

Evaluation of an exercise for measuring impact in e-learning: Case study of learning a second language

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ABSTRACT

Immerse in the designated Information Society is the field of e-learning that, such as other fields that compose it, needs to be measured to establish inputs and support the decision making process with respect to its relevance of application and utility for the environments where it is implemented, among other motivations.

Since the moment of its foundation in 2004, the National Direction of Virtual Academic Services at Universidad Nacional de Colombia uses e-learning as support of education in several areas, including the learning of a second language with the programme ALEX Virtual. In 2008, a study was made about the perception of the quality of service provided by this programme. In this work we presented a methodology for comparative analysis between indicator systems in e-learning and this specific case of evaluation of the formation activities through e-learning. From this comparison, we want to establish new or improve some variables and indicators for new evaluation systems.

Categories and Subject Descriptors

H.4 [Information Systems Applications]: Miscellaneous;
H.5.1 [Multimedia Information Systems]: Evaluation / methodology; J.1 [Administrative Data Processing]: Education; K.3.1 [Computer Uses in Education]: Dis-

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tance learning

General Terms

Information Society, Theory, Validation, Measuring, Experimentation.

Keywords

ALEX Virtual Programme, E-learning, Evaluation, Information Society, Methodology, Universidad Nacional de Colombia.

1. INTRODUCTION

Nowadays, we are in the designated Information Society (IS), which is considered by several authors an engine of economic and social development, from the generation of information and knowledge supported by the advance in Information and Communication Technologies (ICT) [6]. Inside IS, there are different fields such as the provision of services online by part of governmental agencies (e-government), the provision of services online by financial entities (e-banking), remote work, and e-learning among others. Particularly, the field of e-learning is the one that concerns to the work presented in this document. Now well, the existence of these fields makes necessary to identify how much advance has an entity (i.e. an institution, a government, a country) in the transformation from the Industrial Society and Post-Industrial Society to the IS, especially with a look to evaluate “the impact or the contribution of the knowledge (and the information) in the generation of value and economic growth” [1].

So, although there is no consensus in the literature on the definition of the term e-learning, we understand e-learning for this work as “the acquisition and the use of knowledge, distributed and facilitated mainly by electronic means” [7]. Regarding the field of e-learning, preliminary works exist on a series of elements that allow us to do some measurement about it, specifically variables and indicators [2]. However, in the level of case studies, in our opinion, there are also measurement elements that have not been taken into account for these previous works and are those elements that are particular to case studies, that are equally valuable although they might have limitations in his extent, since it can be difficult to extend or generalise them.

This work pretends to take the case study of evaluation in e-learning of the learning programme of a second language. This programme is designated ALEX Virtual and is provided

in association with the National Direction of Virtual Academic Services (NDVAS) at Universidad Nacional de Colombia (UNAL), with the purpose of designing a first approach to the methodology for the evaluation of the perception by part of students of the program, and subsequently, from the results obtained, evaluating how to integrate ICT in learning processes of students in the context of English courses, and in the structure that the courses propose, it is, identifying its impact when applying theories related to the evaluation of information systems in social structures (e.g. the Theory of Structuration [5]).

We have to mention also that this work is part of the second phase of the project e-Metrica Colombia, funded in 2009 by UNAL. This is a project that looks for reviewing the indicator systems of IS and also developing an in-depth study of the indicator systems for the sectors of e-banking, e-learning and digital divide [2].

Section 2 explains in detail the methodology used for the achievement of this research work, that is developed in detail in section 3. Conclusions of the exercise are delivered in section 4 and finally, after the references section, we present some results of the exercise in the appendix section.

2. METHODOLOGY

The review of the state of the art did not provide us related works that presented in an exact way what is looked for being established in this project. So, the design of the research involved three stages:

1. Identification of the state of art of indicator systems in e-learning (Phase I of the project e-Metrica Colombia).
2. Exploratory study of the case study.
3. Diagnostic of the weaknesses and strengths of the case study in the context of the state of art.

2.1 Identification of the state of art of the indicator systems in e-learning (Phase I of the project e-Metrica Colombia)

The review of indicator systems of IS pretends to characterize these in terms of fields, variables, indicators and methodologies of application.

With the mentioned review, there are concrete elements to value the exercise made by the NDVAS in its intention of evaluating the impact of its activities.

2.2 Exploratory study

This stage is when we make the assessment of the case study made by the NDVAS. The assessment initiates with the analysis of elements such as the categories of measurement (i.e. what is wanted to be measured) and, variables and indicators to establish how to measure. Then we analyse the instruments for gathering information to determine how to gather the information related to what is wanted to be measured so, in this way it is possible to establish the extent of the information gathered during the quoted study and also its utility from the point of view of evaluation in the case

study. Finally, a critical analysis on the design of experimentation in the case study is made.

For the development of this work, we take as a foundation the gathering and preprocessing of data made in [4] about the evaluation of the perception of the services provided by ALEX Virtual in the English courses of level I and II in the first semester of 2008, particularly the ones related to e-learning.

Specifically, the study used information gathered directly from students that took an English course in ALEX Virtual during the first semester of 2008. Some results were presented there regarding to the sections that are listed below, so that, according to the NDVAS, all of them together give an idea of the perception from students on the quality of the service provided:

- The contents of interactive modules
- Usability of the interactive application
- Teachers support
- Tutors/Assistants support
- Actual consultancy
- Online consultancy
- Time
- Space (places)
- The Resource Centre of ALEX Virtual
- The final exam

2.3 Diagnostic of weaknesses and strengths

In this phase we present the fundamental findings of the exercise, in front of the indicator systems studied in the phase I of the project e-Metrica Colombia.

3. RESEARCH IN THE CASE STUDY

According to the proposed methodology, we present the results below:

3.1 Identification of the state of art of the indicator systems in e-learning (Phase I of the project e-Metrica Colombia)

During the first phase of the project e-Metrica Colombia we found 67 indicator systems with different fields of measurement [2], and just ten (10) of them measure the field of e-learning, which represents 14.93% of the total of systems found in the period comprised between 1995 and 2009, as we present in Table 1, where we compare the findings until 2009 in [2] with the findings of the previous study of Sánchez-Torres in 2006, remarking the field of e-learning.

3.2 Exploratory study of case study

Below we describe the main characteristics in terms of categories, variables and indicators used by the case study.

Table 1: Relation of aspects of measurement in indicator systems of IS. Source: Data from [3]

Aspect measured	Related systems (%)	
	Bustamante & Sánchez-Torres, 2009	Sánchez-Torres, 2006
Infrastructure	79,1	87,5
Levels of use	70,15	83,33
ICT sector	47,76	20,83
e-Commerce	41,79	37,5
Skills and formation	38,81	37,5
Environment	37,31	16,67
e-Government	29,85	16,67
e-banking	19,4	-
e-Administration	17,91	16,67
e-Learning	14,93	12,5
e-Health	11,94	12,5
Contents	7,46	12,5

3.2.1 Categories of measurement

As mentioned in subsection 2.2, we work on specific portions of the sections presented in the previous study of the NDVAS. These portions are related to the categories of measurement that maintain a relation with the assessment of the impact of the technology on the learning structure of students, that are those that we list in Table 2.

This list of categories was built from what in [4] is known as variables. It is important to remark this difference in order to handle these concepts: category, variable and indicator¹, which is key for the development of this document.

Therefore, we considered 22 of the 57 categories proposed in the initial study, that correspond to the categories that represent the main relevance for measuring the impact of e-learning in the learning process of a second language in ALEX Virtual.

3.2.2 Variables and indicators

In [4], there is a list of elements of interest to measure that, as we mentioned in the previous subsection, reference the categories of measurement, from which a series of variables can be deduced with their respective indicators, which allow us to understand how technology affects learning processes in this case study. In Table 3 we present the detail of the variables identified in the evaluation made by the NDVAS.

In this table we infer 15 variables and 21 indicators, remembering that a variable may be constituted by several indicators. The initial study did not have a clear difference in the information between variables and indicators although, as we mentioned before, that study present a list of categories (in terms of this work) under the title of variables.

In the appendix section we show some figures with prelim-

¹According to Sánchez-Torres in [6], a variable is an aspect that can be measured from an object of study (the object of study in this case is the category). On the other hand, an indicator is an observable and identifiable characteristic from a variable, so that an indicator allows the assignment of a determined value to a variable.

Table 2: Categories of measurement of the case study. Source: Own making based on [4]

Sections of the study	Category
Contents of interactive modules	Education strategies
Usability of interactive application	Help from other people to use the platform
	Ease of use of the platform
	Navigation in-depth of the platform
	Visual arrangement of contents in the platform
	Size of texts in the platform
	Grade of general satisfaction
Teachers support	General qualification to support from teachers
Tutors/Assistants support	General qualification to support from tutors/assistants
Actual consultancy	Assistance to actual consultancies
	Schedules of actual consultancies
Online consultancy	Assistance to online consultancies
	Schedules of online consultancies
Time	Time frames of use of the platform
	Weekly dedication to use the platform
Space (places)	Place of development of the course
Resource Centre of ALEX Virtual	Assistance to the RC
	Type of query in the RC
	Queries to the assistants of the RC
	Material resources in the RC
	Computer rooms in the RC
	General qualification of the RC

inary results based on this set of variables and indicators. These results are the ones that allow us finding precisely how learning processes in students are affected, through the utilization of a theory for evaluation of impact, particularly on the students of ALEX Virtual.

3.2.3 Instruments for gathering information

The instrument used for gathering information in this study is the survey made in [4] to students of the English courses during the first semester of 2008. This survey contains 57 questions formulated to the students at the end of the semester, in its majority questions whose answers were presented as scales (41 questions over the total). The complete description of the questions of the survey used for this purpose is presented in [4].

3.3 Diagnostic of weaknesses and strenghts in the system of evaluation

Regarding the set of indicator systems of IS presented in [2] and described previously, the study of the NDVAS in [4] does

Table 3: Variables and indicators of evaluation in the case study. Source: Own making based on [4]

Variable	Indicator
V01: Effectiveness of the strategies applied for learning through interactive modules	I01: Share of students per grade of acceptance of the effectiveness of the strategies applied
V02: Usability of the e-learning platform	I02A: Share of students that agree with the need of help from other people to use the platform
	I02B: Share of students that agree with the ease of use of the platform
	I02C: Share of students that agree with the intuitive nature of the navigation in the platform
	I02D: Share of students that agree with the intuitive nature of the visual arrangement of contents in the platform
	I02E: Share of students that agree with the adequate size of texts in the platform
V03: Satisfaction with the e-learning platform	I03: Average grade of general satisfaction of students with the e-learning platform
V04: Teacher evaluation	I04: Average general grade of support from teachers
V05: Tutor/Monitor evaluation	I05: Average general grade of support from tutors/monitors
V06: Students' interest in assisting to actual consultancies	I06A: Share of students per frequency of assistance to actual consultancies
	I06B: Share of students per opinion about flexibility in schedules of actual consultancies
V07: Students' interest in assisting to online consultancies	I07A: Share of students per frequency of assistance to online consultancies
	I07B: Share of students per opinion about flexibility in schedules of online consultancies
V08: Schedules for using the platform	I08: Share of students that use the platform per time frames
V09: Weekly dedication to use the platform	I09: Share of students per time intervals of weekly dedication
V10: Assistance to the RC	I10: Share of students per frequency of assistance to the Resource Centre
V11: Type of query in the RC	I11: Share of students per type of query in the Resource Centre
V12: Frequency of queries to the assistants of the RC	I12: Share of students per frequency of queries to the assistants of the Resource Centre
V13: Use of the didactic material in the RC	I13: Share of students per type of material used in the Resource Centre
V14: Availability of computer rooms in the RC	I14: Share of students per category of availability of computer rooms in the Resource Centre
V15: General grade of the RC	I15: Average grade of the service provided by the Resource Centre

not mention that some of the variable or indicator of any of these systems have been used, and neither we could find coincidences in the direct benchmark of variables and indicators of the case study with the specific variables and indicators for e-learning in the work presented in [2]. It indicates that the case study of the NDVAS is not affiliated to any of these proposals, but it may be part of a new proposal of indicator system based in the variables and indicators presented in Table 3. It is important to mention that the initial study of the NDVAS does not incorporate the concepts of variable and indicator as measurement elements, reason why the set of elements shown in Table 3, corresponds to a proposal of indicators created from the instruments presented in that study, mainly statistical data. In the final document of the study, NDVAS mentions that the data delivered had mainly a statistical purpose more than an analytical purpose, that is by the way one of the added values in converting simple statistical data into variables and indicators.

Therefore, we can remark that the set of variables and indicators created are of a specific extent regarding the type of service provided, the modality of the service provided, and even the places where this service is provided with learning purposes and where learning processes are executed in presence of e-learning technologies. This way, the capacity of

generalization of the indicator system is reduced to measure the impact of e-learning in other case studies, but there is a gain in the detail of the results presented to people interested in learning processes in students of the programme.

On the other hand, the methodology proposed implicitly in the initial study is founded on gathering information by means of the survey technique, which is frequent in many proposals of indicator systems, but in this case featured 57 questions, and this fact could not be inconvenient if we think in obtaining data from conscious answers from students at the end of an academic period. For the methodology that we want to propose from this case study, we suggest using a basis of a lower quantity, in a one-to-one relation with the indicators of Table 3, so that a student does not feel uncomfortable when having the survey in his hand.

4. CONCLUSIONS AND FUTURE WORK

Framed in the learning of the English language in the programme ALEX Virtual during the first semester of 2008, we can conclude that students, after accomplishing the main purpose of finishing their respective levels with the particular objectives fulfilled, have done a particular use of the technology to get to this end, determined from the simple

analysis of the indicators elaborated from the preliminary study of the NDVAS presented in [4]. These indicators allow people interested in learning processes of students of the Programme to make an initial approach of idea of the impact of the technological tools used on the support of such processes.

This analysis is possible thanks to the formal building of a methodology of evaluation from the preliminary study of the NDVAS at UNAL, with a set of variables and indicators that work as elements of measurement of the case study, in addition to the description of instruments for gathering information, that are key to see the research problem here treated from qualitative and quantitative elements and related methods that are beyond the scope of this document. These methods allow us later to find applications of technology in learning processes of the students in the programme.

Also, we pretend to find in the future new data on the evaluation in e-learning, based in a methodology similar to the one proposed in this document, that integrates also variables and indicators of general extent like the ones reviewed in [2], in addition to other courses delivered by the NDVAS using e-learning. This considering that we have shown by means of this work also that we can adapt previous results from other methodologies to a more formal methodology that allows us to evaluate subjects such as the impact of ICT in learning processes, built based on categories of measurement, instruments of measurement (variables and indicators) and techniques for gathering information particular to the case.

5. ACKNOWLEDGMENTS

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6. REFERENCES

- [1] C. Bianco, G. Lugones, F. Peirano, and M. Salazar. *Indicadores de la sociedad del conocimiento: aspectos conceptuales y metodológicos*, 2002.
- [2] A. Bustamante and J. M. Sánchez-Torres. *Indicadores de la sociedad de la información para la medición en e-banking y e-learning*. In *Encuentro Nacional de Investigación en Posgrados 2009*, Universidad Nacional de Colombia, Sede Bogotá, 2009.
- [3] A. Bustamante and J. M. Sánchez-Torres. *Indicadores para la medición de la sociedad de la información: una revisión*. *Universidad Nacional de Colombia, mimeo*, 2009.
- [4] Dirección Nacional de Servicios Académicos Virtuales. *Encuesta de percepción de los servicios ofrecidos: Curso*

²GRIEGO stands for *Grupo de Investigación en Gestión y Organizaciones* (Research Group in Management and Organizations), from the Faculty of Economic Sciences at Universidad Nacional de Colombia. Authors are also members of this group which is registered in Colciencias and classified as category A1.

³The ALEX Virtual Programme is part of the Faculty of Human Sciences at Universidad Nacional de Colombia.

ALEX virtual. 2008.

- [5] A. Giddens. *The Constitution of Society: Outline of the Theory of Structuration*. University of California Press, Mar. 1986.
- [6] J. M. Sánchez-Torres. *Propuesta metodológica para evaluar las políticas públicas de promoción del e-government como campo de aplicación de la Sociedad de la Información. El caso colombiano*. Tesis doctoral, Universidad Autónoma de Madrid, 2006.
- [7] T. L. Wentling, C. Waight, J. Gallaher, J. L. Fleur, C. Wang, and A. Kanfer. *E-learning-A review of literature*, 2000.

APPENDIX

Below we present graphically the preliminary results obtained for some of the indicators shown in Table 3 from figure 1 to figure 9.

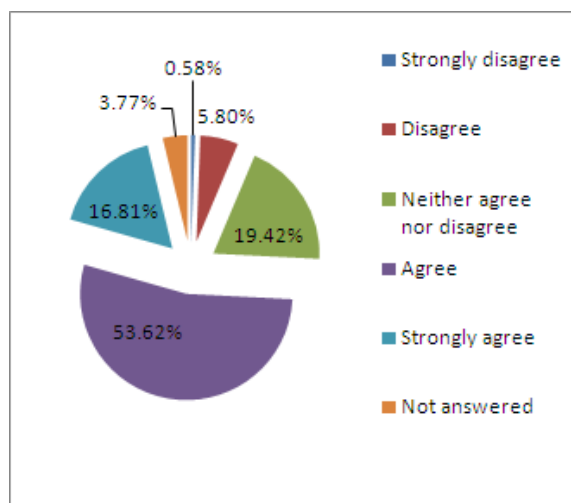


Figure 1: Share of students per grade of acceptance of the effectiveness of the strategies applied. Source: Own making based on data from [4]

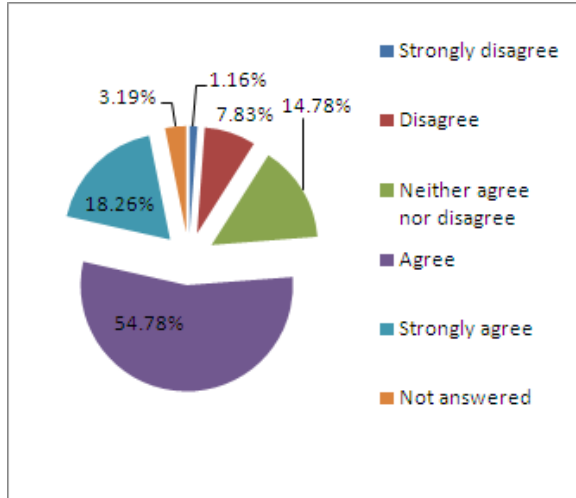


Figure 2: Share of students that agree with the ease of use of the platform. Source: Own making based on data from [4]

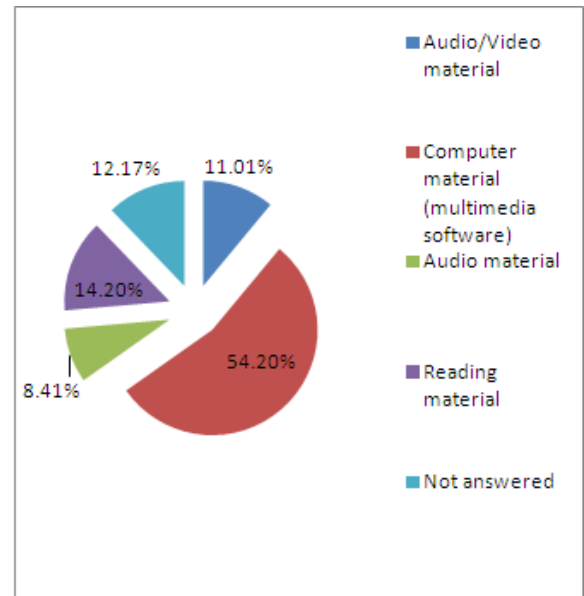


Figure 4: Share of students per type of material used in the Resource Centre. Source: Own making based on data from [4]

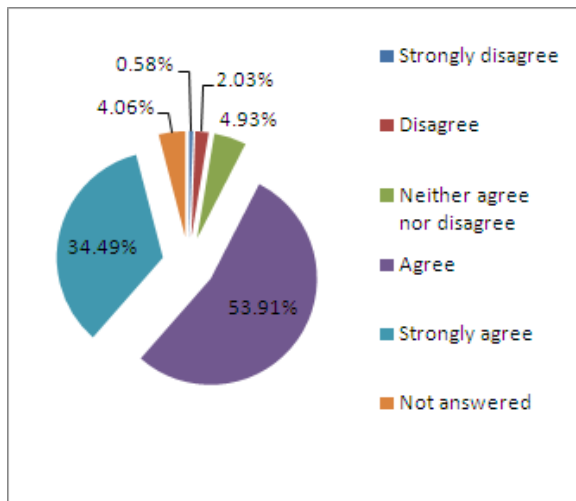


Figure 3: Share of students that agree with the intuitive nature of the visual arrangement of contents in the platform. Source: Own making based on data from [4]

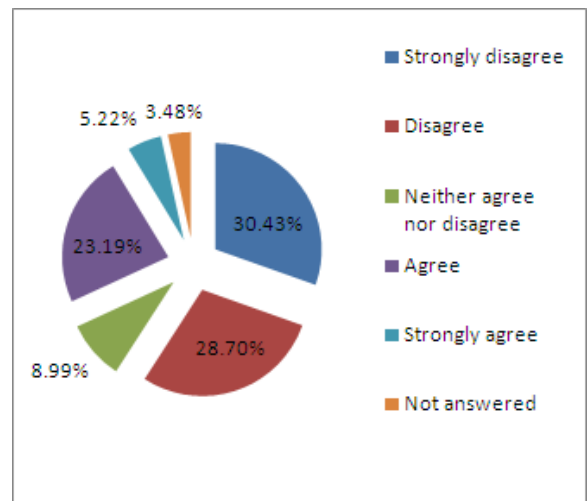


Figure 5: Share of students that agree with the need of help from other people to use the platform. Source: Own making based on data from [4]

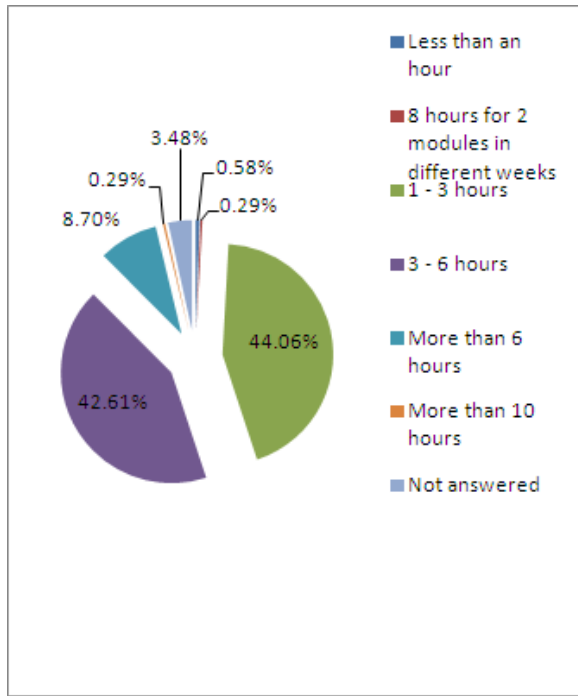


Figure 6: Share of students per time intervals of weekly dedication. Source: Own making based on data from [4]

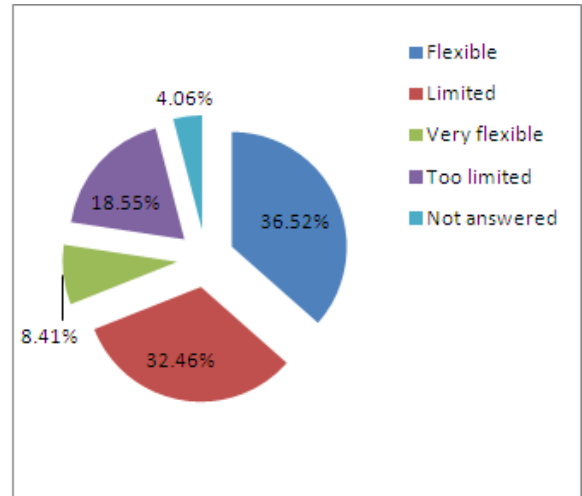


Figure 8: Share of students per opinion about flexibility in schedules of online consultancies. Source: Own making based on data from [4]

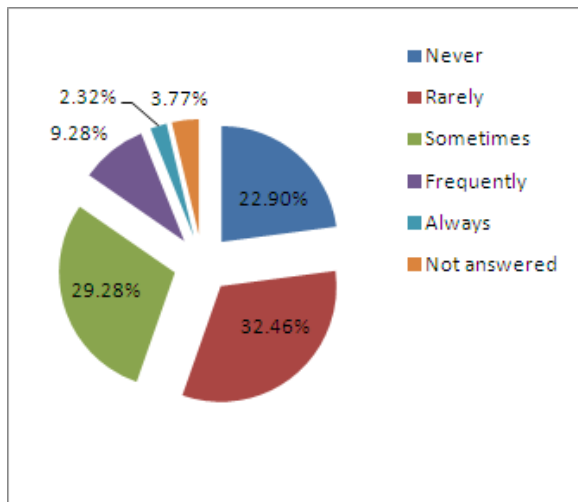


Figure 7: Share of students per frequency of assistance to online consultancies. Source: Own making based on data from [4]

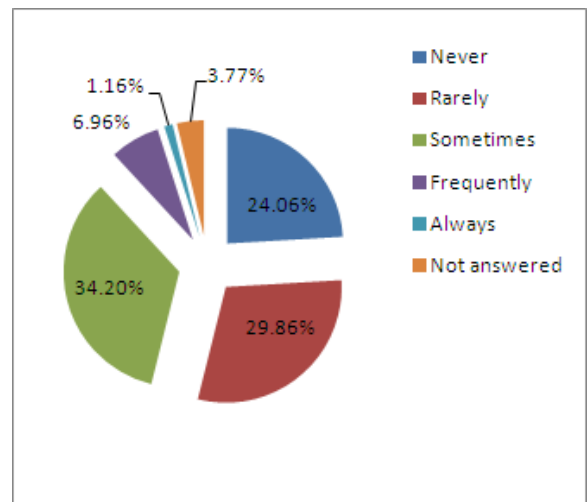


Figure 9: Share of students per frequency of queries to the assistants of the Resource Centre. Source: Own making based on data from [4]