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Implementation of Open Science Principles in Educational Research: Seen through the Prism of Teachers' Engagement in Data Exchange

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The article continues the discussion of pilot study results concerning the specifics of university teachers' support for the idea of Open Science and is devoted to the main types of their engagement in data exchange. For this purpose, we described characteristics, subcharacteristics of engagement, and their indicators; classified the findings, conducted the step-by-step selection of engagement profiles with their further ranking according to the level of engagement, and grouped the types of engagement into common and distinctive ones. The determined types (intense, moderate, selective, and quasi) embrace all the identified relationships between various levels of engagement in empirical data exchange, namely: the shaped intention to share empirical data, the consistent application of its methods, and conscious assistance to it. The main types of engagement characterize teachers' intentions to disseminate empirical data and the possibility of such data reuse by other researchers. The findings can be valuable for the management of higher educational establishments, as it allows to evaluate teachers' readiness to disseminate the collected ED and to give permission for their reuse by other researchers. In general, the conducted research adds an important nuance to the implementation of institutional policies of research management with the purpose of promoting Open Science.

Keywords: open science, data exchange, educational research, university teachers, higher educational establishment, teacher engagement

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INTRODUCTION

Ukraine's integration into the European Research Area encourages teachers of higher educational establishments to actively support the ideas of Open Science (Budapest Open Access Initiative, 2001) through participation in the exchange of research data. Taking into consideration the opportunities it opens for scientists, the importance of such data as a public resource, a basis for political considerations, and an indicator of the achievements in the sphere of higher education (McKiernan et al., 2016), scientific and educational institutions create numerous global data repositories, allowing their scientists/researchers to deposit (self-archive) their findings and make them dynamic, i.e., change/update research data when needed **(**Yaroshenko, 2021).

They contain numerous scientific works, the number of which is constantly increasing every year. However, those dedicated to empirical data of educational research [1] (hereinafter - ED) are scarce, if not completely absent. Consequently, it is immensely difficult to find empirical data of educational research among them. It could have been explained by the fact that university teachers did not support the Budapest Open Access initiative, but it is not the case. Discussions in the academic community indicate that they (educators) are aware of this problem and accept the ideas of open science **(**Drach & Lytvynova, 2020; Ishchenko, 2020; Yaroshenko, 2021).

There are several reasons why ED of educational research are under-represented. First, authors are reluctant to lose their monopoly access to them (ED) or suffer a financial loss due to the inability to monetize them. However, it should be noted, that there has not been a single case in Ukraine when university teachers could monetize the ED from their research in the education sphere. Moreover, it is not a matter of common knowledge whether such cases exist in other countries.

Second, an equally obvious explanation is that reputable Ukrainian journals do not require the author to provide access to the ED mentioned in the materials submitted for publication. This is exemplified in the work undertaken by C. Savage, A. Viskers (2009)**,** where they describe an attempt to receive raw data from medical studies and clinical trials published by ten investigators in either ***PLoS Medicine or PLoS Clinical Trials.*** To their surprise, only one in ten corresponding authors provided what was requested, although the authors had explained that the data were needed to test a new hypothesis, not to challenge conclusions. Consequently, the researchers' original intention to compare the rates of data sharing in journals with and without data sharing policies proved futile (Savage & Vickers, 2009).

Third, the support for the initiative on reconsidering the evaluation of teachers' professional achievements and their academic careers seems insufficient. It could prove

1 Empirical data of educational research in the context of this article means the primary data of original psychological and pedagogical research connected with educational phenomena, which were obtained by the teachers of higher educational establishments as a result of their experiment, observation, testing, etc., but were not presented in the manuscript of the thesis, a published monograph, or a scientific article.

successful provided that it is supported by universities (Lévy, 2020). However, this initiative is hard to implement in Ukraine, since higher educational establishments are not free to change salary scales for academic staff, whose salaries are much lower than in other countries. For example, in 2017/2018, the annual salary of a professor in Ukraine was $5,700, while in the United Kingdom it was $116,700, and in Germany - $99,500 (https://zakon.rada.gov.ua/laws/show/286-2022-%D1%80#Text).

Sluggish ED sharing is also connected with the author's concerns about scrutiny their findings might undergo*: negative perceptions of increased data scrutiny are consequential in inhibiting data sharing*. (Barczak et al, 2022). Indeed, in order not to create additional reputational risks, it is easier to publish the results of the study without providing access to the ED for other scientists to reuse (Vasylenko, 2019). Therefore, teachers follow this path of least resistance, although they understand that, apart from reducing the quality of research and negatively affecting the reliability of their results, it prevents their efforts from being integrated into both domestic and international research datasets.

Thus, the legal, financial, managerial, and ethical initiatives mentioned above do not guarantee the participation of academic staff in it, and their support for ideas of open science, in general, does not translate into the actual dissemination of collected ED.

We believe that to ensure full integration of Ukraine into the European Research Area, it is necessary to enhance the study of reasons why teachers avoid sharing ED by investigating the peculiarities of their engagement in it. A detailed study of existing varieties of teachers' engagement in ED sharing should be considered a necessary link in the research.

The issues mentioned above have become the focus of the current research. The article continues the discussion of pilot study results concerning the specifics of university teachers' support for the idea of Open Science (Zhornova et al, 2021).

Literature Review

In this section, we outline the scientific progress in the study of the phenomenon of engagement, then focus on the specifics of university teachers' engagement, and finally analyze the results of scientific reflection on teachers' engagement in data sharing.

Since the initial work of William Kahn (Kahn, 1990), the engagement phenomenon has been studied for the last three decades in various fields of science, including social and organizational psychology, management, economics, etc. During this period, scientists have formulated more than a dozen definitions including a large number of concepts with similar connotations (Lipatov, 2015). However, all the scientists are unanimous in considering it a positive phenomenon, because they associate it with employees' dedication to the work performed and with the improvement of performance requirements upon their initiative (Robinson et al, 2004; Onuchin, 2013; Macey & Schneider, 2008).

Nowadays, scientific interests have shifted to the analysis of the differences in staff engagement in different industries. Although there are numerous studies concerning the engagement of those employed in the business sector, there remains a dearth of research

related to university staff. Diagnostic tools, which were reviewed by Tokareva, Baronene (Tokareva & Baronene, 2019), are very representative in this respect: the development of different techniques to measure teacher engagement by identifying its levels/stages; different manifestations, such as instrumental, expressive, emotional, interactive, cognitive, etc., are mostly based on a partial modification of widespread questionnaires created to solve specific business problems (e.g., questionnaires by Hewitt Associates, Gallup, Towers Watson, etc.). In an effort to preserve the specificity of the scientific and pedagogical activity, the questionnaires are supplemented with additional questions and/or explanations of the results obtained.

In reviewing the literature on the phenomenon of staff engagement, we noted the recurring issues that can be summarized as follows:

- engagement is interpreted as a specific state of mind; teachers' specific attitude to work; their reactions to the conditions of professional activity (Setyaningsih, & Sunaryo, 2021) ;

- stability of engagement is higher than that of similar constructs, in particular, loyalty (Masalova, 2016; Pranitasari, 2022);

- being actively engaged, teachers identify non-material benefits of their work and attach value to them (Pivovarov, 2013);

- antecedents of teacher engagement include the possibility to show and realize initiative and to discuss urgent issues in education (Vachkova & Chekalina, 2017).

Taking into account the paucity of research devoted to data exchange, it should be noted that scientists investigate this construct indirectly through the following:

- implementation of the principles of Open Science in scientific and educational spheres (Swain, 2020);
- modernization of the main priority areas of psychological and pedagogical research and updating the training content for academic staff (Sovetkanova et al., 2021);
- appropriate scientific support for the creation of national educational and information spaces (Santoso et al., 2019; Musa, 2019;
- use of electronic systems with open access to facilitate quality research (Spirin et al., 2017);
- raising teachers' awareness of the ways and prospects of informatization of education (Zhornova & Zhornova, 2014) and the use of innovative pedagogical and digital technologies, Web 2.0 services in the educational process, etc. (Revenko, 2021);
- research into innovative methods of education and information and communication technologies developed in Ukraine and abroad (in particular, online platforms for distance learning) to improve the quality of the educational process (Mann et al., 2020);
- the use of Open Educational Resources by teachers (Guo et al., 2015), etc.

A review of the current literature revealed that: engagement is a complex multi-dimensional (multilevel) construct having high value; staff engagement has a positive impact on the functioning of the organization, so faculty engagement can improve the performance of higher educational establishments. At the moment there are no known

theoretical studies on the phenomenon of teacher engagement in ED exchange and tested methods of its measuring. As such, it is necessary to carry out an empirical study to identify its main types, understanding engagement in ED exchange as the realization of the initiative shown by teachers within their responsibilities and duties; and its main types as the grouped characteristics of the efforts applied to exchange ED.

METHOD

As stated above, the determination of the main types of engagement in ED sharing is based on its characteristics investigated in our previous study (Zhornova et al., 2021). We have verified the hypothesis that teachers have shaped intentions to share ED, but their efforts to realize it do not usually lead to the integration of the collected data into the body of open empiricism**.**

We will briefly describe the procedure and some findings about the peculiarities of engagement.

The faculty members from Ukrainian higher educational establishments having experience in empirical research acted as informants in the interview on university teachers' engagement in ED exchange (September 2020). Five (5) respondents, including women (4) and a man (1) were chosen using the snowball sampling: the first study subject we addressed provided another referral.

During the interviews, all respondents demonstrated interest in ED exchange. A dataset of verbal statements was created based on their responses concerning the actions that prove the intention to share ED. It should be noted that the majority of statements turned out to be a posteriori: the respondents not only confirmed or denied their engagement in ED sharing but also gave explanations based on their own experience. As the respondents focused on the prospects and not the results of ED exchange, their engagement in the process was considered as a shaped intention to make an effort directed at making ED available for free dissemination and reuse by other researchers.

According to the results of the analysis of verbal statements, the engagement in the ED exchange is manifested through the following meaningful constructs: a) demonstration of interest; b) practice, or at least individual attempts to give access to data collected or/and reuse the data collected by other researchers; c) understanding the process of data dissemination. Their specification and unification resulted in the identification of characteristics and subcharacteristics of the engagement in ED exchange. They were used to develop the questionnaire *Empirical data sharing*.

Determining the main types of teacher engagement in ED exchange was a logical continuation of the research activities described above. To achieve the purpose of the article, at this stage of research we analyzed a dataset with 13 variables, which is based on the responses to 5 out of 20 questions of the questionnaire (Zhornova & Zhornova, 2021).

Sample. Forty-four (44) respondents completed the questionnaire (November 2020). Most of them were women (31). Regarding the age: under 35 years old (three respondents), from 36 to 55 (21), and over 55 (20). Work experience: respondents,

working in higher education for up to five years (2), 6 to 20 years (14), and more than 20 years (28). Three participants do not have a scientific degree, 23 are candidates of science, and 18 have doctoral degrees. The academic titles of the respondents: professors (13), and associate professors (docents), senior researchers, or senior research fellows (23). Two respondents are senior faculty members, five are faculty members; there is an almost equal number of professors and associate professors (18 and 19, respectively). See figure below.

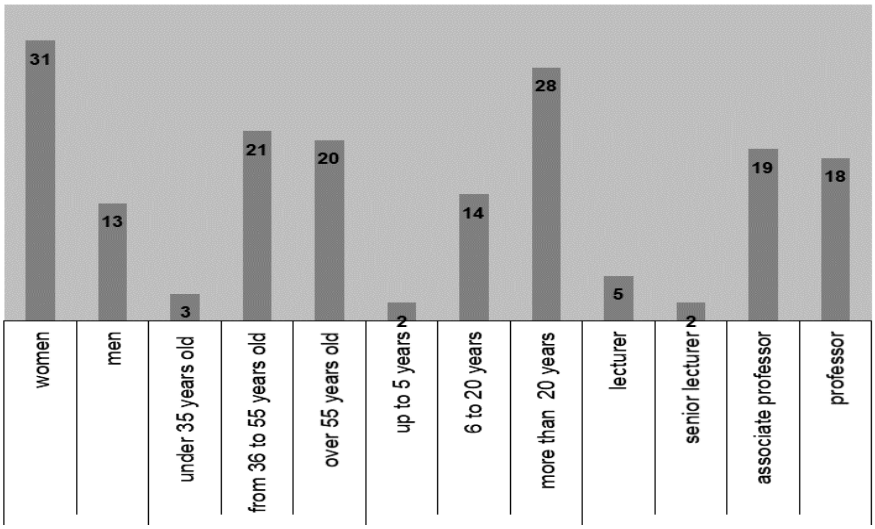

Figure 1
Respondents' characteristics

Data analysis was conducted in several stages:

1. Classification of findings into two groups according to the revealed (or not revealed) characteristics of engagement. Taking into account such multiple-choice measurement, the responses are renamed according to the ordinal scale, where 1 – characteristic is revealed, or 0 – characteristic is not revealed.

2. Step-by-step selection of findings. Since findings at each level correspond with only one respondent, we will further refer to them as engagement profiles. So, the step-by-step selection is based on the gradual grouping of 44 profiles taking into account the revealed characteristics of engagement, where the total manifestation of characteristics means engagement with each subcharacteristic, partial – engagement with several subcharacteristics, and zero manifestation – the absence of engagement with all subcharacteristics. Each next step specifies the results of the previous one.

3. Ranking profiles according to the level of engagement and determining their main types. The level of engagement is a generalized value; it is understood as the intensity of engagement in ED exchange. It is measured with the help of the ordinal scale, which shows a gradual increase in the level of engagement from one type to another, but not the distance between them.

Figure 2 demonstrates a generalized procedure for determining the main types of engagement in ED exchange.

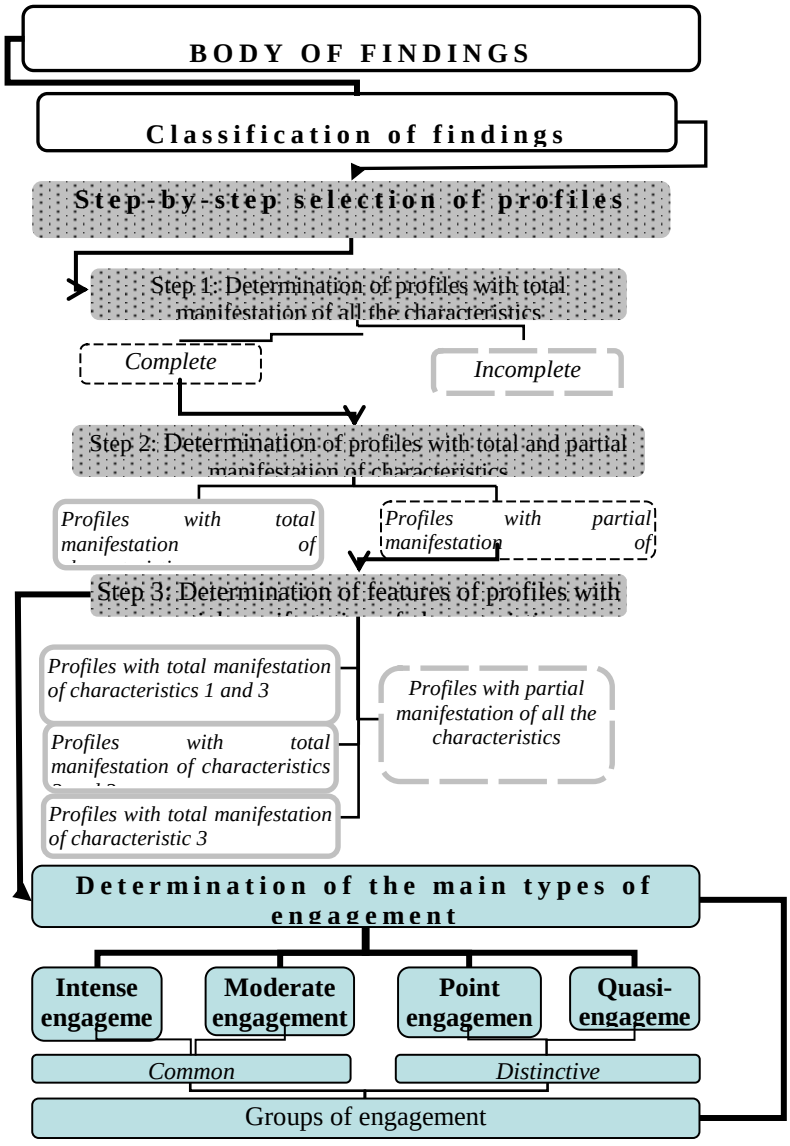

Figure 2
Generalized procedure of determining the main types of engagement in ED exchange

FINDINGS

The classification of findings into two groups is based on the indicators shown in Table 1.

Table 1
Engagement in data exchange: characteristics, subcharacteristics, and their indicators

№	Independent variables	Subcharacteristics	Indicator of the engagement in exchange
Characteristic 1: Shaped intention to share ED			
1.	Relevance of ED exchange	1.1. Considering ED exchange timely and important	Responses *important*, *very important*
2.	Availability of ED	1.2. Readiness to reuse ED from other teachers	All responses except *do not know*
3.	Criteria for selecting ED to share	1.3. Planned collection of ED to share	
Characteristic 2: Consistent application of ED exchange methods			
4.	Importance of uploading ED as an attachment to a publication	2.1. Testing the method of uploading ED as an attachment to a publication	Responses *important*, *very important*
5.	Importance of depositing ED in a data repository	2.2. Testing the method of depositing ED in a data repository	
6.	Importance of posting ED to corporate sites	2.3. Testing the method of posting ED to corporate sites	
7.	Importance of publishing ED in special data journals	2.4. Testing the method of publishing ED in special data journals	
8.	Importance of sharing ED informally	2.5. Testing the method of sharing ED informally	
Characteristic 3: Conscious assistance to data sharing			
9.	Significance of being able to use open license	3.1. Absence of devaluation of the ability to use open license	All responses except *unimportant*
10.	Significance of being able to structure ED	3.2. Absence of devaluation of the ability to structure ED	
11.	Significance of being able to use non-proprietary formats	3.3. Absence of devaluation of the ability to use non-proprietary formats	
12.	Significance of being able to use URLs and other codes	3.4. Absence of devaluation of the ability to use URLs and other codes	
13.	Significance of being able to link data	3.5. Absence of devaluation of the ability to link data	

Frequency analysis showed that a characteristic is manifested in the majority of observations (572): 86.36 % versus 13.64%, which makes it 6.5 times larger. A characteristic is revealed in all the observations (100%) with variables 1, 9, 10, 12, and

13. They are followed by variables 11 (97.73%) and 3 (93.18%). The least represented characteristic is observed with variable 8 *Importance of sharing ED informally*, with less than half of observations (fig. 1).

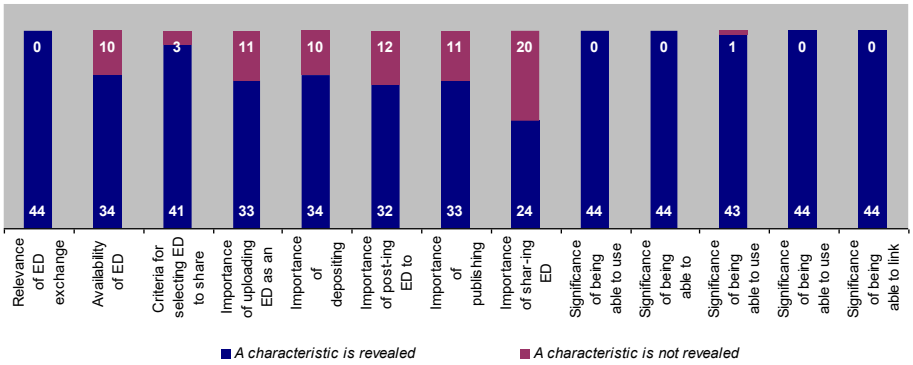

Figure 3
Classification of observations

We will further describe the task of each step and its outcome.

Step 1: Determining profiles with a complete or incomplete set of characteristics.

A complete set of characteristics is understood as a total or partial manifestation of each characteristic, whereas an incomplete set means zero manifestation of at least one characteristic. The result: 43 profiles with complete and 1 with incomplete sets.

Step 2: Determining profiles with the total or partial manifestation of all the characteristics. The result: 11 profiles with total and 32 with partial manifestation.

Step 3: Determining features of profiles with the partial manifestation of characteristics and their grouping based on similarity. The types of combinations of total and partial manifestations and the numbers of profiles are shown in table 2.

Table 2
Features of partial manifestation of engagement

Variant	Types of combination	Number of profiles
A	Total manifestation of characteristics 1 and 3, partial - 2	20
B	Total manifestation of characteristics 2 i 3, partial -1	5
C	Total manifestation of characteristics 3, partial - 1 and 2	6

There is also one profile that does not manifest any of the characteristics.

Figure 4 visualizes percentages of profiles according to the results of their step-by-step selection.

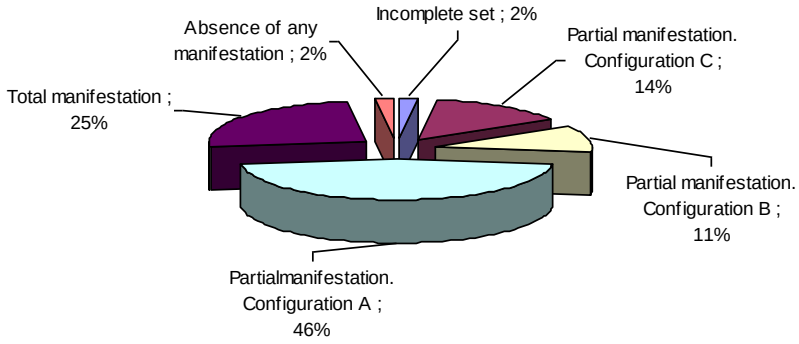

Figure 4
Results of the step-by-step selection of profiles

The proportions of complete and incomplete characteristics in a profile with the peculiarities of their manifestation determine the level of engagement, which becomes the basis for identifying the main types of engagement in ED exchange. For this purpose, each profile receives one rank (out of four) of the engagement level:

- the highest level corresponds to the total manifestation of all the characteristics;
- high – the total manifestation of 2 characteristics;
- medium – the total manifestation of conscious assistance to data sharing;
- low – zero manifestation of any characteristic, or partial manifestation of all characteristics.

Ranks create the ordinal scale of engagement level. As a result, we get values ranging from 1 to 4 on the ordinal scale. They serve as indicators of a corresponding type of engagement: intense, moderate, point, and quasi-engagement. Assigning a profile to this or that type reflects the gradation of efforts applied by respondents to share ED.

It was found that moderate engagement is the most frequent, including more than half of profiles (56.82%); intense engagement is represented by a quarter of profiles, whereas point and quasi-engagement together make up less than the fifth of all the profiles (13.64 and 4.55% respectively).

The determined types of engagement can be further grouped into common and distinctive ones considering their representation in the body of profiles. The group of

common engagement includes the types that occur in every fifth profile, the others are considered distinctive.

Profiles divided into common and distinctive: 81.82% and 18.18% (fig. 3).

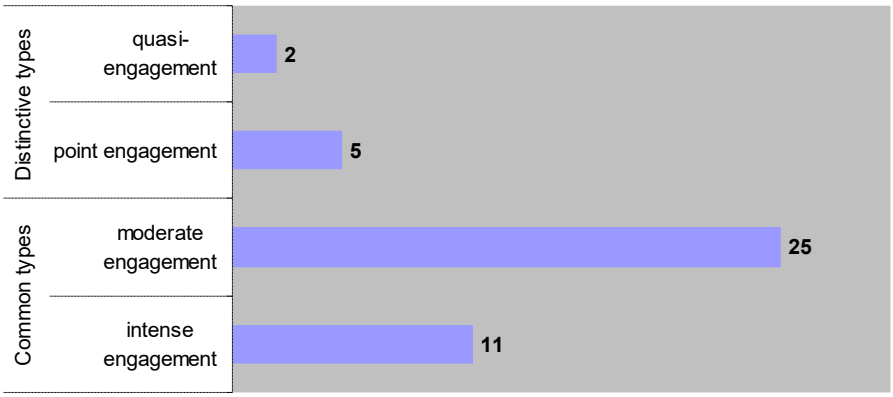

Figure 5
Main types of engagement in ED exchange

CONCLUSION

The determined types of engagement (intense, moderate, point, and quasi-engagement) describe all the identified correlations between complete and incomplete characteristics, namely: the shaped intention to share empirical data, the consistent application of its methods, and conscious assistance to it. They also reflect the current state of implementation of Open Science ideas in educational research.

In our opinion, this state appears moderately optimistic. Such a conclusion was made based on the fact that above 80% of respondents demonstrated either intense or moderate engagement. They are not only interested in ED sharing, but also familiar with the data dissemination process and have already tried to share their ED.

This finding is consistent with other researchers' conclusions about a high level of teacher engagement (Masalova, 2016) and supports the hypothesis that the organizational culture of educational establishments is generally favorable for data exchange (Tokareva & Baronene, 2019).

Why is optimism only moderate? We suppose that all university staff have some ED potentially suitable for analysis, but every fifth university teacher considers approbation of ED sharing methods unimportant and /or devalues corresponding skills. The most plausible explanation for it, in our opinion, is insufficient quality of empirical research.

In different formulations and contexts, both Ukrainian and foreign scientists (Bridges, 2019; Fim'yar et al, 2019) express concerns about the current practice of conducting research. In particular, the analysis of about 3,000 scientific articles (Glewwe et al,

2011), which described the results of educational research, has shown that the researchers focus on the factors influencing the quality of education which include only the availability of desks in the classroom, the teacher's presence, and their knowledge of the subject. Glewwe et al. (2011) argue that such findings are not novel and cannot provide any useful data for educational policies.

Thus, the conclusion made by Gloria Barczak and her colleagues that most respondents would therefore like to see journal policies that foster data sharing (Barczak et al, 2022) seems feasible only in the context of 'Expected communal benefits' as stated by the authors, which presupposes participation in international projects, grant support, international collaboration, etc.

In general, the conducted research adds an important nuance to the implementation of institutional policies of research management with the purpose of promoting Open Science (Drach & Lytvynova, 2020). It should be noted, that focusing on ED exchange, we should bear in mind that teachers' contribution to the ED quality improvement will not be as easily and accurately measurable as, for example, the results of their published research. It is desirable for teachers' efforts to exchange ED to be supported by the appropriate educational policy on the control of research quality at the level of the department, higher educational establishment, state, the academic community, etc. We did not aim to develop special recommendations because we consider it reasonable to start by implementing a complex of measures at the institutional and individual levels for strong support of Open Science (Swain, 2020), as proposed by the scientists of the National Academy of Educational Sciences of Ukraine.

We would like to focus on two points, which will encourage the teacher's initiative to share ED. First, the management of any higher educational establishment is able, within the limits of their responsibilities, to significantly influence knowledge exchange, at least by making teachers' efforts more visible, in particular, through the support of their efforts by the staff of scientific libraries, organization of appropriate training, assistance with participation in conferences, development of institutional partnerships, and so on. Secondly, we would like to emphasize the importance of the national platform, because, the knowledge provided by findings in social and human sciences is important on the national level (Swain, 2020). The National Platform for Digital Education (Ishchenko, 2020), the repository of the Sukhomlinskii National Library of Ukraine (https://dnpb.gov. ua/ua/), as well as the website of one of the most famous national peer-reviewed electronic journals in the field of education "Information Technologies and Educational Tools" (https://journal.iitta.gov.ua/index.php/itlt) can be used as such.

The dynamics of teacher engagement as a harmonious combination of their efforts in all respects is complicated by the fact that it is impossible to determine the point when judgments about ED exchange appear since they are a product of mental processes and become available for analysis only after they are announced; up to that point, they are unobservable. The respondents will probably make different judgments next time, as a result of the reflection on the efforts applied following their participation in the survey. Moreover, the data of the study were collected from a small number of respondents from different higher educational establishments. Therefore, the content of the construct of

engagement in ED exchange needs further verification. The determined types of engagement can be confirmed if to conduct the research using a larger sampling, which will lead to more statistically significant conclusions.

However, the developed method of determining the types of engagement can be useful for researchers studying the problem of knowledge sharing, and the results of its application can be interesting for the management of higher educational establishments because it helps to understand the current status of efforts the teachers make to exchange ED and the ways of its optimization.

Further research should be focused primarily on: verification of whether the specified types of teacher engagement in ED exchange can be extrapolated to other kinds and types of data; conducting experimental research aimed at establishing the factors of teacher engagement in ED exchange. Since our attention was focused on individual teacher engagement due to the fact that it is quite a significant predictor of participation in data exchange, group engagement seems to be an important issue for future investigation, based on the obtained results.

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