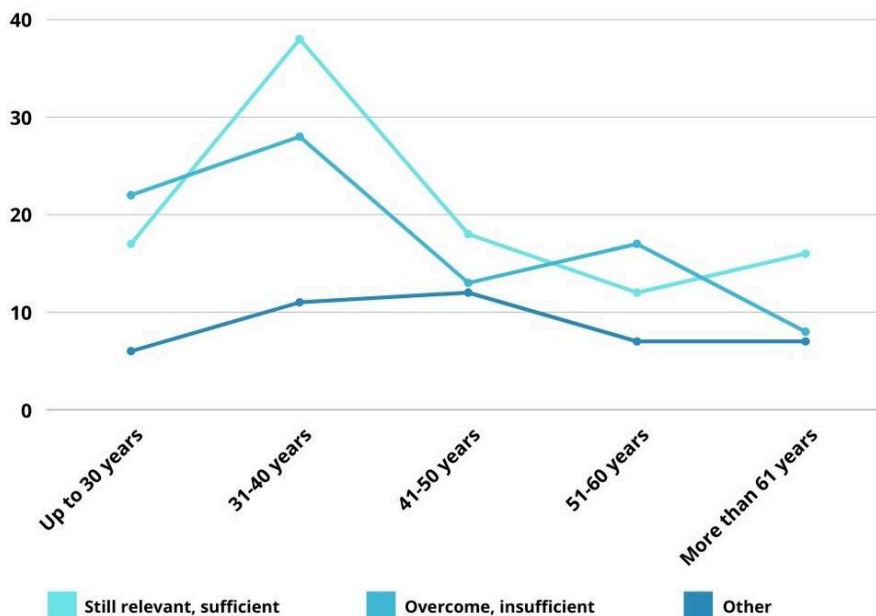
**Figure 5**. The relevance of traditional indicators of assessment – by age groups.

In our search for a straightforward declaration of researchers' stance on alternative indicators, we asked them not only to reveal their general awareness of altmetrics' existence but also to state explicitly their attitude to the possibility of using alternative indicators as a tool for science/research assessment (figure 6), for the reasons as diverse as an academic promotion or institutional and personal financing. It turns out that for 19 % of our respondents the alternative indicators are not relevant in this matter at all. 45 % of them can imagine a sort of supplementary function with traditional indicators. Altmetrics is not a new concept for 15 % of our subjects, however, approximately 30 % of them have not met with it before. Quite a high proportion of respondents (27 %) was not able to identify with any of our propositions.

Complementary answers provided within the option "other" dealt mostly with concern over potential risks of this way of scientific evaluation, connected with the range of expert community present on a specific social media, the particularity of the topic, and the size of the discipline as well as impartiality and trustworthiness of such an evaluation. According to our respondents, social media boosts up subjective approaches and indicators can be quite distorted, people often share stupidities and hoaxes and the issue of the relevance of alternative indicators can be then disputable, and of course, it is quite important what kind of social media we use – Facebook and other public social media should not be included in evaluation practices but ResearchGate, for example, could be a good indicator.

The analysis of the results with regards to broader science areas reveals that it is the researchers in the domain of medicine (24 % of respondents) who declare the highest level of familiarity with the concept of alternative indicators and who can envisage the usage of these indicators in evaluation – which is in line with the results of Slovenian research mentioned earlier. In the case of technical (41 %), agricultural sciences (36 %), and humanities (38 %), the biggest proportion of respondents were uncertain and could not declare their preferences in this matter. In natural and social sciences, most of our respondents (33 % and 36 %, respectively) can imagine altmetrics as a supplementary factor of evaluation, however, they are not familiar with it. Seeing the data from the gender perspective (figure 7), it seems that

women are less well informed about the development in the area of alternative indicators, and at the same time they oppose less strictly the idea of using these indicators for scientific evaluation.
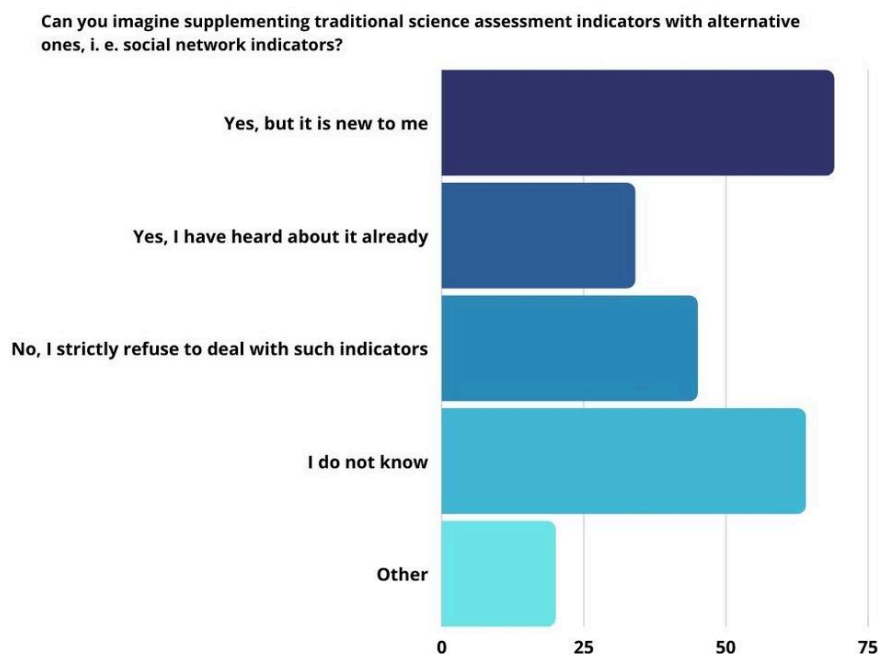


**Figure 6**. Supplementing traditional science assessment indicators with alternative ones.

To get a broader picture of how our respondents' presence on social media might influence their attitude towards alternative indicators, we asked our subjects about their involvement in social media, both public and academic. In the realm of public social media, we concentrated on the two most popular services, Facebook, and Twitter.

Although 88 % of our respondents are acquainted with Twitter as a social medium, only 12 % of them created an account there. The same number of respondents (12 %) claim they do not know Twitter. On the contrary, Facebook is not only a well-known medium but also the share of created user accounts is higher. 97 % of our experts are familiar with Facebook, 71 % claim to have a profile there. 26 % of our respondents declare they are familiar with Facebook but have no profile there. Only approximately 4 % are unfamiliar with Facebook. In summary, just 12 % of our subjects have a profile on both public social media, 59 % only on Facebook, and 0.5 % on Twitter (figure 8).
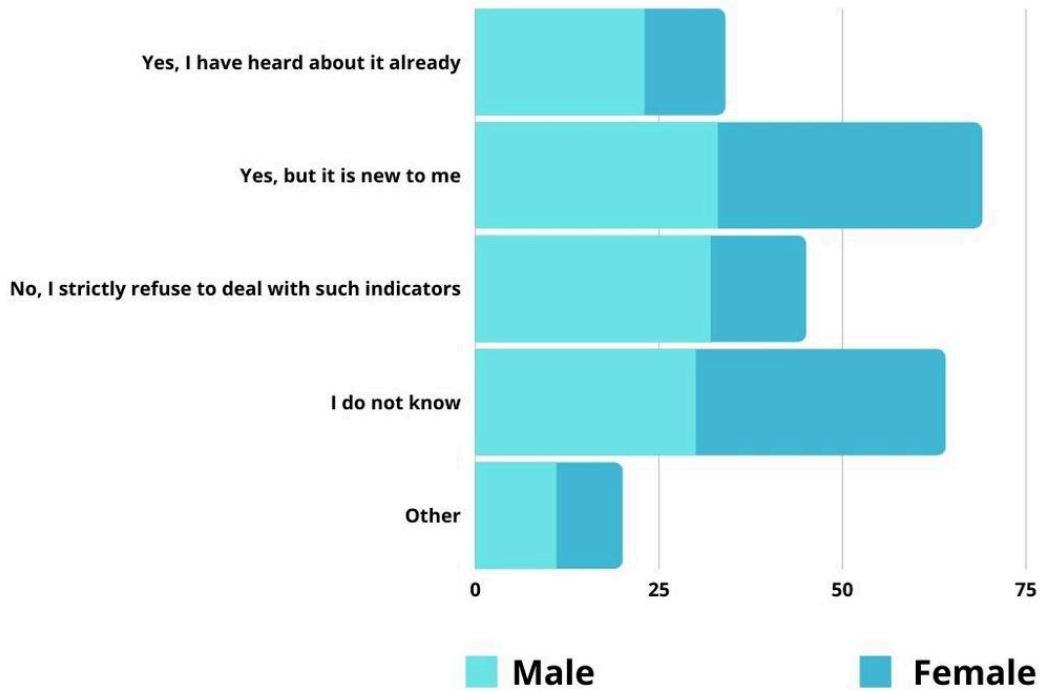
**Figure 7**. Supplementing traditional science assessment indicators with alternative ones – by gender.
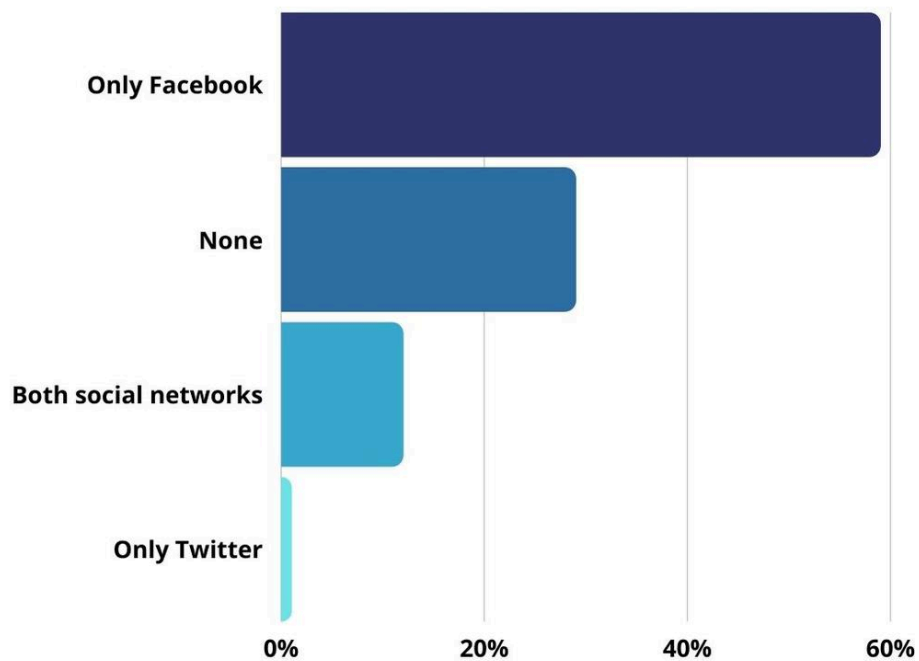


**Figure 8**. Using public social media.

No significant differences were found in the analysis of social media usage across various

disciplines. In Facebook, the values range from 63 % (humanities) to 74 % (medicine), in the case of Twitter it ranges from zero (humanities) up to 27 % (agriculture). Just for comparison, while active use of Facebook in various disciplines is 72 % on average, in Twitter the average value of 74 % represents the share of respondents who are familiar with the medium but do not use it.

As contrasted to public social media, the academic media's primary goal was to share information, articles, publications within the research community – there is no obstacle, however, for the media to be used by people outside of academia. User interaction in academic social media does not consist only in sharing publications, it sustains discussion in a community and reinforces creating new contacts and even interdisciplinary cooperation.

Our results showed that only 11% of respondents do not use any academic social media. The largest fraction of our respondents (41 %) is those who use only the ResearchGate network. Combinations of various media (ResearchGate, Mendeley, and Academia.edu) are also quite common among researchers, although it is rare to have researchers using all three of the above-mentioned academic applications (figure 9). ResearchGate has a dominant position in all disciplines, with medicine, agriculture, natural sciences, and technical disciplines having a share of more than 80 % of respondents using this network. Academia.edu is the leading application in humanities with 62 %, while Mendeley has the highest share among users in natural sciences (34 %). Breaking down these figures according to the respondents' age it shows up that the ResearchGate's fraction steadily declines from the youngest group (up to 30 years of age) with 87 % to the oldest (more than 61 years of age) with 71 %. Anyway, ResearchGate remains the dominant medium in all age groups. Mendeley has the highest proportion in the group of 30 years old (42 %), whereas Academia.edu is the most popular in the age group 51-60 where it reaches the cut-in of 47 %. In general, our respondents perceived Mendeley more frequently as a reference manager and a repository of resources instead of seeing it as a social medium.
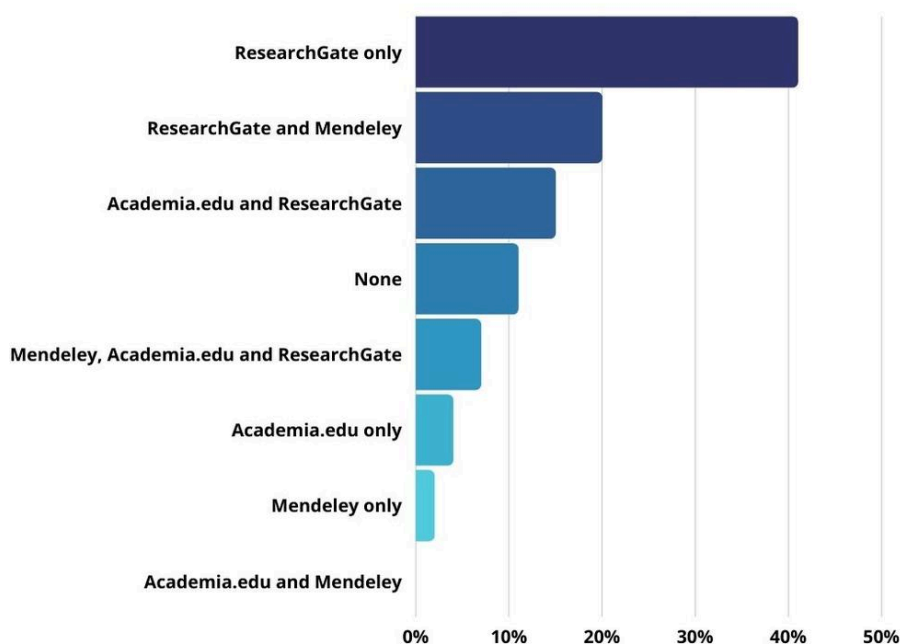


**Figure 9**. Using academic social media.

Following one of our suppositions, we also looked at the data from chart 6 visualizing the acceptance or refusal of alternative metrics for the assessment of science, and their intersection with researchers' presence on social media. For this purpose, we only selected those respondents who accept the idea that alternative indicators could supplement traditional ones in the processes of science assessment (34+69 subjects) and those who strictly oppose this idea (45 subjects). On the other side we grouped those who have no connection to any social medium (No SM), those who take part in no public but at least one academic medium, those who take part in no academic but at least one public medium, and finally those who are active in all the examined social media (Academia.edu, ResearchGate and Mendeley as academic media, Facebook and Twitter as public social media).

The results (figure 10) indicate that those researchers who are slightly familiar with how the media function (they participate either in an academic or in a public medium) refuse the idea of their application in the processes of science assessment more conclusively. It means that a higher proportion of these researchers refuses (33 % and 15 % in each of these groups) rather than accepts (21 % and 3 %, respectively) the idea. On the contrary, and maybe quite surprisingly, the researchers who have experience with none or all the social media show higher numbers of acceptance (approx. 4 % and 13 %) than those of refusal (approx. 2 % and 7 %).
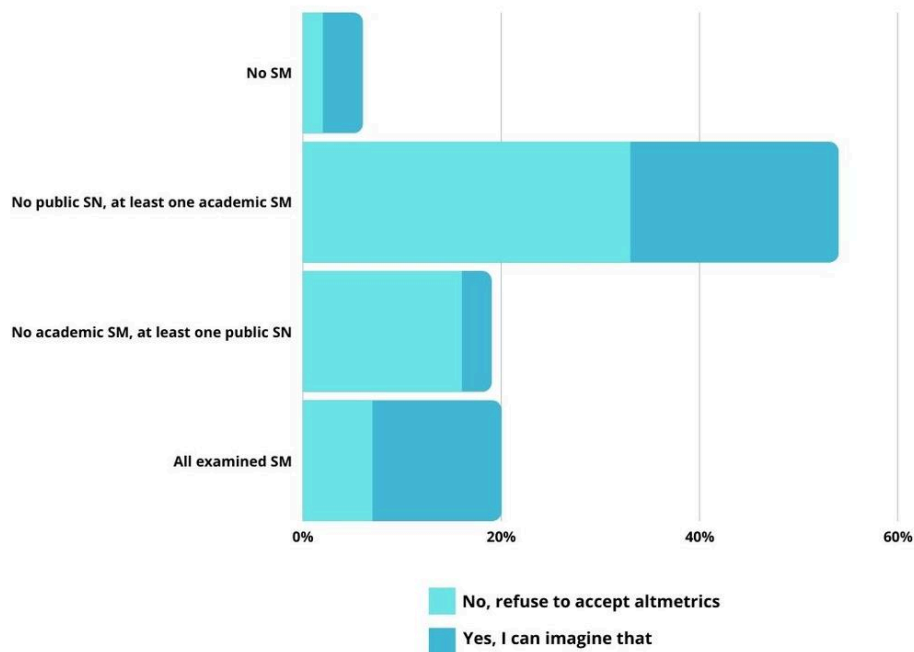


**Figure 10**. Acceptance of altmetrics in the light of social media usage.

## DISCUSSION

The attitude to the application of alternative indicators in research assessment is not significantly more negative among Slovak scientists if we compare it to other countries, like Slovenia (Južnič, Vilar & Bartol, 2014) or Finland (Holmberg & Vainio, 2018). Our findings show that citations are still a respected and time-proved indicator which, alongside its quality marking function, can be seen as a tool for creating bonds between researchers. If the citations are perceived as obsolete, it relates to the experience of researchers whose results

are predominantly aimed at non-academic target groups and it is not easy to document the influence the publication had. Similarly, when the researchers examine social phenomena and problems, it is interesting for them to record the impact outside academia. Nevertheless, due to pragmatic reasons connected with research financing and the role of citations in this matter, registering the citations is almost a ubiquitous priority for our respondents. Even though, as we have seen in our survey, researchers' interest in the number of citations does not always win over their quality expressed in such aspects as who cites and why.

Comparing the substance of alternative indicators in two principal categories of social media, Facebook mention is more likely an indicator of attractiveness, popularity, it indicates a kind of social attention. Mendeley reader, on the other hand, reflects an interest within the academic community which cares more about expertness, scientific substance, and quality of the text rather than the entertaining content of the topic or attractive design of the publication. In the case of Twitter, however, the stance of our respondents is less unambiguous, reflecting the tension between the fact that Twitter is widely perceived as a public social medium on one side and that it is quite frequently used by academicians abroad for sharing scientific content on the other. Taking this into account it is not easy to dissect which kind of attention Twitter indicates. As the results of other studies suggest, expressions of social media attention (e.g., on Twitter) are frequently interpreted as mere mechanical actions of forwarding the information (Robinson-Garcia et al, 2018).

Familiarity and practical experience in using social media were identified as one of the factors influencing the interpretation of alternative indicators in public and academic media. In connection with the search for scientific information, public social media are generally considered not trustworthy (more than 45 % of respondents). As they were not primarily created for the academic community the respondents do not see them as fully functional for searching. However, there is a fraction of our respondents (more than 33 %) who do not exclude this type of use of public social media if they get redirected there from a web search engine. On the contrary, academic social media are used for increasing the visibility of new articles, for monitoring the feedback, and for monitoring and search for new publications. The number of researchers who publish their articles (also) on academic social media is almost three times higher than the number of those who put them (also) on a public social medium (58 % vs. 21 %). Moreover, as Sugimoto puts it, it is not always easy to tell social and scientific attention/impact apart when we consider that social media often serve as a new channel for informal communication among researchers (Sugimoto et al, 2017).

Of course, one of the principal factors affecting the interpretation of alternative indicators is the nuances in viewing the substance of attention on the public and academic social medium. While the first one is mostly seen as accidental, unintentional, the second is largely conceptualized as intentional, focused. A question that remains open is the possibility of capturing the impact within these social tools. Although, if we accept the assumption that citation is an indicator of quality and impact then probably the best way to grasp the shift from attention to impact is to try to find a correlation between citations and alternative indicators. It does not seem correct to oversimplify and state that in public social media we deal solely with attention while in academic media it is the impact that is being expressed and monitored.

In this context, it is worth stressing that our study covered two dimensions of researchers' attitudes to altmetrics. One dimension reflects the overall interest and acceptance of new ways to follow and evaluate the impact a scientific output, theory, or discovery may have on society. In this respect, we can point out that the researchers' opinion, in general, is balanced, the level of positive sentiments is comparable to the negative ones.

The second dimension concerns the possibility to apply these new indicators in the research assessment alongside traditional, citation approaches. From this perspective, the explicit negative attitude is relatively weak – only 19 % of the respondents strictly refuse to accept alternative indicators in research assessment, while 45 % of those questioned declared their willingness to accept these indicators in this task. There is, however, a significant proportion of researchers who do not know the answer to this question (27 %).

If we make an intersection between these two dimensions, it turns out that out of those who consider traditional bibliometric indicators as obsolete and overcome, more than 57 % belong to the group of those who support the application of altmetrics – which is not surprising. More remarkable is the finding that almost 40 % of those who accept altmetrics consider traditional bibliometrics still relevant. And even more so, out of those respondents who refuse to accept altmetrics as a proper way of assessing the science, approx. 27 % do not consider traditional bibliometrics relevant anymore. All these figures may also support the assumption that researchers realize there are still a lot of problems and ambiguities connected with altmetrics and its use in research assessment.

## CONCLUSIONS

Research in the domain of altmetrics covers a wide range of topics and directions. Quite frequently it deals with efforts to measure the correlation between traditional and alternative indicators and with examining the contexts of altmetrics including a broad scope of issues from users' behavior, through their motivation in using altmetrics up to various aspects of interpreting the meaning of individual indicators. What is often being underlined in conclusions to these studies is the fact that the alternativeness of new indicators based on social media does not lie in their capacity or intention to replace traditional bibliometric measurements. Altmetrics indicators represent a different type of impact and they may be useful in complementing citation criteria via their capacity of quantifying interest and attention paid by a broader public.

Our findings based on the survey of opinions and attitudes among Slovak researchers suggest that there are some differences in altmetrics acceptance within various disciplines. In medicine, we can find the biggest proportion of researchers who are familiar with the concept of alternative indicators and who can envisage the use of these indicators in science evaluation. In the case of technical, agricultural sciences, and humanities, the biggest share of our subjects was uncertain and could not declare their preferences in this matter. In natural and social sciences, most of our respondents can imagine altmetrics as a supplementary factor of evaluation, however, they do not know much about it. The researchers who are slightly familiar with how the media operate oppose the idea of using altmetrics in the processes of science assessment more resolutely. It also seems that women are less biased against using new social media indicators as a supplement to traditional bibliometrics in research assessment.

It is evident that traditional bibliometric methods, especially in the area of research evaluation, are still preferred over the altmetrics. As the answers of the respondents in our survey revealed, the scientists realize quite clearly that the kind and the quality of attention that is being captured by the indicators calculated based on social media activities are not comparable with the citation-based impact within science. Probably one of the most important questions is what it means if a publication gets a mention, a reaction in the environment of social media and if it is possible to find an adequate correspondence with a traditional world of bibliographic citations.

Additionally, the researchers that know within the present system of research financing that is dominantly built on bibliometric criteria such as preferred publication categories (so-called indexed publications) or "registered" citations (recorded in Web of Science or Scopus databases) it is unreasonable to strive to excel in a novel type of efficiency indicator that is not considered in budgeting. In this context, however, it is relevant to mention that this conclusion is in line with recommendations of some of the most prominent theorists in the area of altmetrics (e.g., Thelwall, 2020) who suggest that using alternative indicators for formal evaluations is at least questionable.

### Conflict of interest statement

The authors declare that there is no conflict of interest.

### Contribution statement

Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Validation, Visualization, Writing – original draft: Michaela Melicherová.

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### Statement of data consent

The data generated during the development of this study has been included in the manuscript.

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