A Framework for Selecting Sample Size in Educational Research on e-business Application

Andreas Ahrens and Jeļena Zaščerinska
Hochschule Wismar, University of Applied Sciences - Technology, Business and Design,
Philipp-Müller-Straße 14, 23966 Wismar, Germany

Keywords: e-business Application, Generalization, Population, Sample, Sample Size, Measurement Procedures, Probability Sample, Information-Oriented Sample, Case, Factor.

Abstract: Sample size has a two-fold role in research: sample size is inter-connected with statistical analysis of the data and generalization. Therefore, sample size has attracted a lot of research efforts in all the research fields including educational research on E-Business application. However, little attention has been given to a framework for selecting sample size in educational research on E-Business application. The research question is as follows: what shapes sample size in educational research on E-Business application? The aim of the research is to analyze theoretically sample size shaping underpinning elaboration of a framework for selecting sample size in educational research on E-Business aplication. The present research involves a process of analysing the meaning of the key concepts *statistical analysis*, *generalisation*, *population, sample, measurement procedures, probability sample, information-oriented sample, case* and *factors*. Moreover, the study demonstrates how the key concepts are related to the idea of "sample size". Explorative research was employed. Interpretive research paradigm was used. The empirical study involved four experts from different countries in February - April 2013: The findings of the research allow drawing the conclusions on the framework for selecting sample size in educational research on E-Business aplication. Directions of further research are proposed.

1 INTRODUCTION

E-Business application has been widely spreading since its emerging as e-Business application provides businesses with such benefits as time saving, cost reduction, service improvement, management facilitation, etc.

For the increase of efficiency of e-Business application in complex and constantly self-regenerating environments (Kardoff, 2004), a number of issues in e-Business application has to be taken into consideration such as context analysis, customer needs analysis, etc. Success in dealing with the above-mentioned issues in e-Business application is generated by a couple of strategies. For the synergy between theory and practice in e-Business application, one of the strategies is focused on the sample analysis (Mayring, 2007).

Sampling focuses on obtaining a group of subjects who will be representative of the larger population or will provide specific information needed (McMillan, 1996). The goal is to select a sample that will adequately represent the population, so that what is described in the sample will also be true of the population (McMillan, 1996). In educational research, the best procedure for selecting such a sample is to use probability sampling as non-probability sampling does not ensure the construction of a parameter for a population. The primary distinction between the two domains is that the probability sampling study findings can be generalized to the target population while the nonprobability sampling study findings can only be generalized to the institution where the sample was studied (Summers, 1991). The key characteristic of a probability sample is that each element in the population has a known probability of being included in the sample (Sweeney, 2013). The probability sampling procedures include simple random, systematic, stratified, and cluster (McMillan, 1996) as demonstrated in Figure 1.

The process of sample selection reveals such an issue as sample size. Therefore, sample size has attracted a lot of research efforts in all the research

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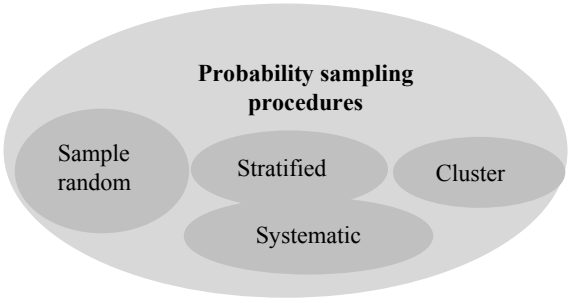

Figure 1: Probability sampling procedures.

fields. In farmer surveys, sampling methods which range from the practical to the mathematical are focused on good practical points (Coe, 1996). In organizational research, the procedures for determining sample size for continuous and categorical variables have been described by use of Cochran's (1977) formulas (Bartlett, Kotrlik, Higgins, 2001). In management and economics research, the emphasis is put on analysis of factors influencing sample size (Kamau, Guandaru, Kariuki, Nduati, 2012). In psychological research, analysis of selection of sample size has contributed to three criteria of sample size (Kroplijs, Raščevska, 2004).

Psychological research and educational research are closely inter-connected as depicted in Figure 2.

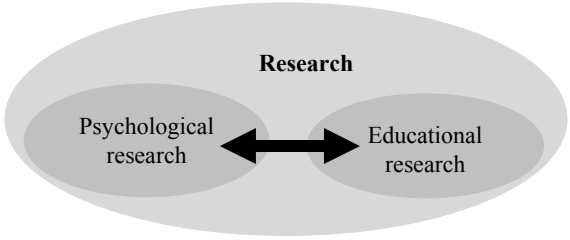

Figure 2: Inter-relationship between psychological and educational research.

Psychological research provides the basis for pedagogical and, consequently, educational developments in terms of organization of educational environment, curriculum, institution activities, and etc. In its turn, educational research facilitates the promotion of psychologists' professional knowledge, competences and behavior aimed at ensuring new discoveries, innovations, etc. Thus, in psychological and, consequently, educational research, selection of sample size is identified by the application of three criteria of sample size (Kroplijs, Raščevska, 2004) such as effort quantity or intensity of interaction with sample components (subjects in educational research) or elements; a number of topis investigated within a particular educational research; subject matter within a particular research. Hence, sample size has a two-fold role in research as depicted in Figure 3: sample size is inter-connected with statistical analysis of the data and generalisation or theory formulation.

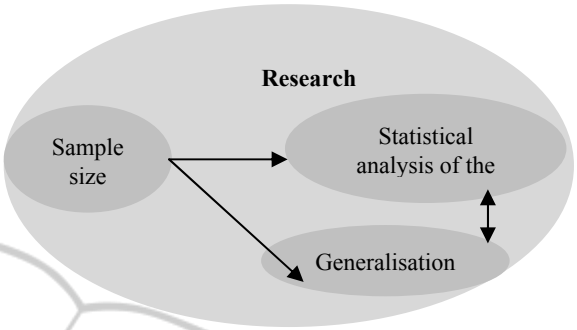

Figure 3: Relationship between sample size and statistical analysis of the data and generalization in research.

In educational research, sample size has attracted a lot of research efforts, too. Traditionally, selection of sample size refers to empirical studies of educational research as illustrated in Figure 4.

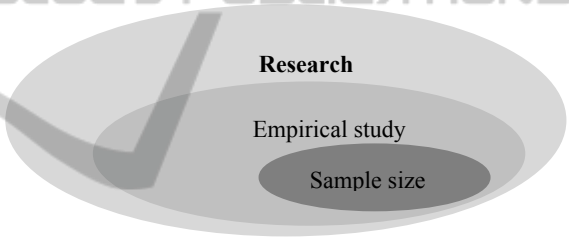

Figure 4: Relationship between research, empirical studies and sample size in educational research.

However, little attention has been given to a framework for selecting sample size in educational research.

The research question is as follows: what shapes sample size in educational research on E-Business application? The aim of the research is to analyze theoretically sample size shaping underpinning elaboration of a framework for selecting sample size in educational research on E-Business aplication.

The present research involves a process of analysing the meaning of the key concepts *statistical analysis*, *generalisation, population, sample, measurement procedures, probability sample, information-oriented sample, case* and *factors.* Moreover, the study demonstrates how the key concepts are related to the idea of "sample size".

The methodological background of the present contribution is based on the System-Constructivist Theory. The System-Constructivist Theory is introduced as the New or Social Constructivism Pedagogical Theory. The System-Constructivist

Theory is formed by Parsons's System Theory (Parsons, 1976) on any activity as a system, Luhmann's Theory (Luhmann, 1988) on communication as a system, the Theory of Symbolic Interactionalism (Mead, 1973), the Theory of Subjectivism (Groeben, 1986). The application of this approach to learning introduced by Reich (Reich, 2005) emphasizes that human being's point of view depends on the subjective aspect (Maslo, 2007):

- everyone has his/her own system of external and internal perspectives (Ahrens, Zaščerinska, 2010) that is a complex open system (Rudzinska, 2008) and
- experience plays the central role in the knowledge construction process (Maslo, 2007).

Therein, the subjective aspect of human being's point of view is applicable to the present research on selection of sample size in educational research on E-Business application.

2 THEORETICAL FRAMEWORK

By a theoretical framework, the unity of concepts, their definitions and existing theories that are used for a particular study are meant. A theoretical framework is used to identify the specific viewpoint (framework) taken into consideration while analysing and interpreting the gathered data.

Educational research in general and sample size in particular is initially shaped by educational research paradigm (Taylor, Medina, 2013). A paradigm is a comprehensive belief system, world view, or framework that guides research and practice in a field (Willis, 2007). Such educational research paradigms are identified (Taylor, Medina, 2013) as

- the positivist paradigm that is commonly used in research to test theories or hypotheses,
- the post-positivist paradigm that includes the analysis of interaction between the researcher and his/her research participants via use of such quantitative methods as survey research and qualitative methods as interviewing and participant-observation (Creswell, 2008),
- the interpretive paradigm which aims to understand other cultures, from the inside through the use of ethnographic methods such as informal interviewing, participant observation and establishment of ethically sound relationships,
- the critical paradigm which involves identifying and transforming socially unjust social structures, policies, beliefs and practices,
- the postmodern paradigm which holds that what goes on in our minds and hearts is not directly accessible to the world outside us,
- the multi-paradigmatic research by combining methods and quality standards drawn from two or more of the newer paradigms, and
- the new 'integral paradigm' that provides a rationale for drawing upon multiple paradigms to design new hybrid methodologies that involve multiple epistemologies and their accompanying quality standards.

Further on, sample size is framed by the research methodology: quantitative methodology that requires large, representative and precise sample, and qualitative methodology that is based on a small and non-representative sample.

Later, selection of sample size in educational research involves analysis of access to the sample which is a key issue in research (Cohen, Manion, Marrison, 2003), and resources such as time, personnel, technical support, competences, experiences, etc (Flick, 2004). It should be noted that research proposals are frequently based on an unrealistic relationship between the planned tasks and the personnel resources that can (realistically) be asked for (Flick, 2004).

Then, selection of sample size is based on the analysis of the inter-relationships between

- sample size and statistical analysis of the data,
- sample size and generalization.

For the analysis of the relationship between sample size and statistical analysis of the data, statistical analysis is identified as the unity of the collection and processing of data and the results' interpretation as demonstrated in Figure 5.

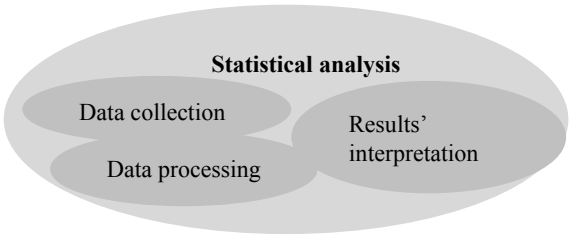

Figure 5: Elements of statistical analysis.

Below the relationship between sample size and each element of statistical analysis is revealed.

Data collection implies use of measurement procedures as depicted in Figure 6.

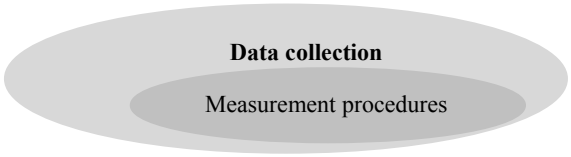

Figure 6: Relationship between data collection and measurement procedures.

Analysis of the relationship between sample size and measurement procedures in the present research is based on measurement procedures defined as measurement tools and scale as shown in Figure 7.

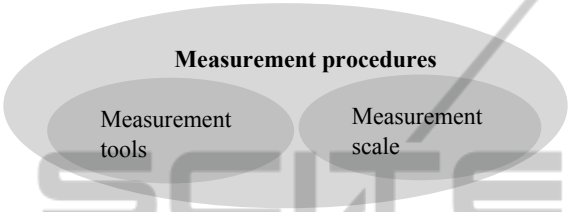

Figure 7: Elements of measurement procedures.

Such measurement tools as questionnaires as well as measurement scales are fixed on one sample and tested in a new sample (Gigerenzer, 2004) as measurement tools and/or scales have to be cross-validated in order not to provide non-precise data. Therein, a sample is to be of such a size as, in the measurement phase of the educational research, the parameters of measurement tools and scales are kept fixed when used by sample's further components or elements.

Traditionally, data processing includes two methods (Geske, Grīnfelds, 2006) as illustrated in Figure 8: method of descriptive statistics and method of inferential statistics.

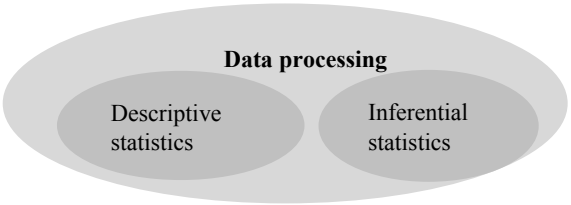

Figure 8: Two methods of data processing.

Figure 9 demonstrates methods of descriptive statistics (Geske, Grīnfelds, 2006).

In educational research such a method of inferential statistics as significance test is closely inter-connected with sample size while null hypothesis testing relates to two measured phenomena, and variance analysis – to a variable's values.

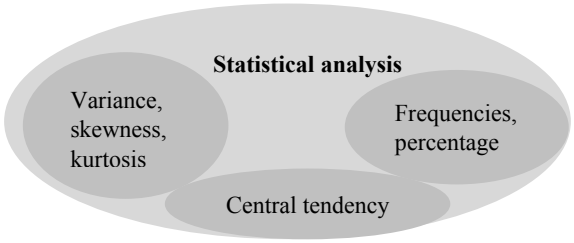

Figure 9: Methods of descriptive statistics.

Figure 10 shows elements of central tendencies (Geske, Grīnfelds, 2006).

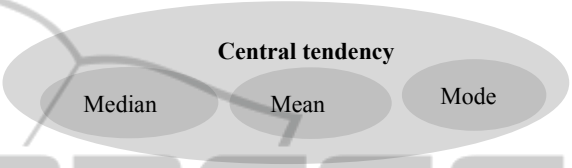

Figure 10: Elements of central tendencies.

In its turn, Figure 11 demonstrates methods of inferential statistics (Geske, Grīnfelds, 2006) in educational research.

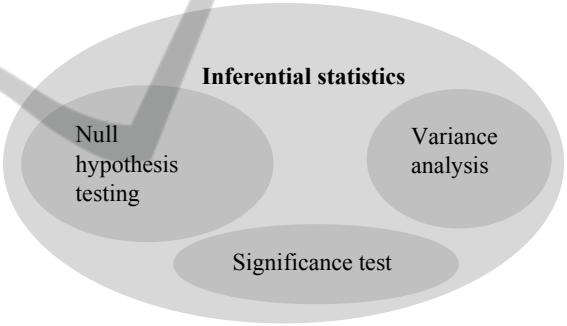

Figure 11: Methods of inferential statistics.

For the analysis of the relationship between sample size and significance test, a sampling distribution is required. Sampling distribution is connected with probability distribution: the sampling distribution of the mean is a probability distribution of the possible values of the mean that would occur if we were to draw all possible samples of a fixed size from a given population (Plonksy, 1997). Knowledge of the sampling distribution is necessary for the construction of an interval estimate for a population parameter (Sweeney, 2013). This is why a probability sample is needed; without a probability sample, the sampling distribution cannot be determined, and an interval estimate of a parameter cannot be constructed (Sweeney, 2013).

Sampling distribution is usually examined by the Kolmogorov-Smirnov test. Statistical Package for the Social Sciences (SPSS) Exact Tests also offers

the asymptotic version of the Kolmogorov-Smirnov test to reach correct conclusions with small samples (Statistical Package for the Social Sciences, 2009). A sampling distribution is considered within the framework of deviation of the empirical distribution. Deviation of empirical distribution is significant if Significance *p* or *Asymp. Sig. (2-tailed)* is smaller than 0.05 (Lasmanis, 2003). The Kolmogorov-Smirnov test identifies that if the deviation of empirical distribution is greater than 0.05, sampling distribution is normal, or if the deviation of empirical distribution is smaller than 0.05, sampling distribution is non-normal. Normal empirical distribution implies the use of parametric methods in the empirical study, and non-normal empirical distribution - the use of non-parametric methods. However, the use of normality tests does not determine automatically whether or not to use a parametric or non-parametric test: they can help make the decision (GraphPad Software, 2007). For example, non-parametric tests have little or no power to find a significant difference if there is a tiny sample (a few subjects in the group) (GraphPad Software, 2007).

In comparison to theoretical sampling which relates not to the sample size determination, but to the analysis of the necessity in the increase of the sample size for the enrichment of theory developed from the data obtained in a previous sample (Kroplijs, Raščevska, 2004) in psychological and, consequently, educational research, empirical sampling distributions are not true sampling distributions, since all possible samples are not chosen (Plonsky, 1997), as well as some differences exist between any natural groups (Gigerenzer, 2004). Therein, a sample is to be of such a size as, in the data processing phase of the educational research, the tests carried out on a given set of data allow extracting the required information in an appropriate form such as diagrams, reports, or tables.

For the analysis of the relationship between sample size and results' interpretation, interpretation and judgement are part of the art of statistics (Gigerenzer, 2004). Thus, a sample is to be of such a size as, in the statistical analysis phase of the empirical study within educational research, the information extracted from the obtained data processing ensures a possibility to make conclusions and generalisations.

For the analysis of the relationship between sample size and generalisation, generalisation is traditionally considered as a central aim of science, as a process of theory formulation for further applications (Mayring, 2007). Types of generalisation include universal laws, statistical laws, rules, context specific statements, similarities and differences, descriptive studies, explorative studies, and procedures to come to results (Mayring, 2007) as illustrated in Figure 12.

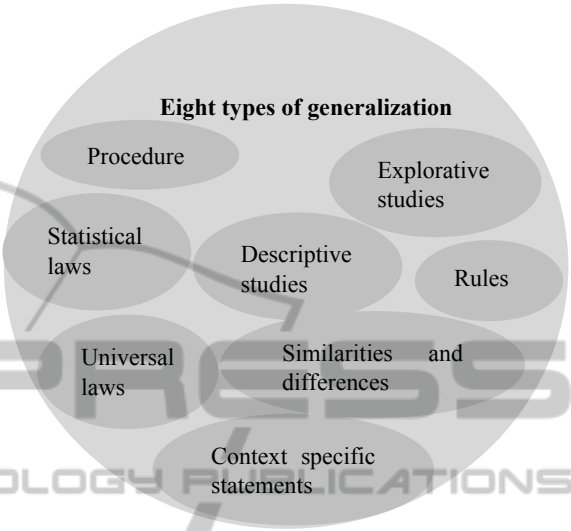

Figure 12: Eight types of generalisation.

Generalisation can be arrived by different strategies which also include analysis of total population and samples (Mayring, 2007). Therein, Figure 13 demonstrates that sample is part of population.

Figure 13: Relationship between total population and sample.

A population is a group of elements or cases, whether individuals, objects, or events, that conform to specific criteria and to which we intend to generalize the results of the research (McMillan, 1996). This group is also referred to as the target population or universe (McMillan, 1996). It is also important to distinguish the target population from a list of elements from which a group of subjects is selected (McMillan, 1996). The list is termed the survey population or sampling frame (McMillan, 1996). The sample is the group of components, elements, or a single element, from which data are obtained (McMillan, 1996). By an individual who participates in a research study or is someone from

whom data are collected, subjects or cases are meant (McMillan, 1996). The term *subject* may also identify individuals whose behavior, past or present, is used as data, without their involvement in some type of treatment or intervention (McMillan, 1996). The focus in selecting the cases has changed to information-oriented sampling, as opposed to random sampling (Flyvbjerg, 2006). This is because an average case is often not the richest in information. In addition, it is often more important to clarify the deeper causes behind a given problem and its consequences than to describe the symptoms of the problem and how frequently they occur (Flyvbjerg, 2006). Random samples emphasizing representativeness will seldom be able to produce this kind of insight; it is more appropriate to select some few cases chosen for their validity (Flyvbjerg, 2006).

In educational research, it is usually impractical and unnecessary to measure all the elements in the population of interest (McMillan, 1996). Typically, a relatively small number of subjects or cases is selected from the larger population (McMillan, 1996). In educational research, a sample should include more than 30 subjects due to the "central limit theorem" (Mayring, 2007), a sample which involves less than 30 subjects is small (Arhipova, Bāliņa, 2003), and a sample which consists of a few subjects is tiny (GraphPad Software, 2007). It should be noted that generalization can be drawn from a single case study, too (Mayring, 2007). However, for the result confirmation and drawing more general conclusions, the case basis is to be widened (Mayring, 2007) up to three-ten single cases (Yin, 2005). Therein, a sample is to be of such a size as, in the analysis phase of the research, sample's further components or elements do not change conclusions or generalisations drawn from the obtained data (Kroplijs, Raščevska, 2004).

Hence , selection of sample size is shaped by the following framework: in the educational research, a sample is to be of such a size as

- in the measurement phase, the parameters of measurement tools and scales are kept fixed when used by sample's further components or elements,
- in the data processing phase, the tests carried out on a given set of data allow extracting the required information in an appropriate form such as diagrams, reports, or tables,
- in the statistical analysis phase, the information extracted from the obtained data processing ensures a possibility to make conclusions and generalisations.
- in the analysis phase, sample's further components or elements do not change conclusions or generalisations drawn from the obtained data (Kroplijs, Raščevska, 2004).

3 EMPIRICAL RESEARCH

The present part of the paper demonstrates the design of the empirical research, survey results and findings of the empirical study.

3.1 Research Design

The design of the present empirical research comprises the purpose and question, sample and methodology of the present empirical study.

The empirical study was aimed at evaluating the framework for selecting sample size in educational research on E-Business aplication.

The empirical research's guiding question was as follows: What is the expert evaluation of the framework for selecting sample size in educational research on E-Business application?

The present empirical study involved four experts from different countries in February - April 2013. All the respondents have been awarded PhD Degree in different fields of educational science. As the respondents with different cultural backgrounds and diverse educational approaches were chosen, the sample was multicultural. Thus, the group (age, field of study and work, mother tongue, etc.) is heterogeneous. The sample of four experts consisted of two researchers in the field of educational research, Educational Research Association, "Freie Universität" (Free University), Berlin, Germany, a researcher in the field of educational research, Latvia University of Agriculture, Jelgava, Latvia and a researcher in the field of applied research in education, CAH - Vilentum University of Applied Sciences, Dronten, the Netherlands. In order to save the information of the study confidential, the respondents' names and surnames were coded as follows: two researchers from Germany were given the codes of E1 (Expert 1) and E2 (Expert 2), a researcher from Latvia was pointed as E3 (Expert 3), a researcher from the Netherlands was considered as E4 (Expert 4).

Interpretive research paradigm that corresponds to the nature of humanistic pedagogy (Luka, 2008) was used in the present empirical study. Interpretive paradigm is characterized by the researchers' practical interest in the research question (Cohen, Manion, Marrison, 2003).

Researcher is the interpreter.

Exploratory research was employed in the empirical study (Phillips, 2006). Exploratory research is aimed at generating new questions and hypothesis (Phillips, 2006). The exploratory methodology proceeds from exploration in Phase 1 through analysis in Phase 2 to hypothesis development in Phase 3 as demonstrated in Figure 14.

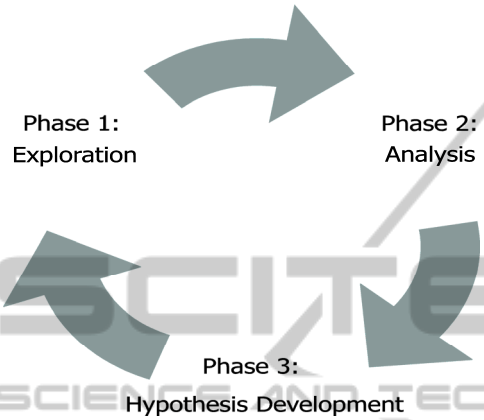

Figure 14: Methodology of the exploratory research.

The qualitatively oriented empirical study allows the construction of only few cases (Mayring, 2004).

The choice of experts was based on two criteria such as recognized knowledge in the research topic, absence of conflict of interests (Lopez, Salmeron, 2011) as depicted in Figure 15.

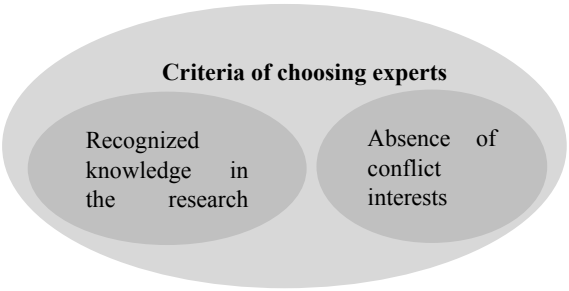

Figure 15: Criteria of choosing experts.

The number of experts depends on the heterogeneity of the expert group: the greater the heterogeneity of the group, the fewer the number of experts (Okoli, Pawlovski, 2004). Thus, four is a good number of experts for the study (Lopez, Salmeron, 2011). Therein, the non-structured interviews comprised four experts who were researchers from different countries. It should be noted that all the researchers were professors in the fields connected with educational research. All the four researchers had received extensive research experience.

3.2 Survey Results

In order to analyse the framework for selecting sample size in educational research on E-Business aplication, non-structured inteviews were caried out. Non-structured interviews with experts were conducted in order to search for the main categories of the research field (Kroplijs, Raščevka, 2004).

Expert 1 thanked the authors for the interesting abstract submitted to the conference where Expert 1 was acting as a reviewer.

Expert 2 underlined that the authors had tried to summarize a study and identify the main characteristics of this study.

Expert 3 was interested in the continuation of the study.

Expert 4 assumed that the factors play a key role in forming the sample size in educational research.

3.3 Findings of the Empirical Study

Summarizing content analysis (Mayring, 2004) of the data reveals that experts positively evaluated the framework for selecting sample size in educational research on E-Business aplication.

4 CONCLUSIONS

The empirical findings of the research allow drawing the conclusions on the experts' positive evaluation of the framework for selecting sample size in educational research on E-Business aplication.

The following research question has been formulated: what are the principles of selection of sample size in educational research?

The role of sample size it plays in research is to be re-considered in further studies. Further research tends to focus on empirical studies to be carried out in other institutions. And a comparative research of different countries could be carried out, too.

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