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WRITING A SCIENTIFIC ARTICLE: DESCRIBING RESULTS

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The presentation of research results is definitely an important part of any scientific article. On the one hand, the findings of the conducted research should be explained in as much detail as possible, whereas on the other, the obtained results must be clear, understandable and relevant. The previous editorials analysed the elements of a scientific article such as the title and summary (Lamanauskas, 2019a), introduction (Lamanauskas, 2019b) and the description of methodology (Lamanauskas, 2020). This editorial briefly discusses the optimal presentation of research results treated as one of the most interesting stages in preparing a scientific article and requires effort, intensive work and creativity. Alternatively, both methodology and research results (empirical research in particular) are considered the most important parts of a manuscript (Fox & Jennings, 2014). As expected, many important points related to the description of research results are given in APA 7th. ed. (2019), and therefore are not intended to be discussed in detail. Although APA standards are widespread, other criteria are also admitted by scientific community and focus in this editorial is more oriented on the practical subjects of academic writing and the most common mistakes.

The Description of the Results of Quantitative and/or Qualitative Research

The presentation of research results to certain extent is subject to the type of research, for instance, a qualitative or quantitative study or a combination of both (mixed research design) (Tashakkori & Teddlie, 2003). Presenting the figures obtained by quantitative analysis inevitably results in numerical information. To achieve the highest possible level of data interpretation, statistical capabilities are demonstrated. First, the measures of descriptive statistics such as counting frequencies are applied thus providing data displacement (position) characteristics (arithmetic mean, median, mode, standard deviation, quartiles, etc.). For testing statistical hypotheses, various statistical criteria are frequently used. In this case, assessing the nature of data (qualitative or quantitative) to be analysed, measurement scales, the characteristics (size, compilation/selection principles) of the sample, etc. play a crucial role. The correct choice of non-parametric and parametric criteria is quite important for receiving the most accurate results. The practice of academic writing frequently applies to a rather common situation when the researcher indicates a specific statistical criterion applied in the text and the obtained statistically significant/insignificant differences between the analysed variables. The level of statistical significance (e.g. $p < .05$) is presented, but the empirical value and degrees of freedom of the applied criterion are not indicated. Thus, it is difficult to assess the correctness/erroneous nature of the statement. Where appropriate, the procedures (e.g. factor analysis, cluster analysis, correlation analysis, regression analysis, etc.) of secondary statistical (probabilistic) analysis are followed. The consistency of the presented results is of utmost importance. Therefore, dividing the chapter *Research Results* of the article into relevant subsections like the results of descriptive analysis, the results of factor analysis, etc. is recommended. On the condition that mixed-research design has been applied in the study (Schoonenboom & Johnson, 2017), there is a great opportunity to integrate both qualitative and quantitative data and the findings obtained from them. Researchers agree that such integration has great potential to strengthen rigor and enrich analysis and results (Wisdom & Creswell, 2013).

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The main text is aimed at providing only the most important and final results. Intermediate results may be provided in appendices or references to other media like repositories, databases, etc.

There are cases when authors present the incorrect results of statistical analysis. An interesting example is given in Figure 1.

Figure 1
An example of the incorrectly presented results

Table 3. Results on the scale of mathematical literacy self-efficacy, mathematical thinking and technological pedagogical content knowledge.

Scale	Test	Statistics	SD	p
Mathematical Literacy Self-Efficacy Scale	Pre-test	.948	28	.197
	Post-test	.984	28	.937
Mathematical Thinking Scale	Pre-test	.979	28	.817
	Post-test	.964	28	.405
Technological Pedagogical Content Knowledge Scale	Pre-test	.973	28	.640
	Post-test	.954	28	.613

Note: The language is not corrected

Figure 1 shows some serious errors, although at first glance, everything seems to be presented correctly. First, it remains unclear what the *Statistics* column in the table means, because neither the title nor the table itself provides a specified statistical criterion. The second error is hidden and hard to spot. The values of a standard deviation are obviously incorrect, which is due to linguistic aspects. Table 1 below provides excerpts from reviewer-author communication.

Table 1
An excerpt of reviewer-author communication

Reviewer's question	Author's answer	Additional reviewer's question	Second author's answer
Dear author, Kindly check again the table 3 in your paper. Is SD really 28?	Dear Editor, The sample of the our study includes 29 people. In the table of 3- Shapiro Wilks Test, value of the SD is taken into account as 28 due to minus one of the sample value. Namely, the value of the SD is 28. Best regards	Dear author, It is somehow incorrect... Are you speaking about df (degree of freedom)? In such a case it can be. But, if you have statistics 0.948 and SD nohow 28.	Dear Editor, Yes, we are speaking about the DF. DF is 28 in our study. SD is abbreviation of df in Turkish. Sorry for this. We are looking forward to see your reply soon. Best Regards

Note: The communication language is not corrected

The problem discussed concerns the national language. The degrees of freedom (*df*) are 'Serbestlik Derecesi' in the Turkish language. Thus, the author simply wrote *SD* instead of *df*. Although such errors are rare, they occur when describing research results, and therefore authors must be extremely careful. Another example is given in Figure 2.

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Figure 2
An example of the results incorrectly presented in the table

Table 4. Result of the χ^2 test of the treatment of cultural heritage content at the observed Social Studies lessons by the grade of teaching

Grade Yes		Treatment of cultural heritage content		Together	Result of χ^2 test
		No			
4	f	12	23	35	$\chi^2 = 2{,}071$ g = 1 P = 0,150
	f%	34,3%	65,7%	100,0%	
5	f	17	16	33	
	f%	51,5%	48,5%	100,0%	
Total	f	29	39	68	
	f%	42,6%	57,4%	100,0%	

Figure 2 shows that the table contains many different inaccuracies. First, it is clear that the table has been 'transferred' from a statistical program and barely edited. The tables imported from statistical data processing applications should be properly managed and edited. Symbols % appear to be redundant. Indicating the values of both frequencies together (e.g. 12 (34.3)) in a single line should be more correct, and the units of measurement can be indicated next to the title. One column of the table uses the term 'Total', whereas the other 'Together'. The decimal places should be marked with dots (".") not with commas (","). The column of the results of the chi-square criterion contains four errors: a) full stops are used instead of commas; b) *g* is an ambiguous statistical symbol (degrees of freedom are likely to be given in this case, and thus *df* should be denoted); (c) the level of statistical significance is indicated in a lower case by Latin letter *p*; (d) 'zero' is not used before the decimal fraction when the statistic cannot be greater than 1 (APA 6th ed., 4.35 on page 113). In addition, it is worth noting that the title of the table is cluttered and unclear. The word *'Result(s)'* should not appear in the title of the table, because it is clear enough that research results are described.

The example provided in Figure 3 is also characteristic. The authors frequently move the elements of the research instrument instead of the results (see the title of the 2nd column 'Questionnaire questions').

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Figure 3
An example of the results incorrectly presented in the table

Table 1. Assessment of transformed ideas on the taken profession among students during their study in the higher school.

№	Questionnaire questions	Likert scale estimates				
		1	2	3	4	5
1	Estimate, from the standpoint of today, your choice of the profession on which you study. (← absolutely wrong choice; absolutely right choice →)	3%	5%	24%	35%	32%
2	Evaluate your views today about what will be the work on the chosen profession after graduation. (← I have absolutely no idea; very good present →)	3%	6%	28%	34%	29%
3	Does the production practice expand of the idea of future work after graduation? (← does not expand the idea of future work Expands the vision of future work →)	4%	5%	16%	30%	44%
4	Assess the degree of your confidence in employment after graduation (← weak; strong →)	5%	9%	26%	31%	29%

Note: The language is not corrected

Figure 3 shows that an attempt is made to replicate the questions of the research instrument (in this case, questionnaire) instead of variables. However, only one question (No 3) is observed. This error is repeated quite often when the elements of the research instrument (questionnaire, test, etc.) are transferred directly to the descriptive part of the obtained results (in this case, 'Questionnaire questions' could be replaced with 'Statements' or 'Transformed ideas' considering the title of the table). The research instrument (questionnaire) provides the respondents with questions and/or tasks (estimate, evaluate, assess). Still, it is completely unclear what context applies to these varying concepts, because their semantic meaning is different (for instance, 'assessment' is the process of gathering evidence in order to make decisions and is different from words 'Estimation' and 'Evaluation'). The presentation of the percentage of findings is questionable (calculating the means of variables and *SD* should be more accurate). The format of the Likert scale containing interval data is also ambiguous.

A more evident example is given in Figure 4 that includes the errors of different nature.

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Figure 4
An example of the incorrectly presented diagram

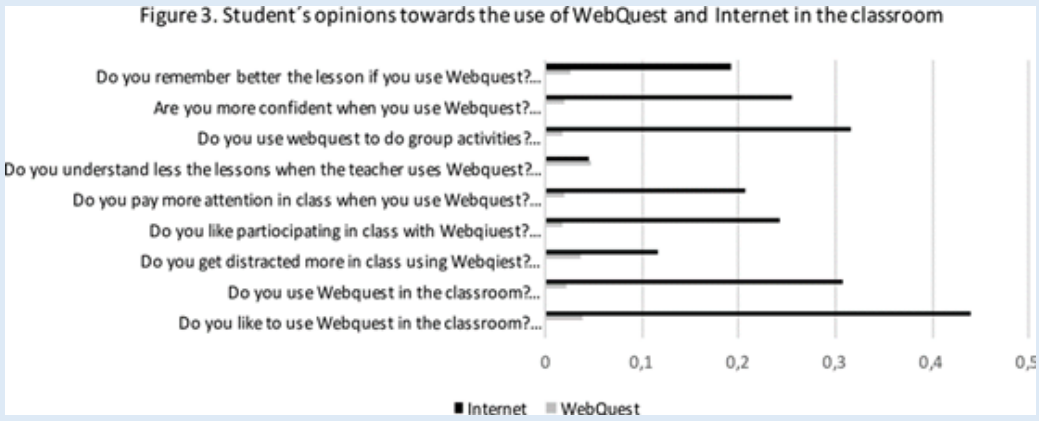

Figure 3. Opinion of the students towards the use of Internet and WebQuest in the classroom.

Note: The language is not corrected

The title is duplicated, i.e. presented twice. Another serious problem emerges when questions (likely to be transferred from the research instrument) instead of variables (respondent opinions on the use of WebQuest and the Internet) are provided. The units of measurement are not given, empirical values are not indicated. Visually, such chart is actually impossible to understand due to extremely low informativeness.

More inaccuracies are provided in the example in Figure 5.

Figure 5
An example of incorrectly presented results

Table 3. Correlation between cooperation and leadership at special needs schools

	Special needs school has its own principal			
	Yes N (%)	No N (%)	Don't know N (%)	Total N (%)
How do you rate the cooperation between primary special school and upper secondary special school?				
Low	51 (78.5)	6 (37.5)	1	58 (68.2)
High	13 (20.0)	10 (62.5)	0	23 (27.1)
Don't know	1	0	3	4 (4.7)
Total	65	16	4	85 (100)

Note: The language is not corrected

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The example in Figure 5 shows a number of inaccuracies. First, asking a question is a wrong option. The wording of the variable should be clear, for example, 'cooperation rating ....', 'rating levels', etc. Measurement scales are incorrect. The ranking scale seems to have been applied; however it is improper (responses 'yes', 'no', 'don`t know', etc. are incorrect because they do not maintain hierarchical ordering). The correct order should be 'yes', 'don`t know', 'no'. The second scale is also inappropriate and should follow the order 'low', 'medium, 'high'. The presentation of the results is unclear and misleading. The title provides it is a correlation between two variables (bivariate correlation), but the values of the correlation coefficient are hardly seen.

Numerical abuses also occur in the presentation of quantitative results. For example, the so-called manipulations of the results of statistical research report only good findings thus ignoring or failing to disclose the bad ones. Researchers often 'succumb' to the temptation to present the established correlation between traits/variables as evidence of a causal relation. Research practice demonstrates both a tendency to select a random sample and a tendency to select calculations. Based on the experience of academic writing, mentioning some more very common inaccuracies quite abundant in the procedures of descriptive statistical analysis is useful. For example, the applied statistical calculations, including all relevant parameters like mean (*M*) and standard deviation (*SD*), must be specified. The latter are employed for normally distributed data. Median and percentiles should be appropriate for displaying asymmetric data. On the condition that increased accuracy is not required, two figures usually follow the decimal point (5.05 rather than 5.054472 are accepted). If samples are extremely small (less than 10), relative values (expressed in percentages) are hardly applied, frequently used for indicating findings and represent the proportions of sample units falling into different categories. Relative frequencies are suitable for comparing different groups and/or distributions when sample sizes vary. In some cases, the average percentage is simply derived from the two available percentages, but this is a wrong option. For example, 35% of 250 surveyed senior and 55% of 350 surveyed junior teachers expressed a positive attitude towards teacher performance appraisal. Thus, putting together or dividing by two these two percent values is barely accepted considering that 45% of the surveyed respondents expressed a positive attitude towards the issue under investigation. Therefore, the weighted average should be applied and the overall relative value should be equal to 46%. As for the given example, the difference between the values of the result is not large (one percent), but the cases when the difference is significant are also possible.

Qualitative research is fundamentally different compared to the quantitative one due to the varying options of qualitative research, data analysis and methods used for describing and presenting the obtained results. No unified or unified methodological construction is observed (Luobikienė, 2008), but in some cases, certain statistical analysis (for instance, a study done by Delphi technique) or coded information only are given. Reflections provided by the researcher are treated as a rather exclusive part of qualitative research data analysis (Piščalkienė et al., 2016), because the researcher must frequently see his/her own code and the category system (Paton, 2002) to present it properly, e.g. in the tabular form (elements/statements/codes – subcategories – categories). If a similar type of analysis is performed using quantitative content analysis, the absolute and relative frequencies of all elements are calculated and the categories are ranked in line to their significance (Figure 6).

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Figure 6
An example of categorization

TABLE 1

Information about health management	34 (26.5)	Information search	24 (18.8)	Ability to search for information about health	12 (9.4)
				Ability to find information about health	12 (9.4)
		Information understanding	10 (7.7)	Ability to understand information about health	8 (6.2)
				Ability to accept the conveyed information	2 (1.5)

Source: Lamanauskas, & Augienė, 2019.

For introducing, for example, the interview-based results, information in the main text as excerpts usually in a font smaller than that in the main text (11pt) is presented. Each excerpt includes additional data: the informant or other required additional information is indicated (Figure 7).

Figure 7
An example of presenting the results of the held interview in the text

Conceptual Domain. The following extracts illustrate that at least some participants were aware that IBST engages learners in constructing new conceptual knowledge and demonstrated an understanding that this process demands that learners should draw from what they already know, express and test their ideas, and also receive conceptually oriented feedback.

> The teacher should discuss the findings with the learners. This will help the learners because as they make conclusions, they may construct conceptions that may not be accurate. (Pre-service teacher 7, interview) [Providing conceptually oriented feedback]

> The teacher should elicit learners' ideas and prior knowledge because this helps the teacher now to know the level of understanding of the learners and their beliefs so now he or she will be in a good position to guide the learners according to their level of understanding and their beliefs. (Pre-service teacher 8, interview) [Eliciting learners' ideas; drawing from learners' prior knowledge]

> Then there must be some hypothesis made by the learners; and a plan to investigate those hypotheses if there are true or not. (Pre-service teacher 8, interview) [Testing their ideas]

Source: Nhlengethwa, Govender, & Sibanda, 2020.

An interview is a widespread type of qualitative research that assists in obtaining non-digital data to be analysed and properly described. On the one hand, qualitative research provides original, up-to-date and useful information, whereas on the other, there is always considerable doubt about the reliability of qualitative results often treated with extreme caution and distrust. Therefore, regardless of the type of interview, the results obtained during the interview must be presented as clearly and in detail as possible. For example, common cases provide that an interview is mentioned as a research instrument, but the specified results gained from the interview data remain omitted (described improperly or the description is very superficial). Thus, evidence related to the interview, for example, excerpts, transcripts etc. must be introduced. It is completely incorrect only to mention that a certain group of researchers (e.g. teachers, students,

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lecturers, staff, etc.) have been interviewed. All results based on the interview data should be carefully presented. Supposing it is a combined study, the results of research are described in two sub-sections of a scientific article, for example, the results based on the questionnaire (quantitative survey) and the results based on the interview (qualitative survey).

The application of the Delphi method is related to another frequently problematic description of the results. The Delphi technique involves the participation of a certain group of experts and is often highly useful for educational settings (Green, 2014). The results of such research must include a detailed description of how experts worked from the beginning to the last stage. It should be several stages (rounds) organized in order to work with experts allowed to adjust their answers in subsequent rounds. In other words, the Delphi method mainly focuses on reaching the 'correct' response through the consensus of experts. Under certain circumstances (e.g. due to over-volume), the aggregated results of all stages of the Delphi survey may be provided, however in this case, it must be clearly indicated.

The description of the results of qualitative research is accepted to be much more complex compared to the presentation of the findings of quantitative research, for example, data collection, analysis, interpretation and report writing are interrelated and simultaneously possible stages (Aleknevičienė et al., 2020).

The Visualization of Research Results

The results are usually displayed in tables. The collection of information (results/data) separated by vertical and horizontal lines are referred to as tables that typically fall into two categories – simple and complex. As the amount of information increases, the table becomes more complex (information differentiation increases). Simple tables show one trait contrasted with another, for instance, gifted – unable; tall people – low people; advanced learners – non-advanced learners, etc. Simple tables are recommended for measurements using nominal and rank scales. The suggested text size of the table is 11pt. The title of the table is an important aspect. Each table must have a clear, specific and unambiguous title. For example, APA Manual 6th ed. recommends to 'give every table a brief but clear and explanatory title' (unit 5.12, p.133). Table titles should avoid irrelevant and/or repetitive words (Table 2).

Other points like centring, italics, bold, etc. are subject to the requirements set by the publisher. In addition to the title of the table, the units of measurement such as absolute and/or relative values (*N* (%)) are indicated. From a technical point of view, it is very appropriate for the table to fit on a single page.

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Table 2
The examples of the inappropriate titles of tables

Example	Comment
Average scores on BOKCS pretest and posttest. Standard deviations are given in parentheses. The maximum of the BOKCS scale was 13.	The title is unclear, completely unnecessary explanations are provided. An attempt to explain the measurement scale is made.
Results of the first survey in the control and experimental groups (in points, the possible interval: from 5 to 25)	The title is vague and ambiguous. The word 'results' is incorrect in the title because everything contained in the tables is findings.
Students' perceptions toward the statements that organic chemistry is boring, more difficult to learn then general and inorganic chemistry, that its' academic content is too voluminous and difficult to understand and that organic chemistry represents an important part of their future university education.	The title is obviously too long, complex and unclear. An attempt to include all possible variables is made.
Comparison of different ICT activities at home for 288 teachers and 211 students, ordered by difference between means	The title is not specified. It is inappropriate to include sample data.
Multiple comparisons of differences between countries on the Adaptor Innovator Scale (Bonferoni post hoc test). Statistical significant differences at the $p< 0.05$ level are bolded.	The title also provides an additional explanation of the level of statistical significance and technical parameters for the font, which could be done at the bottom of the table as a note.
Hypothesised research model based on opinions about the content and teaching of Biology as predictors of students' career aspirations. Legends: (F-B = fascinating – boring; I-M = interesting – mundane; I-U = important – unimportant; A-U = attractive – unattractive; E-U = exciting – unexciting. BIOG: Opinions about Biology content; BIOES: Opinions about Biology content in elementary school; BIOSS: Opinions about Biology content taught in secondary school; BIOTES: Opinions about the teaching of elementary school Biology; BIOTSS: Opinions about the teaching of secondary school Biology.	The first sentence could fit perfectly as the title of the table. The title below explains legends, which makes the title of the table difficult to understand.

Note: The language of the examples provided is not corrected

Depicting the essential results graphically is of considerable importance. For this purpose, various types of the diagram like histograms (values of continuous variables), bar, linear, circular, scatter, etc. diagrams can be used. Each format must be matched to the corresponding results (result values). Thus, the so-called figures are employed. Basically, any graphic information, except for statistical or other types of tables, can be represented by a figure. Each graphic image (picture) must be numbered and named. The titles of figures are written at the top (APA 7th ed., 2020), or otherwise, considering the specified standards and requirements. Hence, the title must reveal the content of the figure as clearly and in detail as possible. If necessary, the units of measurement are indicated in parenthesis at the end of the title.

Duplication is a very common misconception of visualizing results (Figure 8).

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Figure 8
The duplication of the visual presentation of research results

Table 3. Number (f) and structural percentage (f%) of Social Studies lessons in relation to the treatment of cultural heritage

Cultural heritage content treatment	f	f %
Yes	29	42.6%
No	39	57.4%
Total	68	100.0%

From Table 3 and Figure 1 it is evident that teachers addressed the content of cultural heritage at 29 observed lessons. At 39 lessons they did not address cultural heritage content.

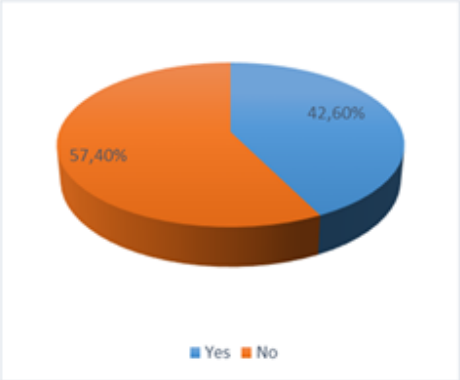

Figure 1: Graphic representation of structural percentages (f%) of lessons in terms of treatment of cultural heritage content

Figure 8 shows that the results of the conducted research are duplicated, i.e. presented in both the table and the pie diagram, which is a very common phenomenon. Besides, a two-colour diagram is completely inappropriate in black-white printing. The table provides that the symbol (%) as a percentage of relative frequency is given next to each value, which is also technically incorrect. Another example (Figure 9) shows that the use of a diagram describing course units is inappropriate.

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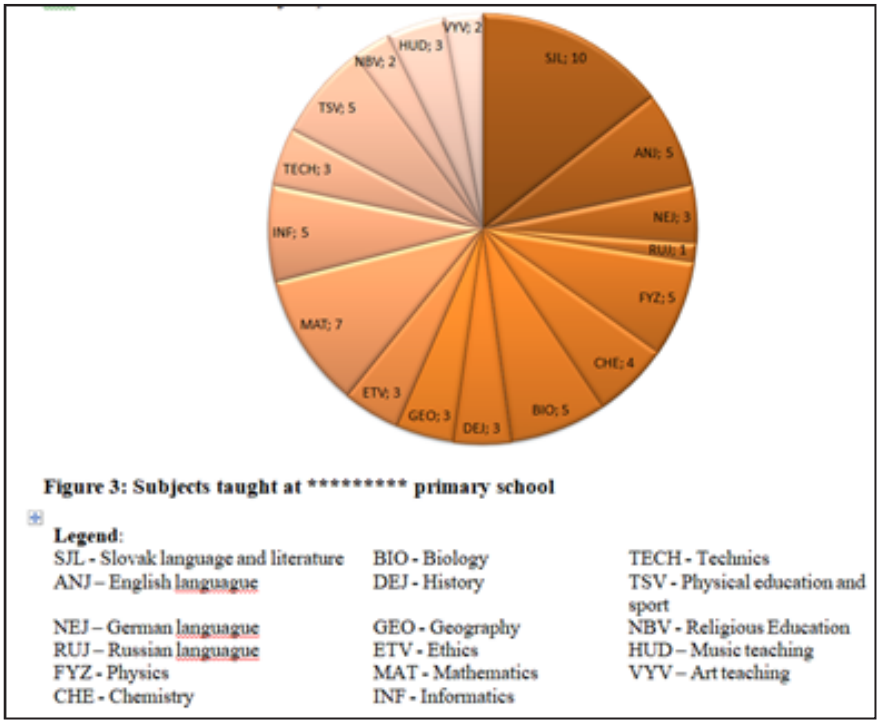
Figure 9
An example of the incorrectly presented results



The course units presented in a simple spreadsheet format should clarify the situation, because the chart is completely pointless in this case. Grammatical errors are detected in the explanations of the legends. The values of the numbers in the sectors of the diagram are not explained.

For imaging, the correct selection of coordinate axes is a must. Typically, an independent variable is specified on axis X and a dependent variable – on axis Y. Selecting appropriate colours for figures is a pressing problem. Scientific texts are usually printed in black and white format, whereas the e-version may involve some colour-based solutions. For printing in black and white, colours interfere with understanding the information provided, i.e., the presented image must be informative in both colourful and black and white formats. 'Visual noise' (various lines, boldness, etc.) must be avoided. It is not infrequent to find a wide variety of graphical solutions in the same article, which complicates the perception of information and makes the text chaotic and inconsistent. It is more like a 'drawing' than a scientific text. The excessive use of the colour reduces the efficiency of a particular image and/or figure.

The researcher should understand that the type of data mainly determines the form of visualization. For example, nominal variables are presented only in *bar charts* (column height corresponds to frequency) or *pie charts* (area of the sectors of the circle reflects frequencies). Parametric variables are often represented by histograms (frequency is characterized by the limited area of the column). There are cases where nominal variables (for example, gender, nationality, country) are presented in a *linear chart*, which researchers believe is incorrect (Merkys et al., 2004). Line diagrams usually represent time series. Scatter plots are better suited to see a possible connection (relation).

Certainly, there are plenty of other important aspects involved in describing and introducing results. However, the article is not aimed at discussing them all. Finally, the

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description of the obtained results depends on the audience, the goal of the carried out research, data and the procedures of the performed analysis. Still, a few more significant moments are worth mentioning. In some cases, the authors present a whole series of tables in the text (section of the results). The latter are not explained in any way (pasting tables that do not disclose the reader the purpose of use). An important point is understanding that each provided table should be explained in one way or another, which does not mean that all information displayed in the specified table is repeated. It is a common unappreciated act by researchers to use words to describe what mentioned in tables or figures by numbers. They also need to understand an important rule that visualization seeks to make research results clear and easy to understand. Nevertheless, overdoing should be neglected, because there are cases when several pages are dedicated to one of the graphic elements of the article. Scientific text must be written (text is primary) not drawn (graphics support the text). Tables and figures should help the reader visualize important results rather than to carry the bulk of the work in the presentation of findings.

The case when the results of the specified research (particularly quantitative, empirical) are 'mixed' with the findings obtained by other researchers is appears regularly and covers the following moments: 1) such comparison is frequently random and superficial; 2) the results of specific research are confused with the discussion and comparison of research findings (discussion). Thus, it becomes difficult to distinguish the authentic results of a certain study. An important point is understanding that

Results should be presented in detail and discussed accordingly without any mix with other studies

The presentation of pictures in the section of research results is also a useful point to mention. However, this is not a very common and/or necessary element of research results and a more general case observed in qualitative research (result may involve important research participants, various objects, situations, environments, etc.). Providing such information in the appendices of the article is one of the solutions. Certainly, if necessary, data may be reflected in the main text. In both cases, it is important that one should specify the source of the picture, i.e. whether the author(s) has/have taken it him/herself/themselves or it is the public domain (Creative Commons) or has been borrowed.

The number of the tables and/or figures used in the article is a frequent issue to be properly solved, as diagrams should not overload the scientific article. On the other hand, researchers (Poviliūnas & Ramanauskas, 2008) do not recommend publishing pictures containing up to 3 different values. The size of tables, figures and diagrams is another important technical aspect indicating that the above introduced instruments are important parts of the text that need to provide detailed information. Hence, their size must be optimal.

Summary

The Past Tense is most frequently used for describing research findings. Various links to figures, tables or other types of visual information are given in the Present Tense. The scientific articles of theoretical nature apply to the Present Tense. Considering the section of results in the article, the description of findings is significantly unified and is straightforward and factual (Perneger & Hudelson, 2004). Fox and Jennings (2014) notice that the main point is to neutrally describe the analytical output and findings from the particular research. The latter are not interpreted in the section of the results, and no evaluation aspect is included, i.e. only the details

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obtained from a specific study are described. Comparison, evaluation, interpretation, etc. is done in the discussion section. In addition, one should not be tempted to demonstrate analytical skills by presenting non-essential results in a plethora of tables and/or figures. As a rule, the key results responding to the main (or one essential) research questions should be described first. Next, interpreting secondary results is recommended. However, an adequate, consistent and logical description of research results hardly guarantee the quality of the scientific article. Researchers remark that good reporting in all other sections of an article is equally important (Norris et al., 2015).

Note

Some examples have been taken from the manuscripts submitted for journals *Journal of Baltic Science Education* and *Problems of Education in the 21st Century*.

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