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Full Length Research Paper

A study on the role of computers in adult education

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This paper discusses how knowledge of computers can affect our daily personal life as well as in the workplace in Greece. Our research is concerned with how useful the knowledge of computers is in the everyday life and work of adults and attempts to investigate the interest of adults for learning computer programmes and different subjects via computers. The research took place from March 30 to April 10, 2015, in Lamia, Greece. Fifty individual adults aged 18-65 years old participated in this study. According to their answers it seems that they consider knowledge of computers essential; however, the same enthusiasm was not expressed when it came to learning through a computer.

Key words: Adult education, computers, technology, literacy, learning theories.

INTRODUCTION

Learning is a personal practice and each person has his own way and perception of learning. Existing perceptions of learning greatly influence teaching methods. There are three major theories of learning, Behaviorism (Watson, 1924; Pavlov, 1927; Thorndike, 1931; Skinner 1968), Constructivism (Bruner, 1961; Duckworth, 1964; Tolman and Hardy, 1995) and Socio-cultural theories of learning (Vygotsky, 1978; Collins et al., 1989; Lave, 1998). In 1995 computers started to be used in the teaching of science and became known as Computer Assisted Learning. In particular, the Department of Veterinary science at the University of Glasgow developed a software package to replace five hours of lectures. The use of technology in the educational process is an important factor in successful teaching because it allows students to learn more in less time. Technology allows students to monitor

their own learning process and also gives them access at the touch of a button to a large amount of information (Lam and Lawrence, 2002). According to Goddard (2002), research shows that there has been an increase in the number of computers used at home and there is also a growing number of technological media in schools for educational purposes. Ginsburg (1998) proposes four approaches related to the integration of technology in adult education. According to Askov and Bixler (1996), the use of information technology can help adult learners to develop various skills such as problem-solving and the development of logical thinking. One important type of literacy in modern times, because of the huge volume of information through new technology, is information literacy. There are several definitions of the concept of information literacy which all agree on the skills needed

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to be able to search, evaluate, organize and use the information collected.

The purpose of this research is to measure how useful the knowledge of computers is in everyday life and work of adults. It also attempts to outline issues relating to adults' learning through the use of computers. According to Lawson (2005), adults have to update their knowledge and improve their skills for job purposes as well as for personal growth. Technology being cheaper has become accessible to everyone and more people have access to computers and the internet (Day et al., 2005). According to Eurostat statistics internet was used by 78% of the households in the EU in 2014 (Eurostat statistics, 2015).

Planning the research

In our attempt to outline the actual opinion of adults about learning through computers, we will present an empirical research investigating these opinions using some simple statistical techniques of preferences through questionnaires, in order to support our findings and our arguments so far.

In order to complete our project, we need to raise a series of research questions that will help us in our analysis of the issues and also guide our research. Thus, the following research attempts to:

1. Outline how useful the knowledge of using technology in is in the everyday and working life of adults.
2. Determine the degree of understanding of adults' relationship with computers.
3. Determine the frequency of computer use from adults.
4. Define how familiar adults are with a series of simple computing applications.
5. Determine the interest of adults for learning computer programmes.
6. Outline the views of adults for learning different subjects via computer.

Sample

For the statistical analysis of our questionnaire, we have chosen a sample of 50 individual adults from the city of Lamia, Greece. This sample replied in our research tool with a sense of responsibility. The completion of the questionnaires was held from March 30 to April 10, 2015. The questionnaire used as research material is listed in Appendix.

Essentially this is a closed-type questionnaire with 14 questions. All of the data and variables created are categorical, 30% of these are nominal and the remaining 70% are hierarchical.

The results of the survey are presented in bar charts in the form of percentages, and frequency allocation tables

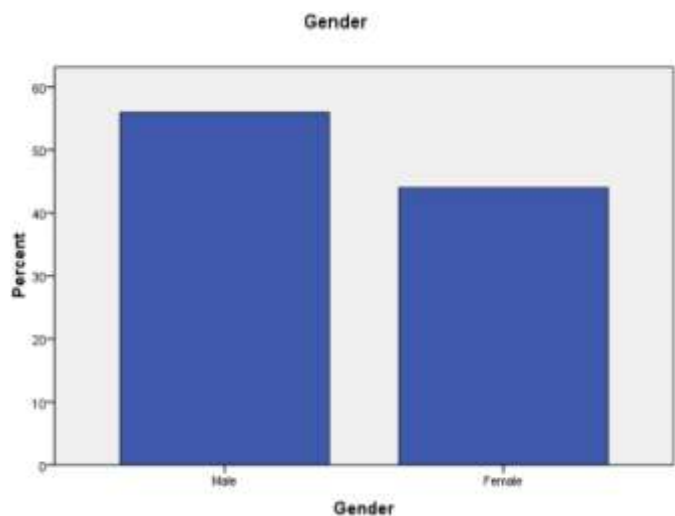


Figure 1. Demographic analysis: Gender.

are listed.

RESULTS

The first two questions of the questionnaire have to do with the demographic features of the sample. Fifty-six percent of those who replied to the questionnaires are men, while the remaining 44% are females (Figure 1).

Forty percent of the respondents are between the ages of 25 and 34 years. 34% are in the age group of 18-24 years old. 16% are between 35 and 44 years. The last 10% range from ages 45 to 65 years (Figure 2).

Fifty respondents were asked to define their level in computers knowledge, 52% of the participants responded that their level is medium, while 30% has a low level. Merely 18% thinks that their level is at optimum.

Next, they were asked how useful the knowledge of computers in their everyday lives is. The majority, that is the 36% of the people asked, answered that their knowledge is medium useful. As shown in the second bar chart, 32% thinks that the knowledge in computers is useful while the 20% in the fourth bar chart that is very useful. 8 and 4% of the sample replied that is not useful and that it is very useful, respectively (Figure 3).

Forty-four percent (44%) of the respondents said that the knowledge of computers is a little useful in their work. Allocations of other responses as shown in the other bar charts do not seem to have large deviations between them. 18% says that is not useful in their work. On the contrary, 14% considers it very useful. Finally, 6% of the participant educators consider that is highly useful (Figure 4).

Seventy-four percent of respondents said that they use a computer, while the remaining 26% do not use

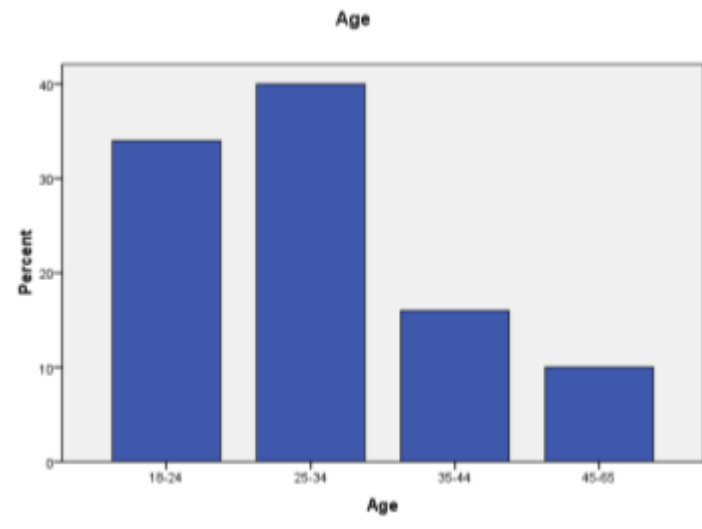


Figure 2. Demographic analysis: Age.

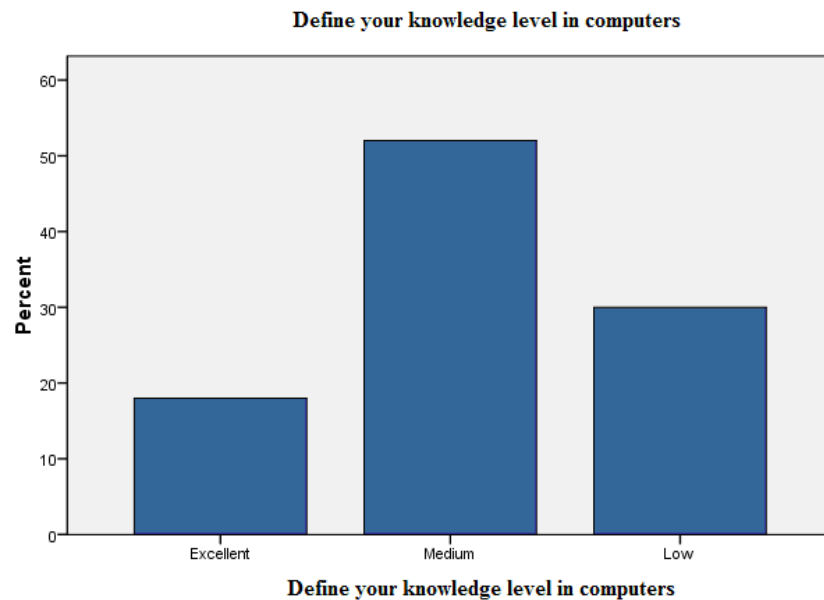


Figure 3. Defining your knowledge in computers.

computers (Figure 5).

Of the thirteen individuals who replied negatively to the question above, 92.3% would be interested in using a computer, unlike the small 7.7% who did not show the same interest for the use of computers (Figure 6). When the individuals were asked whether they have Internet access, 68% replied that they do have access, while the remaining 32% have no access to it (Figure 7). From the 16 individuals that in the previous question answered that they do not have internet access, all of them answered

that they would be interested to have one. That is, 31.4% of the respondents wish to have access to and use the Internet (Figure 8). As shown in the first bar chart, 44% of the respondents use the PC on a daily basis. The remaining response allocations show no particular deviations. 18% of the respondents replied that they use the personal computer on a weekly basis, 20% on a monthly basis, and finally the remaining 18% do not use a computer (Figure 9).

The participants were then asked to describe how

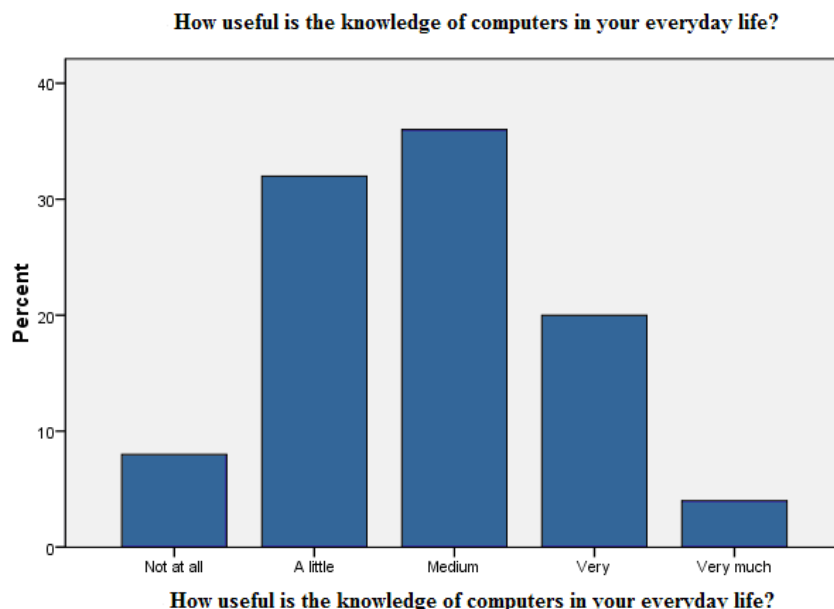


Figure 4. Usefulness of the knowledge of computers.

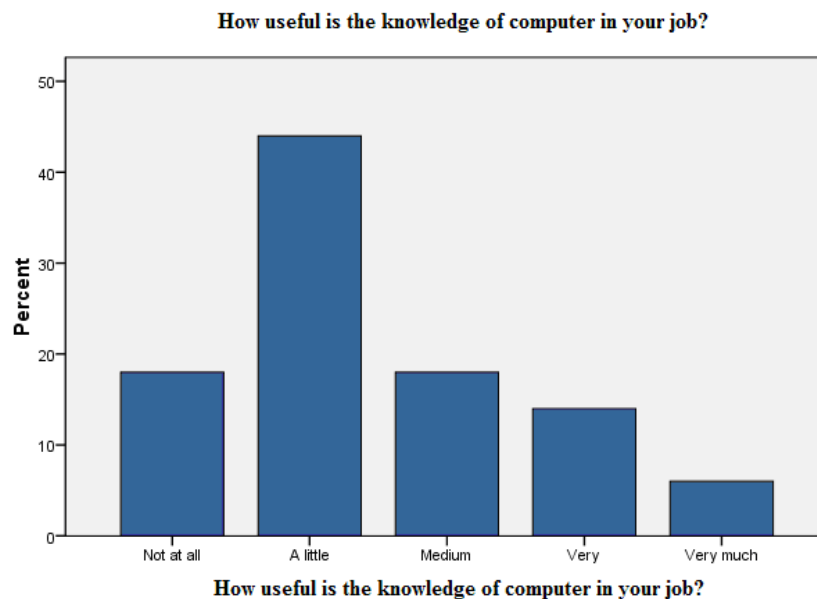


Figure 5. Usefulness of the knowledge of computers in your job.

familiar they are with some computer applications. As far as the Word processor (Word) is concerned, 52% of the respondents replied that they are very familiar with it, 16% are quite familiar, 20% are only a little familiar and, finally, 12% replied that they are not at all familiar (Figure 10). Concerning the use of spreadsheets, 44% responded that they are very familiar with them. The 28% shown in

the third bar chart believe that they are a little familiar, while 10% of the respondents replied that they do not have any familiarity with spreadsheets (Figure 11). For presentation software such as PowerPoint, there is some variation in the results. 30% responded that they have no familiarity, unlike the 12% that believe they have very good familiarity with this kind of software programs. 34%

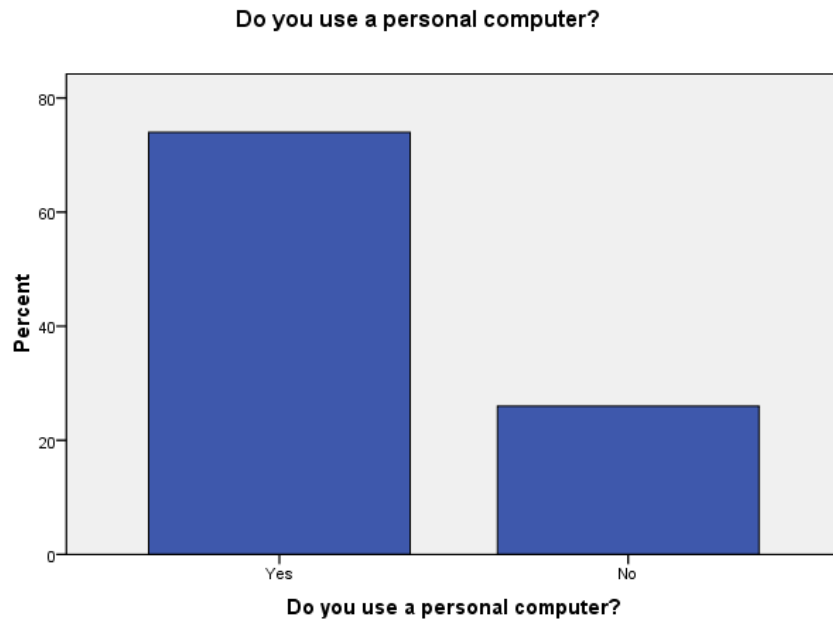


Figure 6. Use of a personal computer.

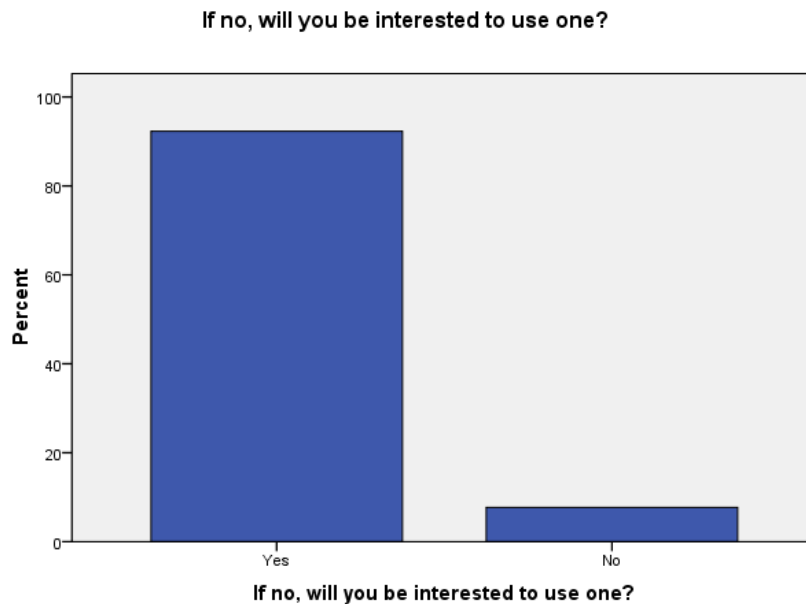


Figure 7. Interest in the use of computer.

think that they have fairly good familiarity with such software and 24% have minimum (Figure 12). Although 66% said that they are very familiar with the Internet, 18% believe that they are a little familiar with the Internet. 12% of the people asked have a pretty good relationship with the cyberspace, while 4% do not have any

relationship whatsoever (Figure 13). Fifty-four percent are familiar with search engines. 22% is also quite familiar with them, but all other distributions do not present any particular answer variation, as seen in the bar chart (Figure 14).

The email is used by 64% of the participants and they

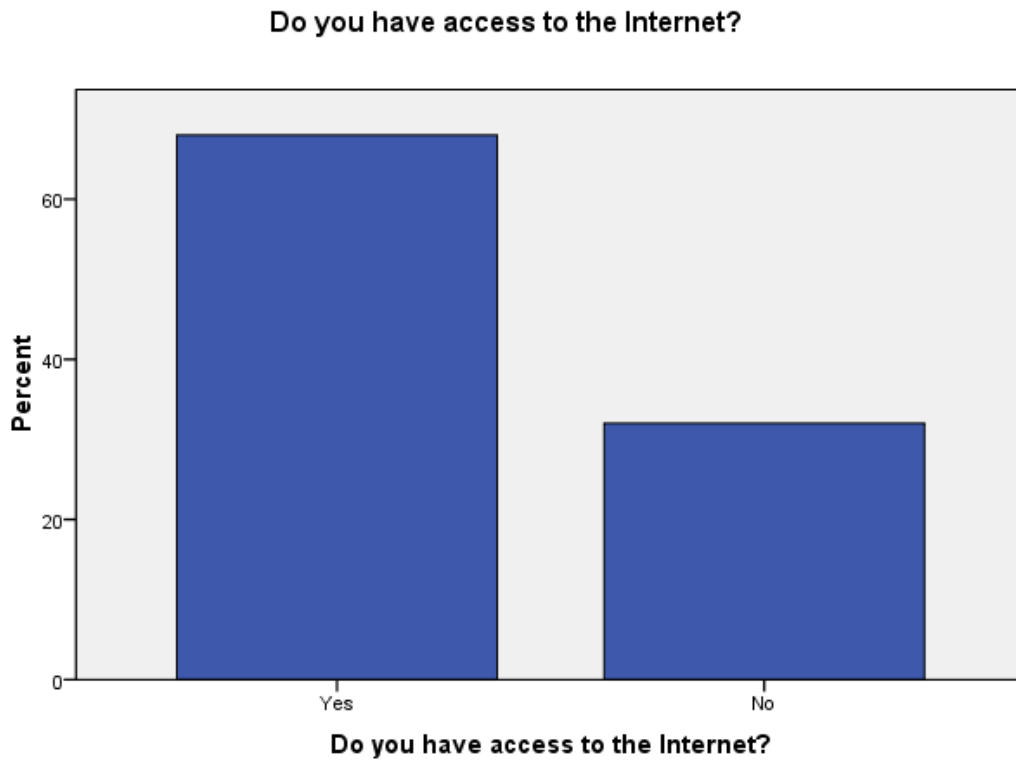


Figure 8. Access to the Internet.

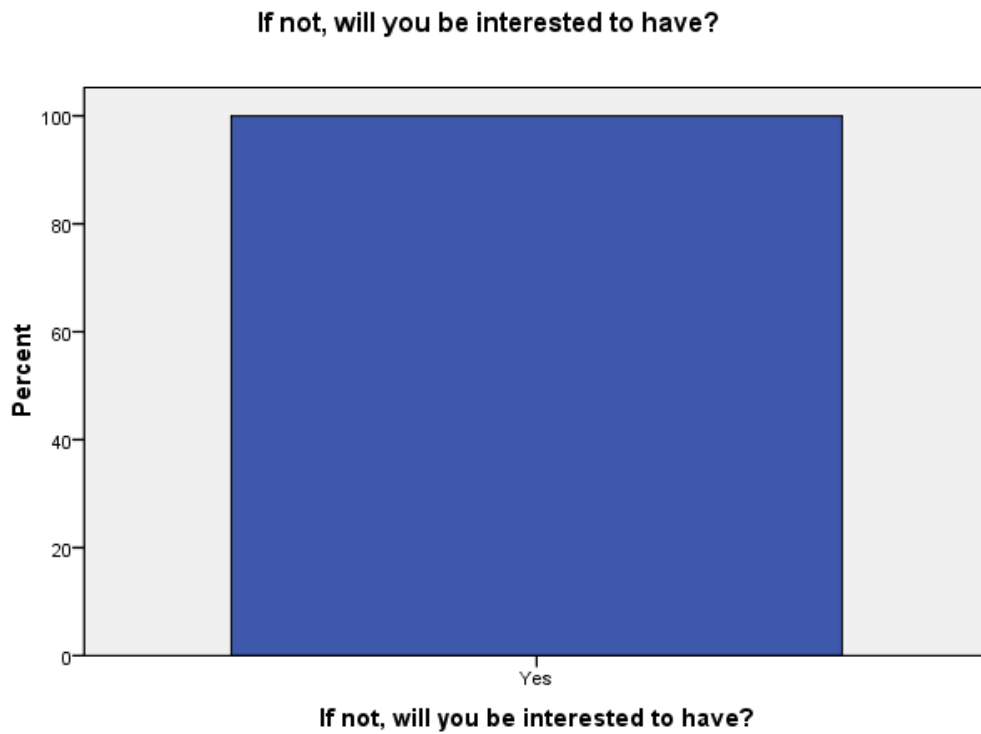


Figure 9. Interest in having access to internet.

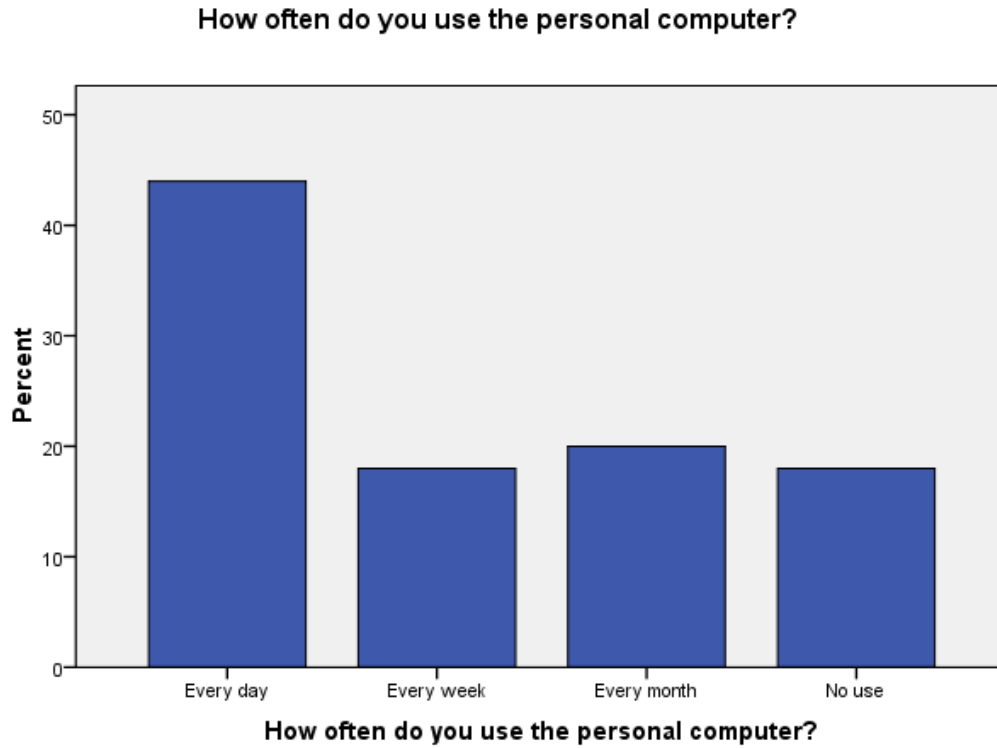


Figure 10. Frequency of computer use.

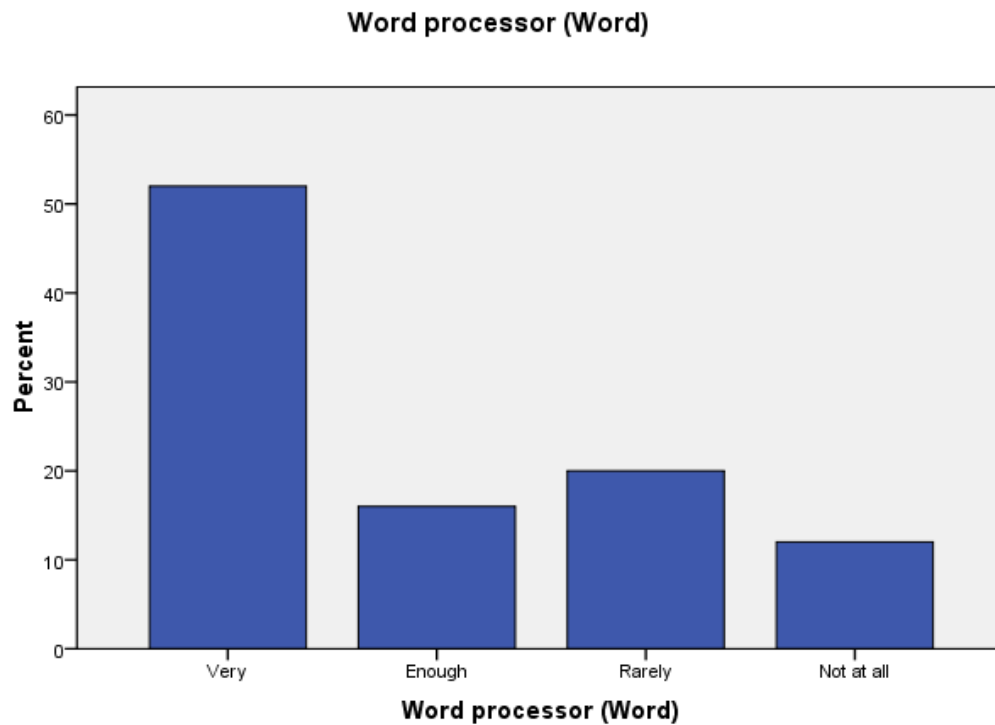


Figure 11. Word processor.

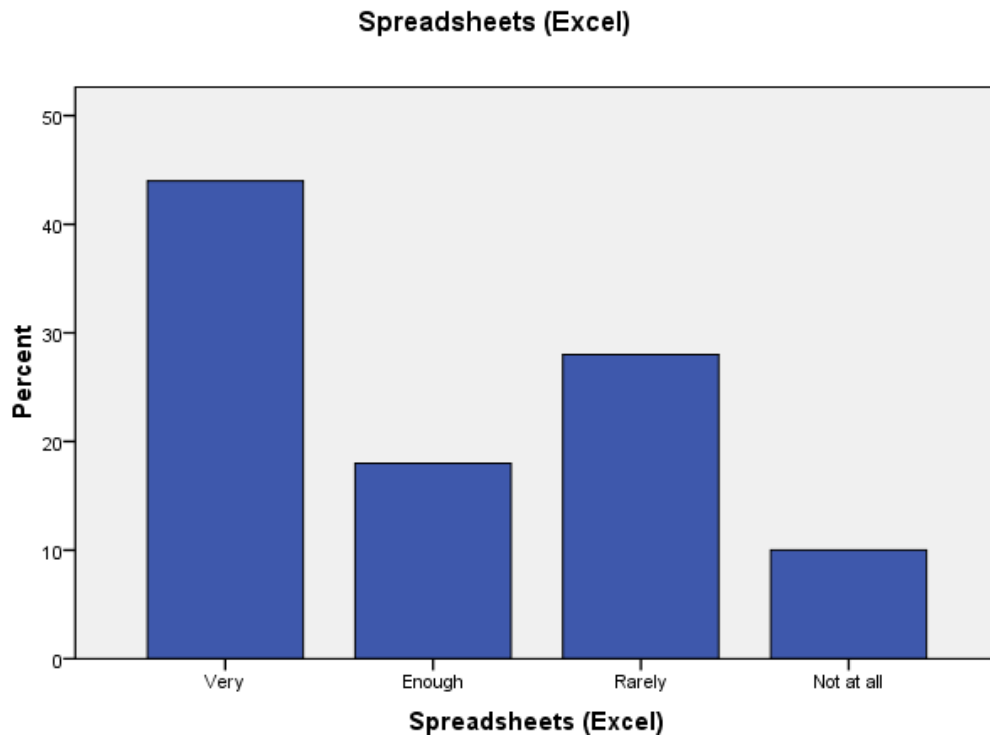


Figure 12. Use of Spread sheets (Excel).

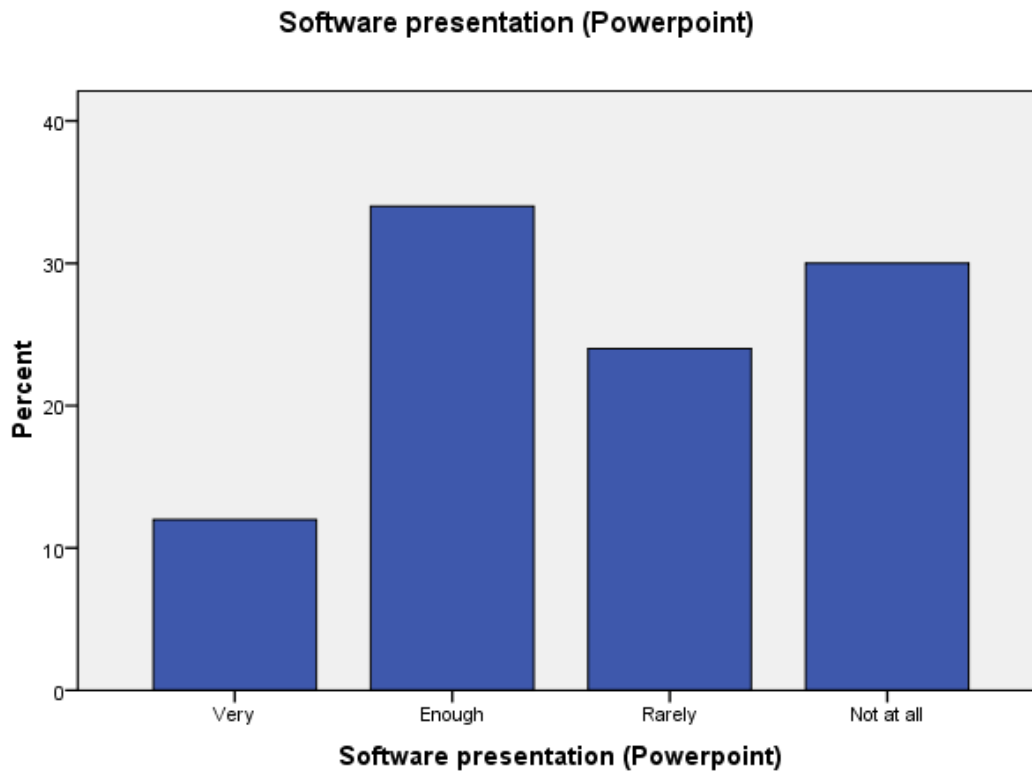


Figure 13. Use of Software presentation (Powerpoint).

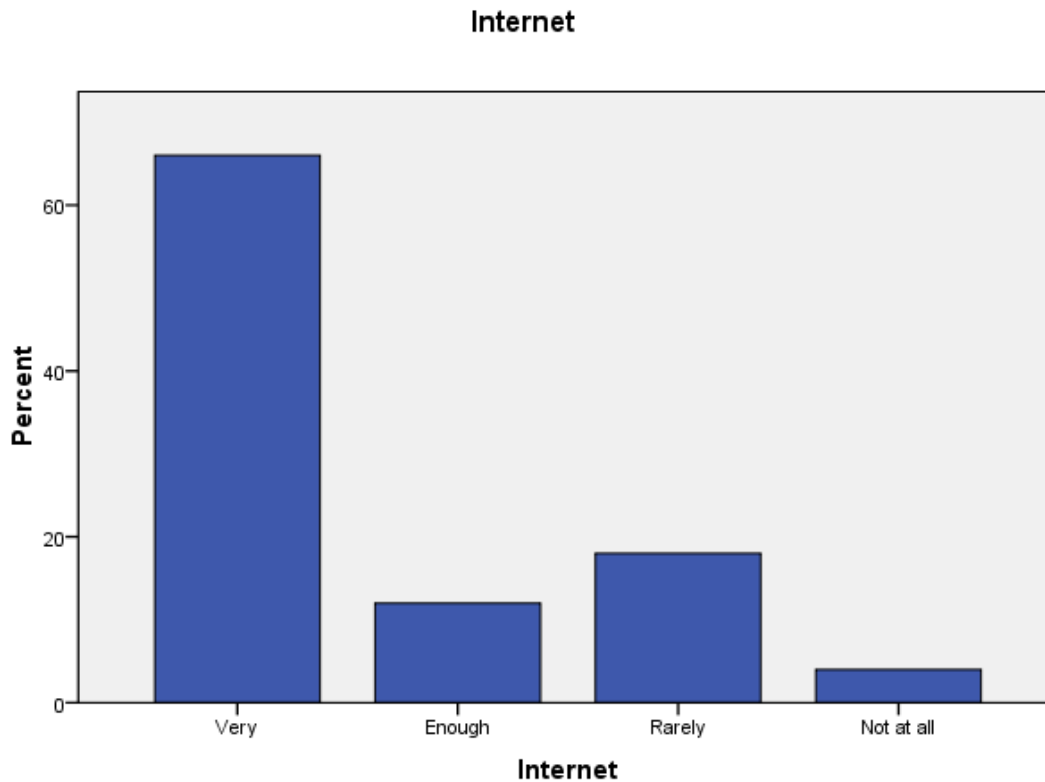


Figure 14. Use of Internet.

have very good familiarity with it, while 16% is quite familiar. 4% of the respondents stated that they are not at all familiar with the use of the email (Figure 15).

As far as Skype is concerned, the situation is a little different. The answers of the respondents are almost identically distributed. As shown in the bar chart, around 20% of the people asked replied that they are a little or not at all familiar with video calling, while around 30% are very familiar or on an average degree (Figure 16). As for blogs, 34% are not familiar with their use. 18% believe that they are very good users, while 26% that they are quite good blog users. Finally, the 22% have nothing to do with blogs (Figure 17).

Forty eight percent are very familiar with the Internet Relay Chat, while 20% said that they are sufficiently familiar with this specific application. All other distributions of responses are of no particular interest (Figure 18).

With regard to Podcasts, 34% answered that they are not very familiar with them, while 26% think that they are very good users of these applications. 26% have no adequate familiarity with Podcasts (Figure 19). As for the USB memory stick, again there is a uniform distribution in the answers of the respondents. 60% believe that they are a little or very little familiar with this device, as shown in the chart. The other 40% is shared between very and no use (Figure 20).

The participants were then asked if they use some kind of learning method. 76% responded that they indeed use some method, while the remaining 24% use no learning method (Figure 21).

Of the 38 individuals who responded positively to the question about using some learning method, 50% replied that they attend tutorial courses. 23.7% have a private tutor and 10.5% are learning using a personal computer (CD-ROM). 5.3% said that they are learning through the Internet, while four people out of 38 (that is, 10.5%), learn some other way (Figure 22).

Forty two percent of the respondents consider that knowing such programs like word or excel is highly useful and would like to improve it. 22% believe that is very useful, while 8% consider that it is not. Distributions of other replies do not show any particular variation (Figure 23). To the question of whether they believe that the computer can be used successfully to learn a specific subject, 62% of respondents replied that they agree with this opinion. The remaining 38% do not believe that the computer helps in learning a specific subject (Figure 25).

From the following diagram, it seems that not many would choose the learning of a specific subject by computer, given that 58% of the respondents stated that they would never choose a learning method through e-learning or CD-ROM. The remaining 42% would actually

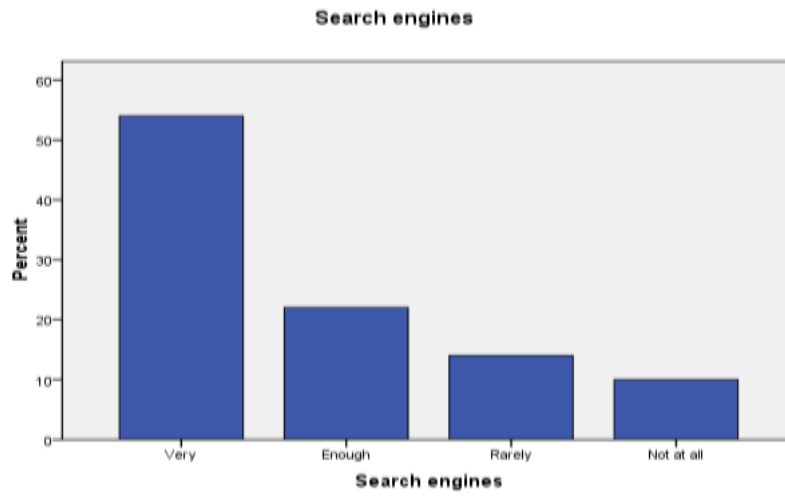


Figure 15. Use of Search engine.

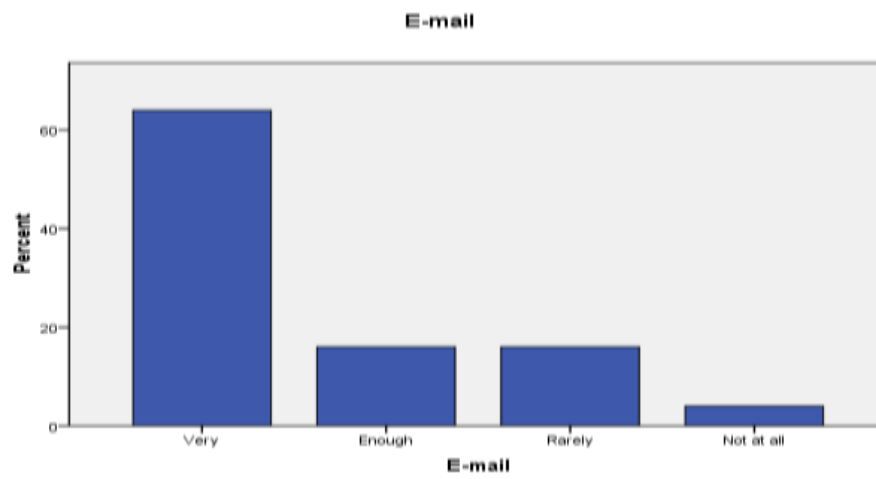


Figure 16. Use of E-mail.

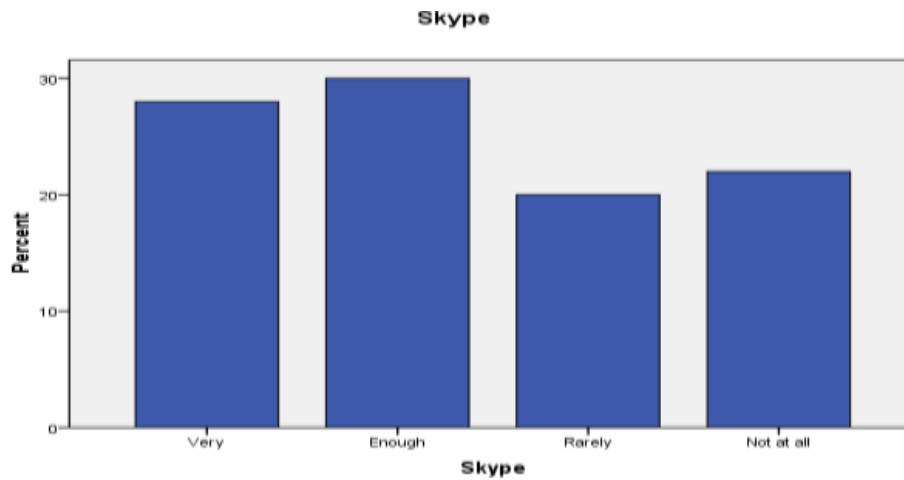


Figure 17. Use of Skype.

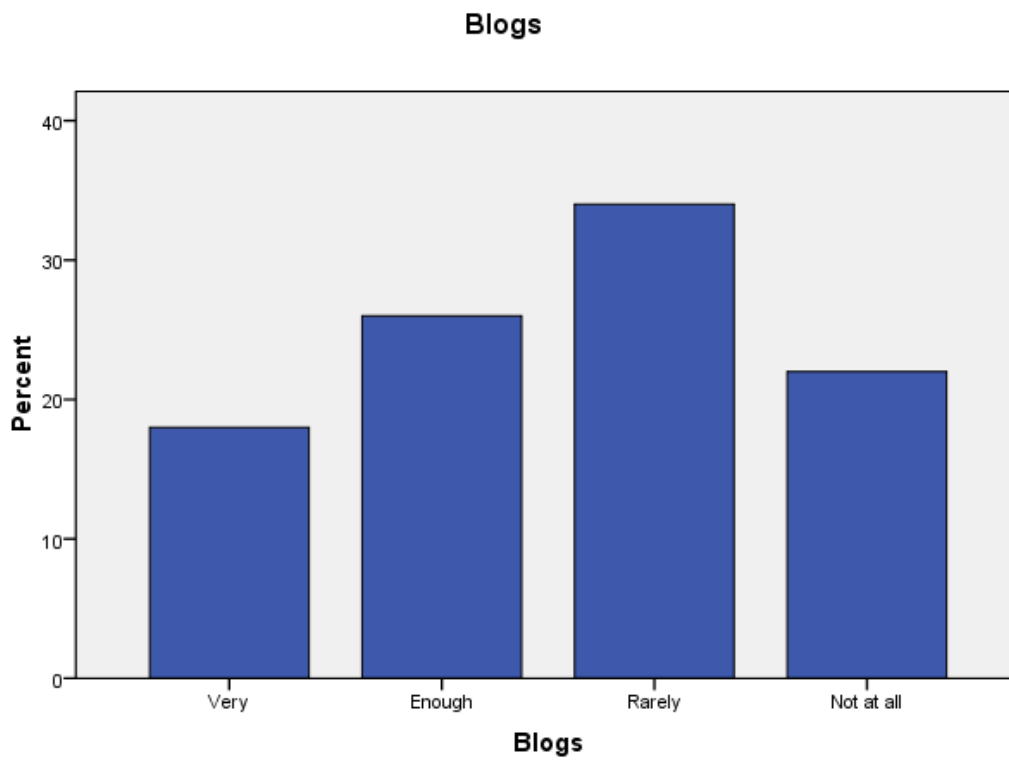


Figure 18. Use of Blogs.

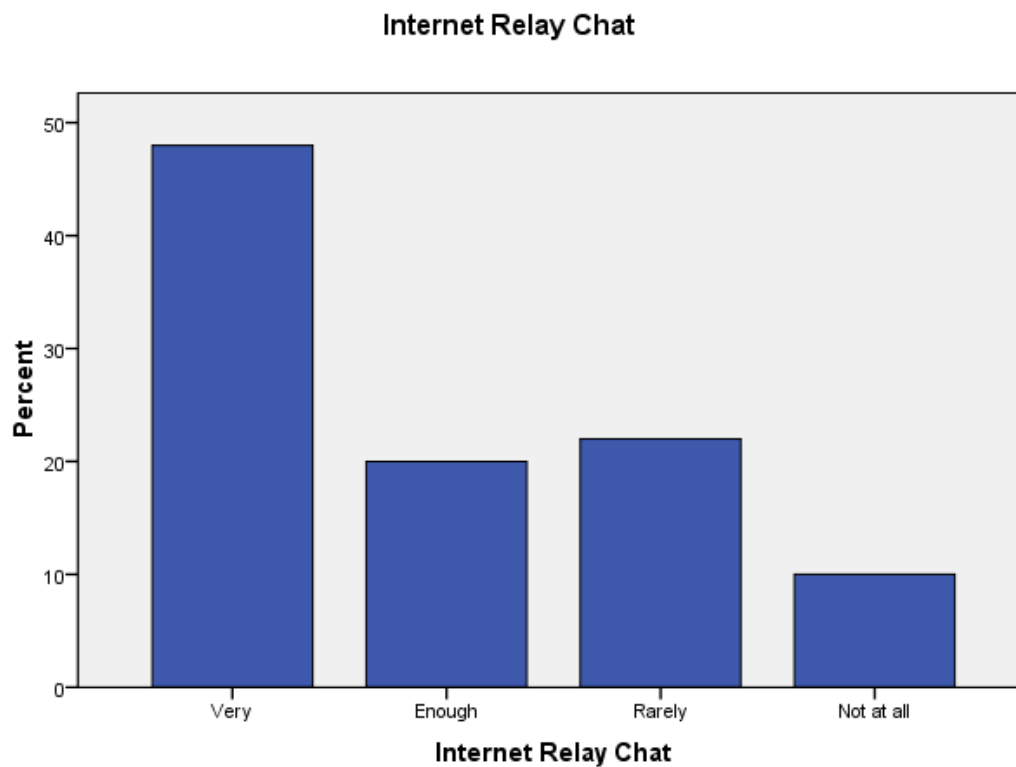


Figure 19. Use of Internet Relay Chat.

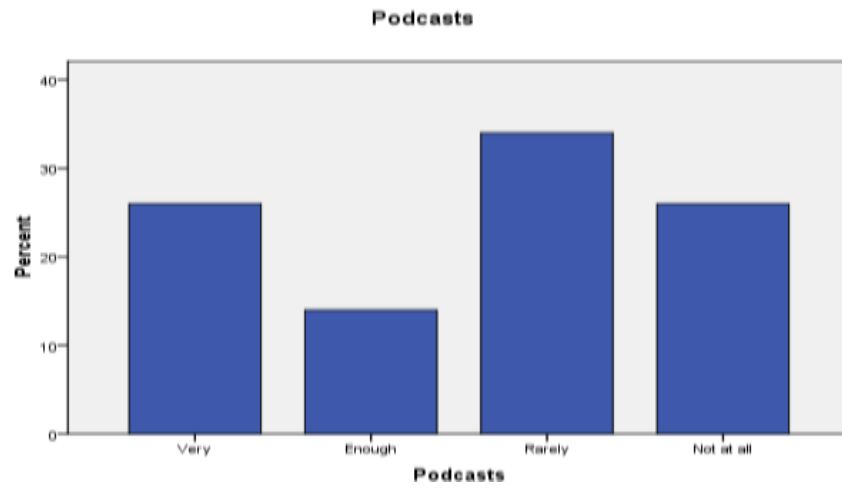


Figure 20. Use of Podcasts.

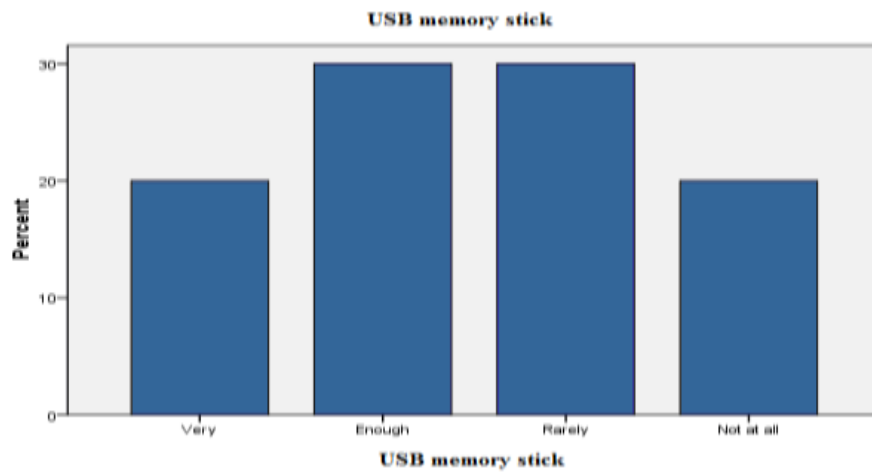


Figure 21. Use of USB memory sticks.

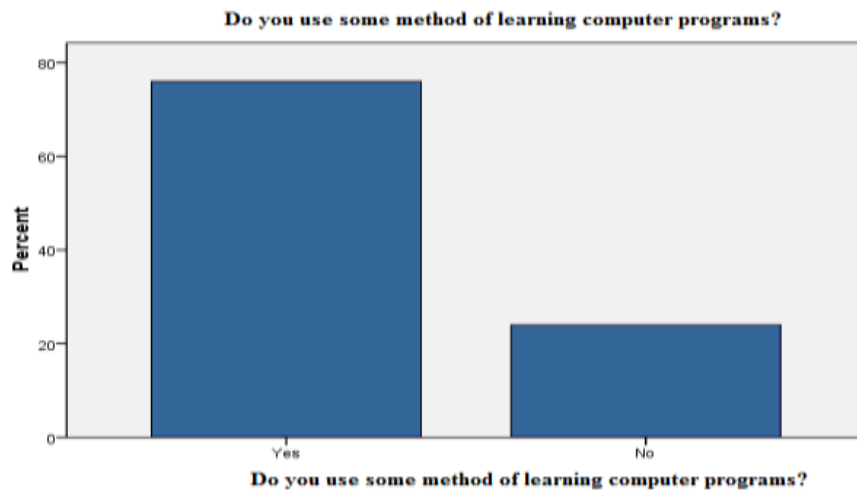


Figure 22. Method of learning computer programs.

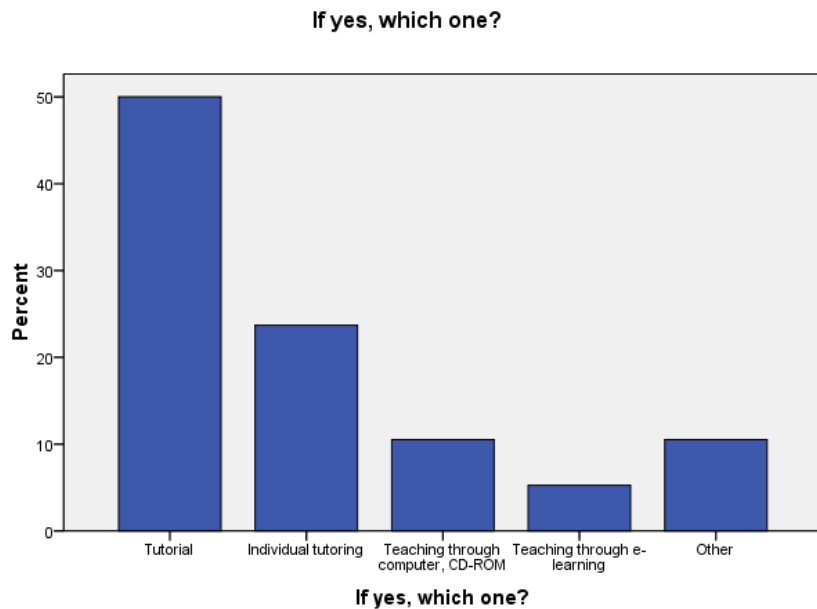


Figure 23. Types of methods.

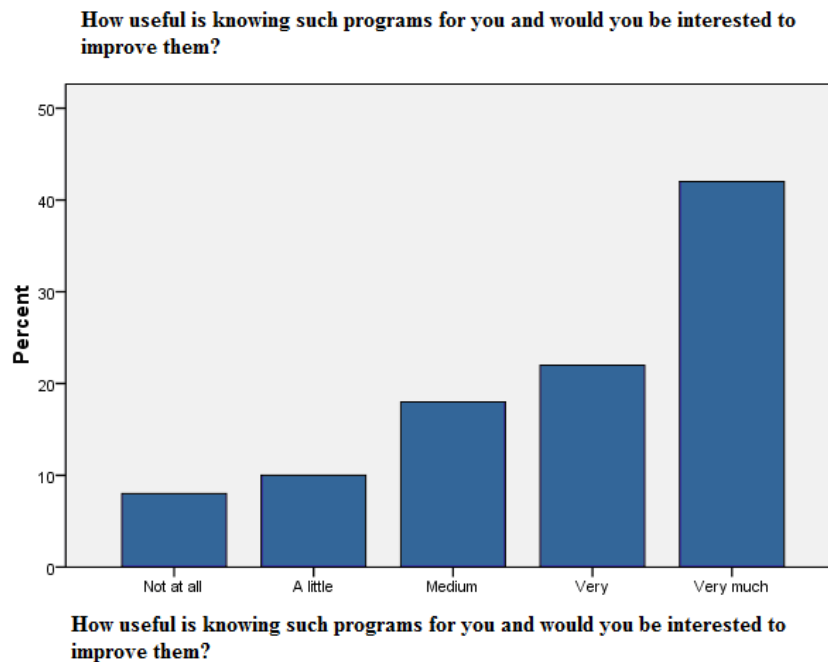


Figure 24. Importance of knowing such programs.

select this method (Figure 26).

Conclusion

The objective of this research is to measure how useful

the knowledge of computers is in the everyday life and work of adults. This research also attempts to outline issues relating to the adults' learning through computing. According to the answers they gave, it seems that they consider the usefulness of knowledge of computers major; however, the choice of learning through a computer

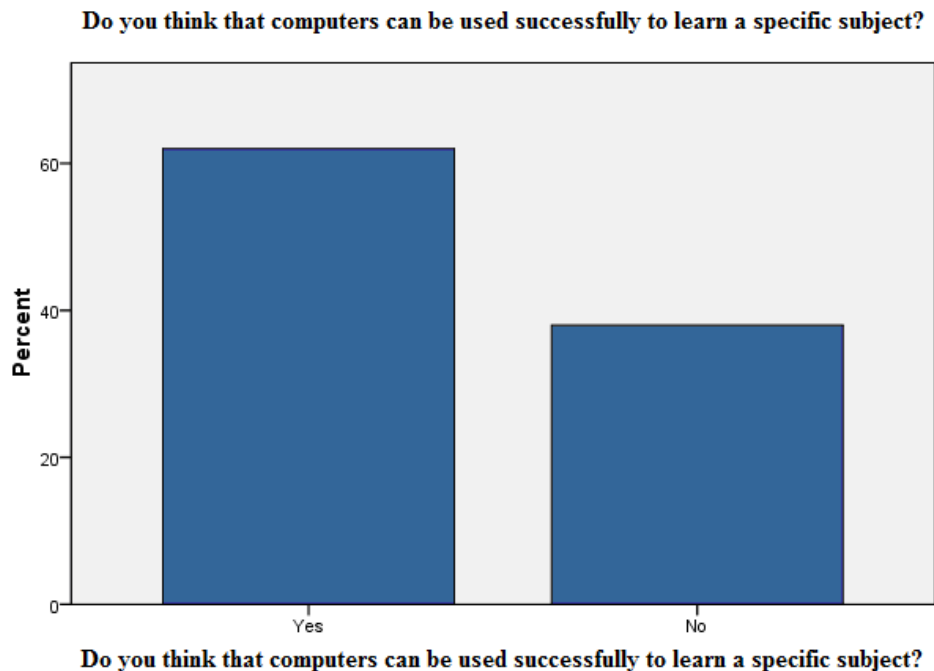


Figure 25. Use of computer to learn a specific subject.

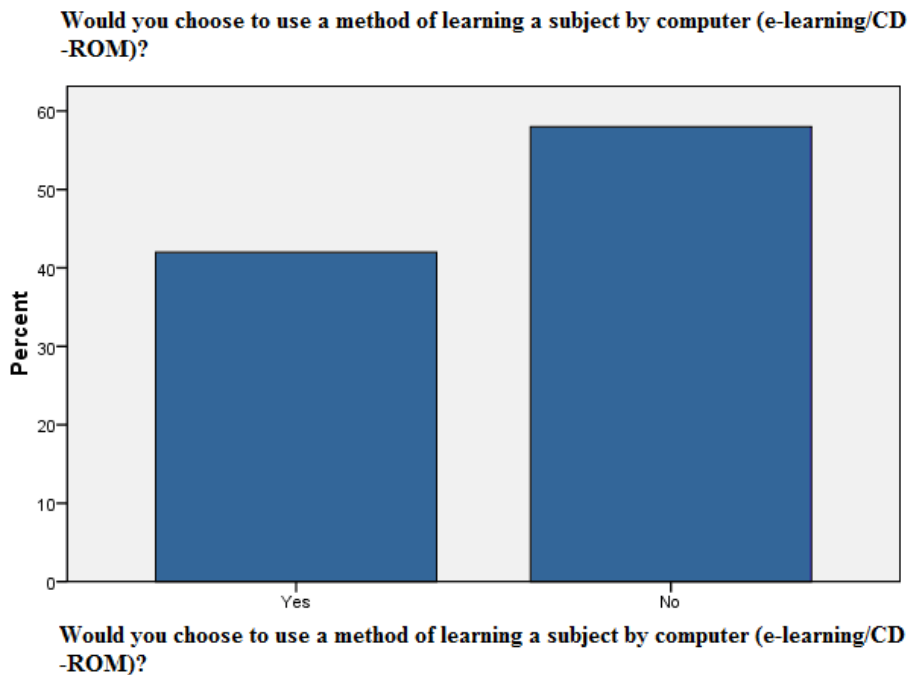


Figure 26. Choice of a method for learning a subject by computer.

does not appear to be of special acceptance. Several adults use computers nowadays and, although not everyone

has access to the Internet, everyone would like to have one. What is more, the frequency of use of computers by

adults is on a daily basis, although many use it on a weekly or even monthly basis.

Concerning the determination of the familiarity of adults with a series of simple computing applications, the findings are ambiguous. In some applications, adults seem to be better users than in some others. Excel, Word, Skype and the search engines are probably closer to the lives of adults, and in many cases, they use them in their work, as well. Thus, familiarity with them is inevitable.

The interest of adults for learning a specific subject with the use of a computer is quite remarkable, and all of them want to improve their knowledge. Many of them use different methods of learning, with tutorials and private tutoring being some of their first preferences.

In any case, of course, the opinion of adults for learning through the computer is not sufficiently encouraging. Most of them believe that learning through the computer is not profitable enough, and they would not select it.

In conclusion, it could be said that, although a large percentage of adults use computers in their everyday lives, they are not familiar enough with them so as to use them for other functions, such as learning a specific subject. Nevertheless, it would be useful to get information from the competent users as regards the benefits and advantages of the method of learning through the computer and for the distance education, as it could be used as an additional means of learning different subjects.

Conflict of Interests

The authors have not declared any conflicts of interests.

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Appendix**QUESTIONNAIRE**

Please tick the appropriate box for the following questions.

Demographic features

1. Gender	Male	Female			
2. Age	18-24	25-34	35-44	45-65	65+

B. RELATIONSHIP WITH COMPUTERS.

3. Define your knowledge level in computers	Excellent	Medium	Low		
4. How useful is the knowledge of computers in your everyday life?	Very much	Very	Medium	A little	Not at all
5. How useful is the knowledge of computers in your job?	Very much	Very	Medium	A little	Not at all

C. Familiarity with the use of a personal computer.

6a. Do you use a personal computer?	Yes	No			
6b. If not, would you be interested to use one?	Yes	No			
7a. Do you have access to the Internet?	Yes	No			
7b. If not, would you be interested to have?	Yes	No			
8. How often do you use the personal computer?	Every day	Every week	Every month	No use	

9. How familiar are you with the following applications/ software or device on the personal computer?

Application/ Software or Device	Very	Enough	Not very	Not at all
Word processor (Word)				
Spreadsheets (Excel)				
Software presentation (Powerpoint)				
Internet				
Search engines				
E-mail				
Skype				
Blogs				
Internet Relay Chat				
Podcasts				
USB memory stick				

D. Interest for learning computer programs such as windows, word etc.

10a. Do you use some method of learning computer programs? Yes No

10b. If yes, which one? Tutorial Individual tutoring Teaching through computer, CD-ROM Teaching through e-learning Other

11. How useful is knowing such programs for you and would you be interested to improve them? Very much Very Medium A little Not at all

E. Learning a specific subject using a computer.

12. Do you think that computers can be used successfully to learn a specific subject? Yes or No

13. Would you choose to use a method of learning a subject by computer (e-learning/CD-ROM)? Yes or No

14. Do you think that there are disadvantages in learning a specific subject with the e-learning method?

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Full Length Research Paper

The development of program for enhancing learning management competency of teachers in non-formal and informal education centers

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The objectives of this research are: 1) to study factors and indicators 2) to study current situations, desirable situations and techniques 3) to develop the Program 4) to study the effect of Program. It comprised 4 phases: 1; studying the factors and indicators 2; studying the current situations, desirable situations and techniques 3; developing the Program 4; to examine the results of the program. The research instruments used for data collection were questionnaire, evaluation form, and test. The statistics used for data analysis were percentage, mean, and standard deviation. The research findings show that: 1. Factors for ELMCT consisted of 6 factors and 30 indicators were in “the highest level”; 2. Current situations were in “moderate” level. The desirable situations were in “the highest” level. Content analysis method was administered. The frequencies were ranged from high to low as follows: training/workshop, site visiting, coaching, self-study, brainstorming and focus group discussion. 3. The results of evaluation found that it was in “the highest” level in usefulness, feasibility, suitability and accuracy. 4. The mean score of pre-development was = 16.95 points or 56.52%, and mean score of post-development was = 24.64 points or 81.12%. The results of evaluation demonstrated that teachers’ learning management competency was in “moderate” level. The post-development was in the highest level”. The evaluation of satisfactions of 22 target persons was in “the highest” level in every aspect.

Key words: Teachers’ competency enhancement, program for enhancing the ELMCT, non-formal education, informal education.

INTRODUCTION

Non-formal education is a kind of study that plays an important role in human development to be important power of national development. The Office enhancing Non-Formal and Informal Education, was a major work unit being directly responsible for Non-Formal Education Management of target group as underprivileged or those

who was lacked of educational opportunity in school so that they would have opportunity in studying and searching for knowledge, practicing their skills, and developing their attitude in order to live happily and suitably with themselves as well as be important power of country. (Cholatid Eam-sam-ang, 2008) Besides, the most

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important responsibility of Office of Non-Formal and Informal Education is in developing new age learning source to occur with quality.

The teachers under jurisdiction of Office of The Non-Formal and Informal Education are responsible for providing activities as well as facilities for target group. The major role of teachers under jurisdiction of Office of the Non-Formal and Informal Education is different from teachers in school system. Since they would not only be those who transferred knowledge content, but also persons who would teach the students' technique in searching for knowledge as student-centered and determiners. Teachers would guide direction for students' knowledge leading to learning, and be facilitators inspiring the enthusiasm and counselors so that the students would be able to solve their own problems (Office of the Non-Formal and Informal Education, 2010). For teacher development, Office of Promotion for the Non-Formal and Informal Education would provide support for teachers' success in work practice as Educational Staffs since it is sustainable staff development relevant to their work practice. The public sector applied Competency-based Approach in developing level of competency and capability which are behavioral group the organization needed from the government officials. Because it was believed that if the government official had working behavior needed by the organization, that official would have had good performance. As a result, the organization would accomplish its expected goal (Office of Civil Service Commission, 2007).

For new age teaching professional development under strategy of Educational Reform, the important indicator of development is Competencies-Based Development. In addition, the teaching professional development includes basic competency necessary for work practice, especially the student-centered learning. Teacher development based on competency is the persons' characteristic development in work practice including knowledge, skills, ability, and other characteristics related to working. Furthermore, it is behavioral characteristic which causes the organizational staffs to have the most prominent performance in various situations caused by different Motives, Traits, Self-image, and Social role. Consequently, there would be different working behaviors. It was supported by guidelines for developing new age competency development of staff management in public sector of Office of Civil Service Commission by promoting and supporting the public sector of human resource management based on Standard for Success (The Office of Basic Education Commission, 2010: 3).

Management of Teacher Development Program, an important thing needed to be considered by teachers, is

self-learning from the teachers' teaching experience determining self-development activities (Somwang, 2006: 46). Moreover, the professional development was a process and activity designed for improving professional knowledge, skill, and attitude which would lead to the students' learning improvement (Guskey, 2000: 16-22). Teacher development based on one's competency is to develop one's characteristic in work performance including: knowledge, skills, ability, and other characteristics related to their work. Behavioral characteristic cause the staffs' most prominent performance in various situations, as a result of different motives, traits, self-image, and social roles. There are different working behaviors.

So, teacher development is important to have skills in providing their students' learning management. Consequently, it is necessary for teachers' teaching in the office of the non-formal and informal education to obtain development in the approach as well as learning activity management by various new techniques relevant to the guidelines for Educational Management of National Educational Act 1999. The important material in Section 24, the Learning Process Management is needed to provide the content material as well as activity relevant to students' interest and aptitude so that they would practice their skills, thinking process. The students can learn from real situation as well as practice for doing, thinking and problem solving. The schools have to promote teachers' competency in providing the students' learning and knowledge (Amonwich, 2001: 8).

According to the above problems and necessities, the researcher as an officer working in the office of the non-formal and informal education, considered that the promotion in the office of non-formal and informal education did not determine the competency of teachers, under jurisdiction of office of the non-formal and informal education, was an important factor of student and school development. Besides, it was also faced with many problems in staff development of this group. Therefore, the researcher was interested in studying the competency of teachers, under jurisdiction of office of the non-formal and informal education by analyzing necessary competency of teachers.

Research objectives

1. To study the factors and indicators for learning management competency of teachers, under jurisdiction of office of the non-formal and informal education.
2. To study the current situations and desirable situations of teachers, and technique for developing the teachers, under jurisdiction of office of the non-formal and informal education

3. To develop the program for enhancing learning management competency of Teachers, under jurisdiction of office of the non-formal and informal education
4. To study the effect of program for enhancing learning management competency of teachers, under jurisdiction of office of the non-formal and informal education

METHODOLOGY

Research and development was administered by 268 directors, and 268 teachers under jurisdiction of Office of The Non-Formal and Informal Education, Kammuang District, Kalasin Province, Thailand. The target group of this study consisted of 22 teachers. There were 2 kinds of research instruments: 1) the instrument for work development: Handbook for Work Implementation, and 2) the instrument for data collection. The statistic used for data analysis included the percentage, mean, and standard deviation. There are 4 phases of in this research.

Phase 1: the researcher determined 3 steps including: Step 1: to study the approach and theory of Factors and Indicators of Competency in Learning Management; Step 2: to synthesize the approach and theory of Factors and Indicators of Competency in Learning Management and Step 3: the factors and indicators of Teachers' Learning Management Competency were validated by 5 experts. The research instrument for data collection was the evaluation form of propriety in factors and indicators of Teachers' Competency in Learning Management by using Likert's 5 level rating scale.

Phase 2: The study of current situations, desirable situations, and techniques for developing the ELMCT, the researcher determined 3 steps including: Step 1: to study the approach, theory, and related research literature of Learning Management; Step 2: to synthesize the Learning Management Factors and Step 3: the current situations and desirable situations for developing the Learning Management Competency of Teachers, were surveyed from 268 administrators, and 268 teachers under jurisdiction of Office of The Non-Formal and Informal Education, Thailand. The research instrument for data collection was the questionnaire asking opinion of administrators and teachers.

Phase 3: The development of Program for Enhancing the Learning Management Competency of Teachers, The 3 stages were determined by researcher including: Stage 1; the information for Phase 1 and Phase 2 were developed the program, Stage 2; To draft Program for Enhancing the Learning Management Competency was outlined based on factors of program development including the following factors: 1) rationale and concepts of program, 2) objectives of program, 3) target performance of program, 4) contents of program including with 6 Modules, 5) techniques for enhancing and development, 6) evaluation of program and 7) output and outcome of 22 teachers. The stage of drafting or designing program consisted of 5 steps as follows: Step 1: the perception and searching for problem, Step 2: planning, Step 3: determining of norm, Step 4: acting, and Step 5: evaluation of development. And Stage 3; To draft handbook for enhancing the program.

Phase 4: The usage of Program Enhancing Learning Management

Competency of 22 target persons under jurisdiction of Office of The Non-Formal and Informal Education, the researcher determined 2 stages. Stage 1: the usage of Program Enhancing Learning Management Competency of Teachers, there are four steps as follows: Step 1: Pre-developing : a) the evaluation of teachers' learning management competency, b) self-study, c) site visiting and d) testing knowledge management competency of teachers. Step 2: Developing program: the training based on program implemented. Step 3: Integrating teachers' learning management by practicing with their routine works, and Step 4: the Post-developing including: a) Following up period, b) Evaluating learning management competency of teachers c) Testing teacher's knowledge, d) Evaluating teachers' satisfactions towards program. Stage 2: the evaluation of learning management competency of teachers, three are three steps: Step 1: Evaluating teachers' learning management competency by using the Test. Step 2: Evaluating teachers' learning management competency by using the evaluation form that was developed by the researcher. Step 3: Evaluating teachers' satisfactions towards learning management competency.

Research Instruments

Two kinds of research instruments are used: 1. The instrument for work development is handbook for working; 2. The instrument for data collection including: (1) the evaluation form of program efficiency, (2) the questionnaire of satisfaction, (3) the record form of activity participation in program use, and (4) the knowledge test of teachers' learning management.

RESEARCH FINDINGS

The findings of this researcher based on research objectives are as follows:

The findings of learning management competency of teachers is in "the highest" level. Considering each factor, ranked in order from high to low is as follows: learning concepts based on learning substance, designing adults learning styles, using and developing learning media and learning innovation, measurement and evaluation, using and developing adult curriculum and providing variety learning process respectively.

The findings of indicators for learning management competency of teachers under jurisdiction of office of the non-formal and informal education are in "the highest" level. The findings of current situations, desirable situations, and techniques for developing learning management competency of teachers are as follows:

The current situations of teachers' learning management competency are in "moderate" level. Considering each factor, ranked in order from high to low is as follows: measurement and evaluation, learning concepts based on learning substance, using and developing learning media and learning innovation, designing adults learning styles, using and developing adult curriculum, and

providing variety learning process respectively. The overall desirable situations are in “the highest” level. Considering each factor, ranked in order from high to low includes: learning concepts based on learning substance, using and developing adult curriculum, measurement and evaluation, designing adults learning styles, providing variety learning process, and using and developing learning media and learning innovation accordingly.

The techniques for developing the learning management competency of teachers under jurisdiction of Office of The Non-Formal and Informal Education were administered by content analysis. The frequencies were ranked in order from high to low: training course, field trip study, coaching, workshop, brainstorming, and focus group discussion.

The findings of development in Program for Enhancing the Learning Management Competency of Teachers under jurisdiction of Office of The Non-Formal and Informal Education are as follows:

The factors of Program for Enhancing the Learning Management Competency of Teachers under jurisdiction of Office of The Non-Formal and Informal Education, are as follows: 1) rationale and concepts of program, 2) objectives of program, 3) target performance of program, 4) contents of program including 6 Modules: Module 1: using and developing adults curriculum, Module 2: learning concepts based on Learning Substance, Module 3: designing adults learning styles, Module 4 providing variety learning process, Module 5: using and developing learning media and learning innovation and Module 6: measurement and evaluation for 180 h, 5) techniques for enhancing and development, 6) evaluation of program and 7) output and outcome of 22 teachers. The design and technique used various methods for constructing intensive knowledge, comprehension, and learning skills for participants to be able to use it in self-development continuously. The techniques of implementation on program were: 1) training/workshop; 2) site visiting; 3) knowledge management; 4) self-study 5) brainstorming and 6) focus group discussion. The 4 Steps of development implementation were determined in development process including: Step 1: Pre-developing; Step 2: Developing program; Step 3: Integrating teachers' learning management; Step 4: Post-developing.

The findings of establishment for handbook of Program for Enhancing Learning Management Competency of Teachers consisted of 4 parts: Part 1; Introduction, Part 2; Program for Enhancing Teachers' Learning Management Competency, Part 3; Enhancement of teachers' learning management competency, and Part 4; Measurement and evaluation.

The usage findings of Program for Enhancing Learning

Management Competency of Teachers are as follows:

The findings of knowledge testing in Learning Management Competency of 22 target teachers are as follows: the mean score of pre-development is 16.95 out of 30 points, or 56.52%. The mean score of post-development is 24.64 out of 30 points, or 82.12%. It indicates that the teachers under jurisdiction of office of the non-formal and informal education obtained significantly higher post development scores than the pre-development; every person can pass criterion of 80%.

The findings of learning management competency of teachers in pre-development are in “moderate” level. For post development, the overall is in “the highest” level. The findings of participants' satisfaction on Program Enhancing Learning Management Competency of Teachers in every aspect are in “the highest” level.

The details of Program Enhancing Learning Management Competency of Teachers are shown in Figure 1.

DISCUSSION

The Factors of Learning Management Competency of Teachers, validated by the experts are in “the highest” level. In addition, the findings of Indicators of Learning Management Competency of Teachers, validated by the experts are in “the highest” level. It was supported by research findings of Suwit (2013: 247-248) on “The Visionary Leaders of Primary School Administrators of Basic Education Commission. It was found that the developed Program for Development of Primary School Administrators of Basic Education Commission consisted of the following factors: 1) the Background and Significance of Program, 2) the Objective of Program, 3) the Design and Technique of Development, 4) the Structure of Program, and 5) the Major Content and Material of Program. It was supported by research findings of Nongnuch (2002: 117-120) on “Factors of Professional Nurse's Competency and Relationship between Professional Competency and Some Selective Factors of Professional Nurses in Hospitals, under Ministry of Public Health.” According to research findings, there are 6 Factors of Professional Nurse: the Nursing Competency, the Management of Administration, the Personality, the Ethics and Morality, the Health Service, and the Specialist Nursing. It was supported by research findings of Yaowapa (2004: Abstract) on “Factor Analysis of Competency in Work Practice of primary school teachers in the Office of Dhonburi Educational Service Area, and the Office of Nongkam Educational Service Area, under jurisdiction of Bangkok.” The research findings found that there are 4 factors of primary school

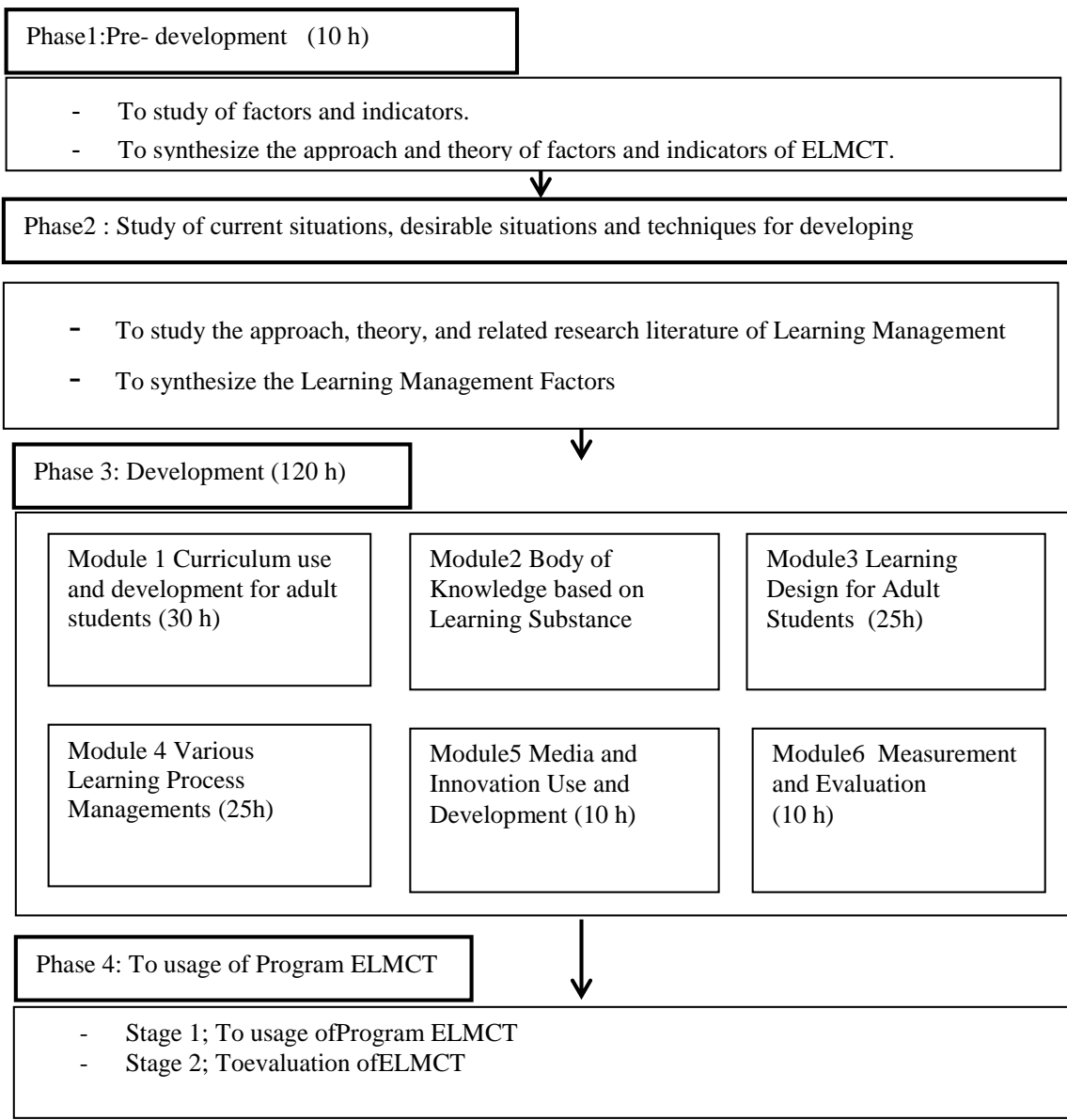


Figure 1. Program for enhancing the learning management competency of teachers, under jurisdiction of office of the non-formal education and informal education.

teachers' competency in work practice: 1) the knowledge and comprehension in learning and teaching, 2) the measurement and evaluation, 3) the application in new techniques for learning and teaching, and 4) the code of conduct in teaching profession. It was supported by research findings of Nipa Pongwirat (2004: 153-161) in "The Comparative Study of School-based Management Competency of Secondary Schools in Bangkok." The research design was mixed methodology. The research

findings showed that according to the Quantitative Research, there are 8 major factors of new management factors of School-based Management in Bangkok Secondary Schools, 12 sub-factors, 60 Indicators. The eight factors are: Goal Setting, Empowerment, Development of Sense of Belongingness, Development of Work Management, Development of Commitment, Work Performance, Charter of Working Right, and Learning and Teaching Management. There were no

significant differences in work practice between the Pilot Schools, and the Developing School. But, there were significant differences in Work Practice of High Level of Work Practice, and the Low Level of Work Practice. Five Best - in - Class Schools were found from each Factor after visiting the samples. It was supported by research findings of Anan (2011: 42) on "Development Program for developing the Basic School Administrators' Competency." It was found that there were 4 Parts of Development Program for developing the Basic School Administrators' Competency: Part 1: the Introduction, Part 2: the Details of Program for developing the Basic School Administrators' Competency, Part 3: the Evaluative Instrument of Efficiency in Program for developing the Basic School Administrators' Competency in Field Study, and Part 4: the Guidelines, Condition, Indicators of Success in applying the Program for developing the Basic School Administrators' Competency. It was supported by research findings of Preecha (2002: 19) on "The Determination of Knowledge Management Factor," that the major factors of Knowledge Management are: the Staff, the Administration and Management, the Building and Site, the Material, Equipment, and Hardware. The Supervision Media was provided including: the printed material, the technology media, the learning media and equipment and supervision, and the following up and evaluation.

Current situations in Learning Management Competency of Teachers are in "moderate" level. Desirable situations of learning management competency of teachers are in "the highest" level. In addition, the Technique for Enhancing Learning Management Competency of Teachers, by content analysis is ranked in order from high to low: training course, field trip study, knowledge management, workshop, brainstorming and the focus group discussion. It was supported by research findings of Suwit (2013: 247-248) on "Development of Visionary Leadership of Primary School Administrators, under the Office of Basic Education Commission." The research findings showed that the current situations of visionary leadership, and the need for developing the Visionary Leadership of Primary School Administrators are in "high" level. Besides, it was supported by research findings of Chaipong (2005) on "Private School Administrators' Competency in Nongkai Province." It was found that the Private School Administrators in Nongkai Province, had competency in their work practice in "high" level including: the competency in Ethics and Morality, the Working Competency, and the Competency in Knowledge respectively. Moreover, it was supported by viewpoint of Boyatzis (1982: 58) that "Competency" referred to the person's Underlying Characteristic including: Motive, Trait, Skill, Self-Image or Social Role or Body of Knowledge which

were necessary to be used in work practice for better performance/higher than specified criterion. Furthermore, it was supported by research findings of Radsame Sukanya 2006: 1) included definition of "Competency" in Knowledge, Skill, and Personal Characteristic of Attributes which caused the person to work with better responsibility than the others. It was supported by research findings of Narong (2503: 29) on the significance of knowledge management. Knowledge management in school is an important variable on students' learning achievement regarding the ethics and moral inculcation for students as well. For the administrators who emphasized student development to be "Intelligent Person," and "Good Person," it was necessary to focus on learning development in school. Besides, it was supported by research findings of Department of General Education (2001: 4), which defined "Knowledge Management" as Knowledge aimed to develop different skills and abilities which would help each person to be able to learn independently as life-long learning, and to use their full potential. In other words, Learning could help students to have self-actualization.

The Program for Enhancing Learning Management Competency of Teachers, consisted of 7 factors: 1) rationale and concepts of program, 2) objectives of program, 3) target performance of program, 4) contents of program including with 6 Modules: Module 1: using and developing adults curriculum, Module 2: learning concepts based on Learning Substance, Module 3: designing adults learning styles, Module 4 providing variety learning process, Module 5: using and developing learning media and learning innovation and Module 6: measurement and evaluation for 180 hours approximately; 5) techniques for enhancing and development, 6) evaluation of program and 7) output and outcome of 22 teachers. The various designs and techniques aimed to construct intensive knowledge, comprehension, and learning skill so that the participants would be able to use it continuously for their self-development. The techniques used for program development are: 1) training/workshop) 2) site visiting, 3) coaching, 4) self-study, 5) brainstorming and 6) focus group discussion. Four steps were determined for development process including: Step 1; Pre-development, Step 2; Development program, Step 3; Knowledge Integration, and Step 4; Post-development. In addition, the findings of establishment in Handbook of Program for Enhancing Learning Management Competency of Teachers, consisted of 4 parts. Part 1: Introduction, Part 2: Enhancing Learning Management Competency of Teachers, Part 3: Enhancement of Teachers' Learning Management Competency, and Part 4: Measurement and Evaluation. It was supported by research findings of Parinya (2009) on "The Effect of

Program Design for Teachers' Participatory Professional Development," found that most of teachers administered 8 Designs of professional development including: the Training, the Observation, the Participation in Development Process, the Group Study by every school teacher, the Action Research, the Self-study, the Coaching System, and the study in Higher Education. It was supported by research findings of Yod-a-nong (2010) on "Development of Program for enhancing the Leader Teachers in Knowledge Management based on Guidelines for Educational Reform," found that the Program was effective since the teachers who participated in development program, obtained higher posttest Mean Score than the specified criterion. It was supported by research findings of Sirilak (2011) on "Program Development of Teachers for Learning Reform in Small Sized Primary School, found that the implementation based on Project in Shared Thinking, Affection, and Intention Setting, the teachers obtained higher knowledge, comprehension, attitude, and skill in curriculum, the class management, the Knowledge Management, and the Evaluation. Besides, it was relevant to use the approach of Hansa (2000: 41)'s conclusions of 3 Parts of Factors in Program Development including: 1) Context, 2) Goal, and 3) Plan or Method. The 3 factors needed to be appropriate or adequate for being successful in development. It was supported by statement of Osborn (2013 : Website) regarding 7 major factors of Staffs' Development Training Program: 1) the congruence with goal, 2) the congruence with learning culture of organization, 3) the need assessment, 4) the content, 5) the determination of evaluation indicating the success, 6) the marketing and communication, and 7) the measurement of business strategy and impact.

The findings of usage of program for enhancing learning management competency of teachers are as follows: knowledge testing in the learning management competency of teachers had pretested Mean Score of 16.95 out of 30 Full score, or 56.52%. The post-test Mean score was 24.64 out of 30 Full score, or 82.12%. It indicated that every teacher had higher post-test score than the pre-test score, passing the criterion 80%. For the findings of evaluation in learning management competency of teachers, the pre-test is in "moderate" level. Their post-test score was in "the highest" level. It was supported by research findings of Anan (2011: 42) on "Research and Development of Program for Developing the Basic School Administrators". It was found that the Program for Developing the Basic School Administrators was viewed by: 1) the experimental group reacted the Program for Developing the Basic School Administrators, in overall and each aspect, in "high" level, 2) for the post-test of development based on the Program for Developing the

Basic School Administrators, the experimental group obtained knowledge and skill based on Basic School Administrators' Competency. They applied their knowledge and skill into practice. In addition, their post-test performance from work practice was significantly higher than the pre-test at .01 and .05 levels, and 3) the post-test of development based on Program for enhancing the Basic School Administrators' Competency in the experimental group was significantly higher than the control group at .01 level. It was supported by research findings of Chintana (2011: 762-770) in "Research and Development of Program for enhancing the Academic Leadership in Basic Schools"; he found that: 1) the pre-test and post-test in trying out the Development Program enhancing Academic Leadership, with every kind of participants, was significantly higher at .01 level, 2) the academic change of schools was in "high" level, 4.49, 3) the samples' reaction on the project was in "high" level, 4.40, 4) the Students' Desirable Characteristic based on Basic Education Curriculum 2001, in overall, was in "high" level, or 92.85%. It was indicated that the developed Program for developing Academic Leadership of Basic School Staffs, had quality based on the specified research hypothesis.

According to the stated reasons, the researcher developed the program for enhancing learning management competency of teachers, under jurisdiction of office of the non-formal and informal education, recognized in value, and viewed that the program of development included utility, propriety, feasibility, and accuracy which could be used in real situation.

RECOMMENDATIONS

1. For application of Program for Enhancing Learning Management Competency of Teachers, under jurisdiction of Office of The Non-Formal and Informal Education, the objective, duration, content, methodology, supplementary media, and evaluation should be studied to be relevant to target group for the most useful and efficient.
2. The research participants should be teachers who are interested in self-development by program for enhancing learning management competency, and willing to cooperate with development.
3. The use of Program for Enhancing Learning Management Competency of teachers, under jurisdiction of Office of the Non-Formal and Informal Education could be willing to cooperate with development.
4. The web of information system in Learning Management Theory for Adults as well as activities and games promoting the learning, should be established to be sources for teachers to use in developing their

Learning Management Competency and working more efficient.

5. Comparative study of various development techniques should be conducted in order to compare comparative findings, and search for techniques to develop the learning management competency most efficient and effective.

6. The research studies should be conducted in order to follow up or further study in enhancing other aspects of competencies of teachers under jurisdiction of office of the non-formal and informal education, for instance, the enhancement of community learning.

7. The program for enhancing the work of administration for non-formal and informal education. This study should be administered into program for enhancing the work practice in non-formal and informal education through internet so that it would be studied or cause self-development in every place and time by teachers under jurisdiction of office of the non-formal and informal education.

Conflict of Interests

The author(s) have not declared any conflicts of interests.

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Full Length Research Paper

Using the wonder of inequalities between averages for mathematics problems solving

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The study presents an introductory idea of using mathematical averages as a tool for enriching mathematical problem solving. Throughout students' activities, a research was conducted on their ability to solve mathematical problems, and how to cope with a variety of mathematical tasks, in a variety of ways, using the skills, tools and experiences they have acquired. The article illustrates different mathematical averages, the relation between them, and the ability to use them as an important alternative tool for solving mathematical problems. Various examples for the use of the properties in the relations between the different averages were given for the following purposes: proving inequalities, solving algebraic and trigonometric equations, investigating functions and determining the properties of geometric shapes in the plane and in the space. Also presented was the methodological aspects of the use of averages and a minor research conducted among students, on the contribution to the knowledge of this tool for mathematical problem-solving.

Key words: Problem-solving, different proofs, combinations of fields in mathematics, various mathematical averages.

INTRODUCTION

The study attempts to integrate mathematical domains and properties as a useful tool in the course "strategy for solution of mathematical problems", as part of the program of studies of the unit for mathematical education in the high school route of the "Shaanan" College for Teacher Training. The study attempt to teach mathematics through problem-solving working, based on the various mathematical averages and the relationship between them. The mathematical averages can be an important and powerful tool for solving mathematical tasks belonging to different fields: algebra, geometry, analytical geometry, trigonometry and also in differential

mathematics.

Problem-solving

The problem-solving "concept" has been a staple of school mathematics since the early 1980s. Its importance has been emphasized in documents that guide mathematics teaching and learning in various countries, and researchers have sought to better understand students' thinking and reasoning, to improve their problem-solving and, ultimately, their learning (Chunlian

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et al., 2014). Most mathematics educators agree that the development of students' problem-solving abilities is a primary objective of instruction, and how this goal is to be reached involves consideration by the teacher of a wide range of factors and decisions (Lester, 2013).

Proofs in mathematics

Proof and reasoning are fundamental in solving mathematical problems: they help us make sense of the mathematics, aid in communicating mathematical ideas, and justify the validity of mathematical theorems (Martin et al., 2005). One would never doubt the importance of proof in mathematics in general, nor in school mathematics (Harel and Sowder, 2007). The roles of proof are to prove, to explain, and to convince (Hanna, 1990; Herch, 1993). Stylianides (2007) defines *proof* as "A *mathematical argument*, a connected sequence of assertions for or against a mathematical claim, with the following characteristics:

1. It uses statements accepted by the classroom community (*set of accepted statements*) that are true and available without further justification;
2. It employs forms of reasoning (*modes of argumentation*) that are valid and known to, or within the conceptual reach of, the classroom community;
3. It is communicated with forms of expression (*modes of argument representation*) that are appropriate and known to, or within the conceptual reach of, the classroom community (p. 291)."

Stylianides uses this definition to analyze instruction involving proof and to illuminate possible actions teachers may take to support proving activities in their classrooms. Lo and McCrory (2009) propose that in order to understand proving activities in mathematics courses, a fourth element in the definition should be added:

4. The proof is relative to objectives within the context (*context dependence*) which determine what needs to be proved.

Rav (1999) indicates that a proof is valuable not only because it demonstrates a result, but also because it may display fresh methods, tools, strategies, and concepts that are of wider applicability in mathematics and open up new mathematical directions. In Rav (1999) view, proofs are indispensable to the broadening of mathematical knowledge and are in fact "the heart of mathematics, the royal road to creating analytic tools and catalyzing growth". As Rav's (1999) states in his thesis, "proofs, rather than the statement-form of theorems, are bearers of mathematical knowledge". Hanna and Barbeau (2008) examine Rav (1999) central idea on proof, and then discuss its significance for mathematics education in general and for the teaching of proofs in particular.

Hemmi and Lofwall (2009) after a study in which they explored mathematicians' views on the benefits of studying proofs, concluded that "all mathematicians in the study considered proofs valuable for students because they offer students new methods, important concepts, and exercise in logical reasoning needed in problem solving". It is thus no wonder that developing students' ability to prove and reason is one goal of the curricular standards in many countries. For example, one principle for American school mathematics is: "reasoning and proof should be a consistent part of students' mathematical experiences in prekindergarten through grade 12" (NCTM, 2000).

Learning mathematics is fundamentally about "acquiring a mathematical point of view", "developing mathematical reasoning", "learning to communicate mathematically", "making connections" in mathematics, and building "connections" with other disciplines and (among mathematical) experiences (NCTM, 2000). Because learning mathematics involves discovery, proof and reasoning are powerful ways of developing insight, making connections and communicating mathematically. National Council of Teachers of Mathematics (NCTM) underlines this fact by claiming:

"Being able to reason is essential to understanding" (NCTM, 2000).

This suggests that proficiency in mathematical proof and reasoning is an integral part of mathematics. Similar to NCTM, mathematics educational researchers also argue that they should not undervalue the role of argumentation and proofs in students' learning and support the idea of including this subject in the school curricula and in teacher education programs. For example, Ball et al. (2000), Dreyfus (2000) and Hanna (1996) support this position:

"Proof is central to mathematics and as such should be a key component of mathematics education. This emphasis can be justified not only because proof is at the heart of mathematical practice, but also because it is an essential tool for promoting mathematical understanding" (Ball et al., 2000, IX ICME). "Proof is at the heart of mathematics, and is considered central in many high school curricula" (Dreyfus, 2000). "It maintains that proof deserves a prominent place in the curriculum because it continues to be a central feature of mathematics itself, as the preferred method of verification, and because it is a valuable tool for promoting mathematical understanding" (Hanna, 1996).

One problem, multiple solutions and proofs

Mathematics educators agree that linking mathematical ideas by using more than one approach to solving the

same problem (for example, proving the same statement) is an essential element in the development of mathematical reasoning (NCTM, 2000; Polya, 1973; Schoenfeld, 1985). Problem-solving in different ways requires and develops mathematical knowledge (Polya, 1973), and encourages flexibility and creativity in the individual's mathematical thinking (Krutetskii, 1976; Silver, 1997; Tall, 2007; Leikin and Lev, 2007).

In addition to the specific roles of proof in mathematics, the study suggest that attempts to also prove a certain result (or solve a problem) using methods from several other different areas of mathematics (geometry, trigonometry, analytic geometry, vectors, complex numbers, etc.) are very important in developing deeper mathematical understanding, creativity, and appreciating the value of argumentation and proof in learning different topics of mathematics. The study approach of presenting multiple proofs to the same problem, as a device for constructing mathematical connections is supported by the study of Polya (1973, 1981), Schoenfeld (1988), NCTM (2000), Ersoz (2009) and Levav-Waynberg and Leikin (2009).

Very similar to the study notion of 'One problem, multiple solutions/proofs' is the idea of multiple solution tasks (MST) presented by Leikin and Lev (2007), Leikin (2009) and Levav-Waynberg and Leikin (2009). MSTs contain an explicit requirement for proving a statement in multiple ways. Leikin (2009) indicates that the differences between the proofs are based on using:

1. Different representations of a mathematical concept.
2. Different properties (definitions or theorems) of mathematical concepts from a particular mathematical topic.
3. Different mathematics tools and theorems from different branches of mathematics or
4. Different tools and theorems from different subjects (not necessarily mathematics) (Stupel and Ben-Chaim, 2013).

Adding the concept of multiple solutions/proofs for one problem into the curriculum of mathematics studies, as well as MSTs, allows the development of connected mathematical knowledge not only for students, but for their teachers as well.

The aesthetics and the beauty of mathematics

Many times over the last 50 years, important things have been said about the polyphonic aesthetics and beauty of mathematics. Also various studies in mathematics but mostly in mathematics education engaged on the importance and their contribution to the teaching profession. Here are a few quotes and sources for this subject:

"Mathematics is one of the greatest cultural and intellectual achievements of human-kind and citizens should develop an appreciation and understanding of that achievement, including its aesthetics and even recreational aspects" (NCTM, 2000).

"The mathematician's patterns, like the painter's or the poet, must be beautiful; the ideas, like the colors or the words, must fit together in a harmonious way. Beauty is the first test: there is no permanent place in this world for ugly mathematics" (Hardy, 1940).

"Although it seems to us obvious that the aesthetics is relevant in mathematics education, the aesthetics also seems to be elusive when attempting to purposefully incorporate it in the mathematical experience" (Gadanidis and Hoodland, 2003).

"Mathematical beauty is the feature of the mathematical enterprise that gives mathematics a unique standing among the sciences" (Rota, 1997).

"Mathematicians who successfully solve problems say that the experience of having done so contributes to an appreciation for the power and beauty of mathematics" (NCTM, 1989).

Mathematicians and mathematics educators believe aesthetics should be an integral part of math class (Sinclair and Crespo, 2006; Sinclair, 2009; Dreyfus and Eisenberg, 1996).

Various mathematical averages

In daily life, when one uses expressions such as "average age", "average salary" and "average height", everyone understands the meaning of the expression, since the average is an essential tool in statistics.

In mathematics, there are several types of averages, as elaborated in the present study. To differentiate between the different types of averages, each one is given a different name. To clarify the issue, it is specified where the different averages appear, what is the relation between them and how these relations are used for proving inequalities, for solving algebraic and trigonometric equations, for investigating functions and for determining the properties of geometrical shapes in the plane and in the space. Illustration of averages in different fields, proof of the relations between them and their utilization for solving problems, point to the beauty and completeness of mathematics.

The studies and the implementation of the material to the solution of various problems do not require complex mathematical tools, and therefore the spectacular material presented in this study is suitable not only for pre-service and in-service teachers of mathematics, but also for high-school and pre-high-school students. The study mainly presents mathematical tools for solving "by a different method", which is sometimes shorter and very

simple. Many mathematicians dealt with proofs and applications of inequalities between averages; the study wanted to stress the effectiveness of using inequalities in cases in which usual ways lead to difficulties and complications.

Definitions

For n positive numbers $a_1, a_2, a_3, \dots, a_n$ the study define the following averages:

Arithmetic average: $\frac{a_1 + a_2 + a_3 + \dots + a_n}{n}$

Geometric average: $\sqrt[n]{a_1 \cdot a_2 \cdot a_3 \cdot \dots \cdot a_n}$

Harmonic average: $\frac{n}{\frac{1}{a_1} + \frac{1}{a_2} + \frac{1}{a_3} + \dots + \frac{1}{a_n}}$

The average of squares: $\sqrt{\frac{a_1^2 + a_2^2 + a_3^2 + \dots + a_n^2}{n}}$

(Handbook of mathematical functions, 1964; Dragoslav and Mitrović, 1970).

Averages appear often in geometry and algebra. It is only worthy to mention that the property that characterizes an arithmetic progression is the one according to which every term starting from the second is the arithmetic average of its two neighbors, and for this reason the progression is called an arithmetic progression.

Similarly, in a geometric progression with positive elements, each term starting from the second one is the geometric average of its two neighbors, and hence follows the name of the progression. When considering the sequence $1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \dots$, it is easy to see that each term, starting from the second one, is the harmonic average of its two neighbors. This sequence is called a harmonic sequence, and the series $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots + \frac{1}{n} + \dots$ that is called a harmonic series is very important in differential calculus. It is also easy to show that each sequence of numbers, whose terms are the inverses of the terms of an arithmetic progression, is a harmonic sequence.

Additional examples for the harmonic average

Average velocity

A bicycle rider cycles uphill at the steady velocity of v_1 ,

and back downhill at the velocity v_2 . What is the average velocity along the entire route?

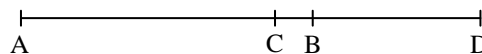
Solution

The study denote the travelled distance by S. The time it took to cycle uphill was $\frac{S}{v_1}$, and the time downhill was $\frac{S}{v_2}$. The study denote by V the average velocity, and obtain the equation $\frac{2S}{V} = \frac{S}{v_1} + \frac{S}{v_2}$. After some algebra, the study obtain that the average velocity of the bicycle rider is $V = \frac{2}{\frac{1}{v_1} + \frac{1}{v_2}}$, which is the harmonic average of v_1 , and v_2 .

Harmonic division of a segment

The following are the definitions of harmonic division of a segment by Hardy et al. (1952).

1. If a point C that is located on the segment AB divides the segment so that the ratio $\frac{AC}{CB} = \frac{m}{n}$ is maintained, then the point C divides the segment AB by **an internal division** with the ratio $\frac{m}{n}$.
2. If a point D that is located on the continuation of the segment AB satisfies $\frac{AD}{DB} = \frac{m}{n}$, then the point D divides the segment AB by **an external division** with the ratio $\frac{m}{n}$.
3. If a point C divides AB by an internal division with the ratio $\frac{m}{n}$, and the point D divides the segment by an external division with the same ratio, then the points C



and D divide AB by a **harmonic division** with the ratio of $\frac{m}{n}$.

The word “Harmonic” that appears in the definition points to the special connection between the formed segments:

From the definition, $\frac{AC}{CB} = \frac{m}{n}$, the study obtain that:

$$\frac{AC}{AC+CB} = \frac{m}{m+n} \Rightarrow AC = \frac{m}{m+n} \cdot AB$$

From $\frac{AD}{DB} = \frac{m}{n}$, the study obtain that:

$$\frac{AD}{AD-DB} = \frac{m}{m-n} \Rightarrow AD = \frac{m}{m-n} \cdot AB$$

and using simple algebra, the study obtain:

$$\frac{2}{\frac{1}{AC} + \frac{1}{AD}} = \frac{2}{\frac{m+n}{m \cdot AB} + \frac{m-n}{m \cdot AB}} = \frac{2mAB}{2m} = AB,$$

$$\min\{a_1, a_2, a_3, \dots, a_n\} \leq \frac{n}{\frac{1}{a_1} + \frac{1}{a_2} + \frac{1}{a_3} + \dots + \frac{1}{a_n}} \leq \sqrt[n]{a_1 \cdot a_2 \cdot a_3 \cdot \dots \cdot a_n} \leq \frac{a_1 + a_2 + a_3 + \dots + a_n}{n} \leq \sqrt{\frac{a_1^2 + a_2^2 + a_3^2 + \dots + a_n^2}{n}} \leq \max\{a_1, a_2, a_3, \dots, a_n\}$$

and equality holds if and only if it is $a_1 = a_2 = a_3 = \dots = a_n$. An algebraic proof of the system of inequalities can be found in study of Hardy et al. (1952), Handbook of mathematical functions, 1964, Dragoslav and Mitrinović, 1970 and Niven (1981). A geometric proof for $n = 2$ can be found in in the study of Dragoslav and Mitrinović (1970) and Niven (1981).

Applications of the relations between the inequalities of the averages

Throughout students' activities, when students were about to finish their teacher-training program at the college, a research was conducted on students' ability to solve mathematical problems, and cope with a variety of mathematical tasks, in a variety of ways, using the skills, tools, and experiences they have acquired. Some group discussions were conducted on various methodological aspects.

Following the presentation of the various features of inequality average, the students were asked to solve the tasks using the "new" tool, including explanations and clues. Finally, the new tool implementation strength was assessed, and an expectation of its future use in teaching was made.

Extremum problems with several variables

The high school curriculum in mathematics permits one to solve extremum problems with a single variable. The use of average inequalities permits the solution of various problems with a single variable and with several variables without using differential calculus, which is one of the fascinating features of mathematics. Examples for the

which means that the segment AB is the harmonic average of the sections AC and AD. For example, in every triangle the bisectors of the internal and external angles of a vertex divide the base by a harmonic ratio, which equals the ratio between the lengths of the sides of the triangle.

Theorem

If $a_1, a_2, a_3, \dots, a_n$ are positive numbers, then the following set of inequalities holds:

applications of the relations between the averages can be found in the study of Arbel (1990), Hardy et al. (1952), Kazarinoff (1961) and Niven (1981), however in order to put an emphasis on this tool, the study will present additional examples.

Problem 1.1

What is the value of the maximal surface area of a right cuboid with a diagonal whose length is a?

Solution

Let x, y and z be lengths of the edges that issue from one vertex of the cuboid. The diagonal of the cuboid and its edges satisfy the relation $x^2 + y^2 + z^2 = a^2$ (the spatial Pythagorean theorem). The value of the surface area S is:

$$S = 2(xy + xz + yz).$$

From the inequality of the geometric and arithmetic averages, one can write the following relations:

$$xy = \sqrt{x^2 \cdot y^2} \leq \frac{x^2 + y^2}{2}$$

$$xz = \sqrt{x^2 \cdot z^2} \leq \frac{x^2 + z^2}{2}$$

$$yz = \sqrt{y^2 \cdot z^2} \leq \frac{y^2 + z^2}{2}$$

and hence, using the formula for the surface area and by

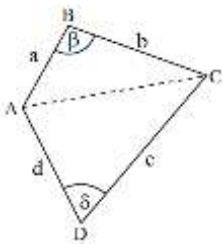
adding the aforementioned inequalities, one can obtain:

$$S = 2(xy + xz + yz) \leq 2 \cdot \frac{2x^2 + 2y^2 + 2z^2}{2} = 2a^2$$

The maximal area of $2a^2$ shall be obtained when $x = y = z$, for a cube.

Problem 1.2

Prove that the area of some quadrilateral is not larger than a quarter of the sum of the squares of its side lengths. In which quadrilateral does equality hold?



Solution

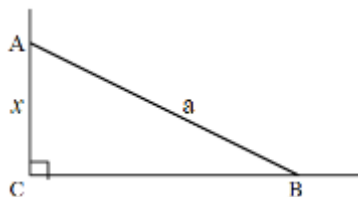
From the trigonometric formula for calculating the area of a triangle, and using the relation between the arithmetic and geometric averages, the study obtain:

$$S_{ABCD} = \frac{ab \sin \beta + cd \sin \delta}{2} \leq \frac{ab + cd}{2} \leq \frac{\frac{a^2 + b^2}{2} + \frac{c^2 + d^2}{2}}{2} = \frac{1}{4}(a^2 + b^2 + c^2 + d^2)$$

Equality holds when $a = b$ and $c = d$, and $\beta = \delta = 90^\circ$, that is, the quadrilateral is a square.

Problem 1.3

The ends of a given segment whose length is “a” move on the sides of a right angle. In which position of the segment will the area of the formed triangle be the largest?



Solution

The study denote $AC = x$, and then $BC = \sqrt{a^2 - x^2}$.

Hence the area of the triangle is

$$S_{\Delta ABC} = \frac{1}{2}x \cdot \sqrt{a^2 - x^2} = \frac{1}{2}\sqrt{x^2(a^2 - x^2)}$$

From the inequality between geometric and arithmetic averages, the study obtain:

$$\sqrt{x^2(a^2 - x^2)} \leq \frac{x^2 + (a^2 - x^2)}{2} = \frac{a^2}{2}$$

and then $S_{\Delta ABC} \leq \frac{a^2}{4}$.

Equality holds only when $x^2 = a^2 - x^2$, in other words $AC = x = \frac{a}{\sqrt{2}}$ and also $BC = \frac{a}{\sqrt{2}}$.

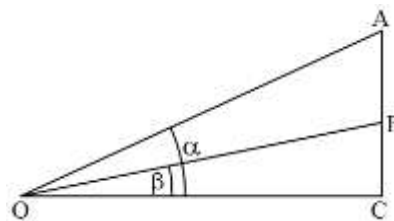
Conclusion: The area of the triangle ΔABC shall be the largest when the formed triangle is not only right-angled, but is also an isosceles triangle.

Note: The last problem can of course be solved using calculus.

The presented method does not require knowledge in differential calculus, but rather only the ability to apply and think creatively.

Problem 1.4

A picture 60 cm long hangs on a wall. At what distance from the wall must one stand in order to view the picture at the maximal angle of view?



Solution

The study denote $AB = 60$ cm, the length of the picture; O is a point at eye level above the floor, at the distance of x from the wall. Find the distance OC , so that the angle AOB is maximal.

In addition, the study denotes:

$$AOC = \alpha, \quad BOC = \beta.$$

Using the trigonometric equality $\operatorname{tg} \text{ AOB} = \operatorname{tg}(\alpha - \beta) = \frac{\operatorname{tg} \alpha - \operatorname{tg} \beta}{1 + \operatorname{tg} \alpha \operatorname{tg} \beta}$ the study obtain that:

$$\operatorname{tg} \text{ AOB} = \frac{\frac{AC}{x} - \frac{BC}{x}}{1 + \frac{AC \cdot BC}{x^2}} = \frac{60}{x + \frac{AC \cdot BC}{x}}.$$

The angle AOB obtains its largest value together with its tangent (increasing function). The value of the denominator satisfies the inequality:

$$x + \frac{AC \cdot BC}{x} \geq 2\sqrt{AC \cdot BC}.$$

Equality is obtained if and only if $x = \frac{AC \cdot BC}{x}$, in other words when $x = \sqrt{AC \cdot BC}$.

Conclusion: When the point O is located at a distance of $\sqrt{AC \cdot BC}$ from the wall, the picture is viewed at the maximal angle of view.

Problem 1.5

Find the minimal value of the function $y = \frac{(x+1)(x+4)}{x}$ for $x > 0$.

Solution

$$y = \frac{x^2 + 5x + 4}{x} = x + \frac{4}{x} + 5$$

From the inequality between the arithmetic and the geometric average, the study have

$$x + \frac{4}{x} \geq 2\sqrt{x \cdot \frac{4}{x}} = 4, \text{ therefore } y \geq 9. \text{ The minimal}$$

value of the function is obtained when $x = \frac{4}{x}$, in other words $x=2$.

Final answer: (2,9) is the point of absolute minimum of the function for $x > 0$.

Problem 1.6

Find the maximal value of the function $y = \sqrt{\cos^2 x + a \sin^2 x} + \sqrt{\sin^2 x + a \cos^2 x}$ for $a > 0$.

Solution

The study squares the two sides of the given function:

$$y^2 = 1 + a + 2\sqrt{(\cos^2 x + a \sin^2 x)(\sin^2 x + a \cos^2 x)}$$

Using the inequality between the geometric and arithmetic averages the study had:

$$\sqrt{(\cos^2 x + a \sin^2 x)(\sin^2 x + a \cos^2 x)} \leq \frac{\cos^2 x + \sin^2 x + a \sin^2 x + a \cos^2 x}{2} = \frac{1+a}{2}$$

In other words, $y^2 \leq 2(1+a)$, and equality is obtained if and only if

$$\begin{aligned} \cos^2 x + a \sin^2 x &= \sin^2 x + a \cos^2 x, \\ \cos^2 x - \sin^2 x &= a(\cos^2 x - \sin^2 x) \\ \cos 2x &= a \cos 2x \Rightarrow \cos 2x = 0 \end{aligned}$$

$$x = \frac{\pi}{4} + \frac{\pi}{2}k \text{ (k is a whole number)}$$

Final answer: The points of absolute maximum of the function are: $\left(\frac{\pi}{4} + \frac{\pi}{2}k, \sqrt{2(1+a)}\right)$.

Identity inequalities obtained from the average inequalities

From the average inequalities one can produce a large number of other identity inequalities, which themselves constitute tools for multidisciplinary application. From the inequality between the arithmetic and geometric averages, it follows that for each pair of positive numbers (a, b) there holds:

$$\frac{a}{b} + \frac{b}{a} \geq 2 \tag{2.1}$$

Equality holds only when $a = b$ (this relations has uses in several branches of mathematics).

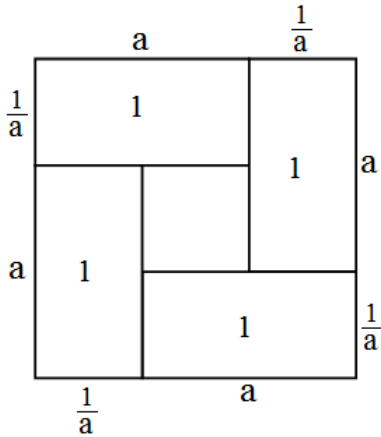
A particular case of the inequality (2.1) is that for each positive number a, there holds:

$$a + \frac{1}{a} \geq 2 \tag{2.2}$$

Equality in (2.2) holds only when $a=1$.

One of the geometric illustrations of inequality (2.2) is via the combination of four identical rectangles, each having

one unit area, which are joined together to form a square, as shown below:



The area of the outer square is $(a + \frac{1}{a})^2$, and it is larger than four area units. The inner square disappears when $a = \frac{1}{a}$, or $a = 1$.

The study show several aspects whose proof is based on the use of average inequalities.

Problem 2.1

Prove that for each triplet (a, b, c) of positive numbers, there holds:

$$\frac{a+b}{c} + \frac{b+c}{a} + \frac{a+c}{b} \geq 6$$

Solution

By decomposing each fraction, the study obtains:

$$\frac{a}{c} + \frac{b}{c} + \frac{b}{a} + \frac{c}{a} + \frac{a}{b} + \frac{c}{b} = \left(\frac{a}{c} + \frac{c}{a}\right) + \left(\frac{a}{b} + \frac{b}{a}\right) + \left(\frac{b}{c} + \frac{c}{b}\right) \geq 6,$$

since each of the expressions in the brackets is equal or larger than 2 based on the identity in example 2.1.

Problem 2.2

Prove that for n positive numbers, $a_1, a_2, a_3, \dots, a_n$, the following inequality holds:

$$\frac{a_1}{a_2} + \frac{a_2}{a_3} + \dots + \frac{a_n}{a_1} \geq n \tag{2.3}$$

and equality holds only when $a_1 = a_2 = a_3 = \dots = a_n$.

Solution

By employing the average inequality for the numbers $\frac{a_1}{a_2}, \frac{a_2}{a_3}, \dots, \frac{a_n}{a_1}$, the study obtain:

$$\frac{a_1}{a_2} + \frac{a_2}{a_3} + \dots + \frac{a_{n-1}}{a_n} + \frac{a_n}{a_1} \geq n \sqrt{\frac{a_1}{a_2} \cdot \frac{a_2}{a_3} \cdot \dots \cdot \frac{a_{n-1}}{a_n} \cdot \frac{a_n}{a_1}} = n$$

Problem 2.3

Prove the following numeric inequality:

$$\log_{30}^2 2 + \log_{30}^2 3 + \log_{30}^2 5 > \frac{1}{3}.$$

Solution

In accordance with the inequality between the arithmetic average and average of squares, the study had:

$$\sqrt{\frac{\log_{30}^2 2 + \log_{30}^2 3 + \log_{30}^2 5}{3}} > \frac{\log_{30} 2 + \log_{30} 3 + \log_{30} 5}{3} = \frac{\log_{30} 2 \cdot 3 \cdot 5}{3} = \frac{\log_{30} 30}{3} = \frac{1}{3}$$

By squaring both sides and multiplying by 3, the study obtains:

$$\log_{30}^2 2 + \log_{30}^2 3 + \log_{30}^2 5 > 3 \cdot \left(\frac{1}{3}\right)^2 = \frac{1}{3}$$

Problem 2.4

Prove that in any triangle the following relation holds for the angles of the triangle α, β, γ :

$$\sqrt{\text{tg} \alpha \text{tg} \beta} + \sqrt{\text{tg} \beta \text{tg} \gamma} + \sqrt{\text{tg} \alpha \text{tg} \gamma} \leq \text{tg} \alpha \text{tg} \beta \text{tg} \gamma$$

When does the equality hold?

Solution

From the inequality between the geometric and the arithmetic averages, will obtain:

$$\sqrt{\text{tg} \alpha \text{tg} \beta} + \sqrt{\text{tg} \beta \text{tg} \gamma} + \sqrt{\text{tg} \alpha \text{tg} \gamma} \leq \frac{\text{tg} \alpha + \text{tg} \beta}{2} + \frac{\text{tg} \beta + \text{tg} \gamma}{2} + \frac{\text{tg} \alpha + \text{tg} \gamma}{2} = \text{tg} \alpha + \text{tg} \beta + \text{tg} \gamma$$

From a well-known trigonometric relation, the study had:

$$\operatorname{tg} \gamma = \operatorname{tg}[\pi - (\alpha + \beta)] = -\operatorname{tg}(\alpha + \beta) = -\frac{\operatorname{tg} \alpha + \operatorname{tg} \beta}{1 - \operatorname{tg} \alpha \operatorname{tg} \beta}$$

By multiplying diagonally, the study obtained:

$$\operatorname{tg} \alpha + \operatorname{tg} \beta + \operatorname{tg} \gamma = \operatorname{tg} \alpha \cdot \operatorname{tg} \beta \cdot \operatorname{tg} \gamma$$

Substitution of this relation proves the inequality.

Equality shall be obtained for:

$\operatorname{tg} \alpha = \operatorname{tg} \beta = \operatorname{tg} \gamma$, and since $\alpha + \beta + \gamma = \pi$, the study obtained that $\alpha = \beta = \gamma = \frac{\pi}{3}$, that is, the triangle is equilateral.

Problem 2.5

Prove that for $a > 0$, $b > 0$, $c > 1$, the following relation holds:

$$\frac{\log_c a + \log_c b}{2} \leq \log_c \frac{a+b}{2}. \text{ When does equality hold?}$$

Solution

Based on the relation between the averages, $\frac{a+b}{2} \geq \sqrt{ab}$, and from the fact that for a base of $c > 1$ the logarithmic function is an increasing function, the study obtained:

$$\log_c \frac{a+b}{2} \geq \log_c \sqrt{ab} = \frac{\log_c a + \log_c b}{2}$$

Thus proving the relation, equality holds when $a = b$.

Solution of equations using the system of inequalities between the different averages

The study presents a special kind of algebraic and trigonometric equations, for whose solution one can apply the inequality between the averages.

Example 3.1

Solve the irrational equation $\sqrt{5-x^2} + \sqrt{x^2+3} = 4$.

Solution

From the inequality between the arithmetic average and average of squares, one can write:

$$\frac{\sqrt{5-x^2} + \sqrt{x^2+3}}{2} \leq \sqrt{\frac{(5-x^2) + (x^2+3)}{2}} = 2$$

And the equality $\sqrt{5-x^2} + \sqrt{x^2+3} = 4$ holds only when $5-x^2 = x^2+3$, that is, when $x = \pm 1$.

Example 3.2

Solve the following irrational equation:

$$\sqrt{x+1} + \sqrt{2x-3} + \sqrt{50-3x} = 12$$

Solution

From the inequality between the arithmetic average and the average of squares, the study obtain:

$$\frac{\sqrt{x+1} + \sqrt{2x-3} + \sqrt{50-3x}}{3} \leq \sqrt{\frac{x+1+2x-3+50-3x}{3}} = 4$$

In other words, $\sqrt{x+1} + \sqrt{2x-3} + \sqrt{50-3x} \leq 12$.

Equality holds only when $x+1 = 2x-3 = 50-3x$.

The obtained system of the equation is contradictory, and therefore the original equation has no solution, even though the inequality:

$$\sqrt{x+1} + \sqrt{2x-3} + \sqrt{50-3x} < 12$$

has a solution for an x in the domain.

Example 3.3

Solve the trigonometric equation:

$$\sqrt{4\cos^2 x + 1} + \sqrt{4\sin^2 x + 3} = 4.$$

Solution

From the inequality between the arithmetic average and the average of squares, one can write:

$$\frac{\sqrt{4\cos^2 x + 1} + \sqrt{4\sin^2 x + 3}}{2} \leq \sqrt{\frac{4(\cos^2 x + \sin^2 x) + 4}{2}} = 2$$

and the equality $\sqrt{4\cos^2 x + 1} + \sqrt{4\sin^2 x + 3} = 4$ holds only when:

$$4\cos^2 x + 1 = 4\sin^2 x + 3 \Rightarrow \cos 2x = \frac{1}{2} \Rightarrow x = \pm \frac{\pi}{6} + \pi k$$

Example 3.4

Solve the equation $\frac{\sqrt{x-1}}{5} + \frac{5}{\sqrt{x-1}} = 2$.

From the formula (2.1), having $\frac{\sqrt{x-1}}{5} + \frac{5}{\sqrt{x-1}} \geq 2$ for any $x > 1$ (the domain of definition). Equality is obtained only when $\sqrt{x-1} = 5$, in other words $x = 26$.

Example 3.5

Find all the solutions of the system

$$\begin{cases} x_1 + x_2 + \dots + x_n = 3 \\ \frac{1}{x_1} + \frac{1}{x_2} + \dots + \frac{1}{x_n} = 3 \end{cases}$$

Solution

Addition of the two equations yields the relation

$$\left(x_1 + \frac{1}{x_1}\right) + \left(x_2 + \frac{1}{x_2}\right) + \dots + \left(x_n + \frac{1}{x_n}\right) = 6 \tag{3.1}$$

From the relation (2.2), the value of each addend is larger or equal to 2, and therefore $n \leq 3$.

If $n = 3$, equality holds only for $x_1 = x_2 = x_3 = 1$.

If $n = 2$, the study obtains the system of equations:

$$\begin{cases} x_1 + x_2 = 3 \\ \frac{1}{x_1} + \frac{1}{x_2} = 3 \end{cases} \Rightarrow \begin{cases} x_1 + x_2 = 3 \\ x_1 \cdot x_2 = 1 \end{cases} \Rightarrow x_1^2 - 3x_1 + 1 = 0 \Rightarrow \begin{matrix} x_1 = \frac{3+\sqrt{5}}{2} \\ x_2 = \frac{3-\sqrt{5}}{2} \end{matrix}$$

If $n = 1$, the study obtains a contradiction:

$$x_1 = 3 \text{ and also } \frac{1}{x_1} = 3.$$

In other words, the final solution is:

$$n = 3 \Rightarrow x_1 = x_2 = x_3 = 1$$

$$n = 2 \Rightarrow x_{1,2} = \frac{3 \pm \sqrt{5}}{2}$$

Example 3.6

Prove that there are no positive numbers x and y that satisfy the following system of equations:

$$\begin{cases} x^{19} \cdot y^{92} = 2^{1992} \\ 19x + 92y = 5752 \end{cases}$$

Proof

From the inequality between the arithmetic and geometric averages the study had:

$$\frac{19x + 92y}{111} = \frac{x + x + \dots + x + y + y + \dots + y}{111} \geq \sqrt[111]{x^{19} \cdot y^{92}}$$

Therefore, $x^{19} y^{92} \leq \left(\frac{5752}{111}\right)^{111} < 52^{111} < (2^6)^{111} = 2^{666}$, and the study obtain a contradiction to the data in the first equation.

Example 3.7

Solve the equation:

$$2^{x^6} + 2^{x^2} = 2^{x^4+1}.$$

Solution

By using the inequality between the arithmetic average and the geometric average twice, sequentially, the study obtains:

$$2^{x^6} + 2^{x^2} \geq 2\sqrt{2^{x^6} \cdot 2^{x^2}} = 2^{\frac{x^6+x^2}{2}+1} \geq 2^{\sqrt{x^6 \cdot x^2}+1} = 2^{x^4+1},$$

which means that equality shall be obtained only when $2^{x^6} = 2^{x^2}$, in other words:

$$x^6 = x^2 \Rightarrow x = 0, x = 1, x = -1$$

Conclusion: the equation has three solutions.

A practical problems

Problem 4.1

River boat should pass some distance against the direction of water flow of river. The operation costs per unit of time are proportional to the square forward speed. We need to find the speed of the boat so that the expenses will be minimal. River water speed is c kilometers per hour.

Solution:

Let x km/h be the ship's own speed (speed of standing water). Let ℓ be the distance it needed to pass.

The ship's expenses per hour is kx^2 , so expenses of all the way is $f(x) = kx^2 \cdot \frac{\ell}{x-c}$.

Let observe at

$$\frac{1}{f(x)} = \frac{x-c}{k\ell x^2} = \frac{1}{k\ell} \cdot \frac{1}{x} \cdot \frac{x-c}{x} = \frac{1}{k\ell c} \cdot \frac{c}{x} \cdot \left(1 - \frac{c}{x}\right)$$

By using the inequality of the geometric and arithmetic averages, one can write the following relations:

$$\sqrt{\frac{c}{x} \cdot \left(1 - \frac{c}{x}\right)} \leq \frac{\frac{c}{x} + \left(1 - \frac{c}{x}\right)}{2} = \frac{1}{2}$$

and then $\frac{1}{f(x)} \leq \frac{1}{4k\ell c}$, or $f(x) \geq 4k\ell c$.

Equality holds only when $\frac{c}{x} = 1 - \frac{c}{x}$, i.e. $x = 2c$.

Conclusion: The expenses of the ship are the smallest when its speed is twice the speed of the water flow in the river.

Problem 4.2

In pole scales an arm's length are a and b when $a > b$. We weigh 2 kg of sugar by two ways:

1. We put the sugar to right palm of the scales and a 1 kg weight on the other.
2. We put the sugar to left palm of the scales and a 1 kg weight on the other.

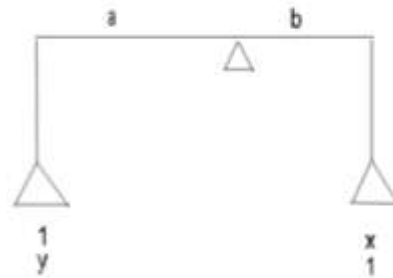
Do you get 2 kg of sugar? And if not, who earned: seller or buyer?

Solution

Let X kg be the weigh of sugar in the first case and y kg be the weigh of sugar in the second case.

For scale balance it is needed that

$$\begin{cases} a \cdot 1 = b \cdot x \\ a \cdot y = b \cdot 1 \end{cases}, \text{ thus, } y = \frac{b}{a}; x = \frac{a}{b};$$



$$x + y = \frac{a}{b} + \frac{b}{a} > 2 \quad (a \neq b)$$

Conclusion: The buyer profited.

The methodological research aspect of the use of the properties of various averages

The subject of various averages and the connections between them, was presented to students teaching mathematics training courses usually in the third year, in the course "Strategies of Math Problem Solutions", but also in courses like: "Integration of mathematical topics" and "Mathematical Enrichment Seminar", where different aspects of the averages are presented. Each of the three courses mentioned earlier is attended by approximately 15 to 20 students.

Stage one

In this stage, the students were asked which of them know the term 'Mathematical average' and in which domains it appears. The students were told that there are a few kinds of averages. All students mentioned they know the term in connection to average salary and average speed, when the subject was taught during statistics studies. Some students mentioned that in an arithmetic progression each member is the average of the two members adjacent to it.

Some students mentioned the term 'Weighted average', and as an example noted the method used to calculate the average of their final exam grades, where each subject has its own weight. Only about 10% of the students mentioned the term 'Geometric average' in a geometric progression. Only about 5% knew that the

arithmetic average is bigger than the geometric one, and they are equal only if the two numbers are equal. None of them have heard of any other types of averages.

The students were impressed by geometric proofs of inequalities between averages. They were surprised to know that average speeds are actually a harmonic average. It was new for them to know that harmonic division of segment connect to harmonic average. Students learned about the connections between names of progressions (arithmetic, geometric, harmonic) and their basic features (property of three successive members).

Stage two

In this stage, the students learned 5 different types of averages, examples of their usage and their relationship. To convince the order of the averages beyond numerical examples, algebraic and geometric proofs were brought for every two types of averages. Using two different mathematical fields for a proof helps to increase the importance of using different aspects of math, and demonstrate how different mathematical subjects are all interwoven.

Stage three

In this stage, the students were asked to solve the problems of this article, and some additional ones in the ways that are familiar to them. Some of problems could be solved in a conventional way (by using the regular and known methods taught in high-school or during academic studies). Then, the students were asked to solve the problems using properties of averages. The students having trouble (most of the students) were given hints. For example, they were told which inequality they should use, or how to break tasks data, or which of the previous problems they should refer to. After that process, they were given the nice, easy solution. All groups expressed great interest and desire to pass the knowledge on to their future pupils.

Stage four

In their homework, the students were asked to solve two relatively simple problems, when the aim was using averages in the process. Indeed, 80% of the students solved one problem correctly, and 55% solved both. 6 additional problems were given to them as homework and they were required to solve each one in the conventional way, and then using properties of averages. Some of the problems were given with hints.

Stage five

The problems that were given to the students gave

impressive results. Some were introduced to the rest of the students. About 80% of the students successfully solved the problems on their own. Usually, the students learning two from the three courses mentioned earlier, and the subject of averages and their application is taught over 3 to 4 lessons only.

Stage six

At this point, the students were asked a few questions about the importance of obtaining knowledge on the subject, and here are a few statements gathered from their answers:

1. The subject promoted to expanding the toolbox of methods to solve math problems.
2. Elementary knowledge was received to help solve problems quickly and easily.
3. The new tools and their application show the beauty of math and how its fields all connect one to other.
4. The time dedicated to the subject was too short and it requires additional practice for better ability to use it in class.
5. The mathematics timetable is massive and it's doubtful that enough time can be dedicated to teaching the subject to high school students. For this reason, and considering the fact that good students often need additional challenges, it's better to teach the subject of averages during mathematical circles in schools.
6. Problems that were difficult to solve using algebra were easily solved using the properties of averages.
7. It was suggested that while teaching fractions to elementary students, it's a good idea to teach them that the sum of every two inverse positive numbers is always equal to or greater than 2, and let them practice this using numerical examples.

General satisfaction from the course

In addition to this study, feedback regarding this course was obtained via post-course assessment forms distributed by the college. The courses involving multiple solutions scored relatively well. The average assessment was 5.7 (out of 6), and trainees expressed fairly high satisfaction from the course and its management in the free-text section.

CONCLUSION

There are different strategies for improving and solving problems in different areas of mathematics. The strategies are based on the use of standard mathematical tools that are suitable for the type of the task. Sometimes, the solution of the task is achieved by means of mathematical

tools from one area, and in other cases by a combination of tools from different areas. The more tools exist in the toolbox, the higher is the chance of successfully dealing with the task. A “complete toolbox” and extensive mathematical knowledge permit one to find different methods of solution for the same task, and in particular to reach the fastest, simplest and clearest solution, thereby showing the beauty of mathematics. The “elegant” solution is usually brief, aesthetic and instructional and it is better than the “Standard” solution which is usually longer and is based on ordinary technique. The study presented a collection of various tasks from different fields in mathematics, whose solution is attained more easily by means of the special relations between the different averages, with the purpose of familiarizing ourselves with these relations and strengthening the use of them as a tool that in many cases allows one to achieve short, simple and very surprising solutions

Conflict of interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

The views of Turkish teachers on the use of humor in secondary schools

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Humor is the type of expression and writing representing the humorous aspect of life by adorning with jokes and wit. The main objective of humor is to criticize, ironize, and correct the flaws and hideousness in life. Humor develops the sensitivity, the empathizing ability and social facts' multi-dimensional perception of individuals. Humor enlivens life, entertains people, positively contributes to social relationships, and improves the imagination of individuals. This research has been conducted in order to determine the usage level of humor by secondary school Turkish teachers, and their attitudes and opinions regarding humor. The attitude scale prepared for the research was given to 128 Turkish teachers in total. The data obtained from the results of the research was interpreted by calculating its percentages, frequencies, arithmetical means and standard deviations. In order to determine the differences in the sample group's responses -for the attitude scale- as per their genders, the "independent sample t test" was applied and interpreted. And in order to determine the differences of the subject's responses -for the articles of survey- as per their seniority in their profession, the "one way ANOVA" test was applied and interpreted. According to the results of this research, humor may be used as an effective form of communication and socialization tool. Through humor, the learning environment may be made more attractive, and the linguistic skills and vocabulary of the students may be enriched. It is possible to use humor in order to motivate the students for the course, to make the course more interesting, to increase the academic success of the students, and to improve the solution generation skills of the students. As per the results of the research, it was determined that there was no significant difference among the opinions of teachers -regarding the use of humor in secondary school Turkish courses- in respect of their seniority in the profession. In the same manner, it was determined that there was no significant difference among the opinions of the teachers -regarding the use of humor in secondary school Turkish courses- in respect of gender variables, and that the humorous items used in the Turkish textbooks are wholly insufficient.

Key words: Humor, Turkish education, opinions of teachers, language skills.

INTRODUCTION

The type of oral or written literature, by which the ridiculous, unusual, and contradictory aspects of incidents

are expressed by adorning with various expressions, opinions, wit, jests, jokes and teasing, is called humor

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(Kocer et al., 2012). Individuals show their joy, satisfaction, and appreciation, by reactional behaviors such as smiling or laughing.

These emotional reactions are called laughter (Recepoglu and Ozdemir, 2012). As laughing is among the main objectives of humor, humor is intended to criticize, ironize, and correct the flaws and hideousness in the lives of individuals and society (Durmus, 2005).

Humor reveals the humorous and entertaining aspects of incidents, facts and values in real life. (Yalcinkaya, 2015) Humor is the art of expressing the negative, incompatible, and contradictory aspects of national and moral values in a ridiculous style (Esigul, 2002). Humor is a natural line of defense being effectively used in order to struggle with the problems of daily life, and to overcome the difficulties encountered (Sanders, 2001). Humor is a medicine used to solve the issues, remove the problems, and treat the injuries in social life. In other words, as well as satirizing and trying to correct the mistakes, the problems may be mitigated, social conflicts may be prevented, and tensions in social life may be softened by using humor (Eroglu, 2008).

It is possible to address humor in three levels. The humor in the first level is the type of humor that can be understood by everyone without considering the socio-cultural status. Involuntary smiling at someone who slips and falls is this type of humor. The humor in the second level is a method of humor used to free oneself from an oppressive condition. This type of humor is used mostly regarding religious, political, or sexual issues. And the humor that requires a high level of understanding, and that has abstract topics which cannot be easily understood is the humor of the third level.

It is possible to categorize the humor arising in social interaction and communication into three parts. The first one is realized by telling to others the recalled jokes and humorous stories. The second one consists of oral ones that are generated by the individual, or that arises by itself in the social interaction process, and the third one are the ones that arise unintentionally.

Humor has been conceptualized under four styles as being: the confirmative humor style, the productive humor style, the transmissive humor style and the non-humorous style (Cemaloglu et al., 2012).

The place and importance of humor in the education of individual

The most important purpose of education is to prepare individuals for life. In this process, humor has a separate place. It is not right to deem humor –which is frequently used in our daily lives- only as a means of amusement and entertainment for people. In the education of an individual, humor has a separate place.

Humor develops the sensitivity, empathizing ability, and social facts' multi- dimensional perception of individuals. Humor enlivens life, entertains people, positively

contributes to social relations and improves the imagination of individuals. The use of oral and written humor elements in social life such as wit, jest, jokes, comics, or plays on words is effective in helping positive behaviors to arise, in removing the obstacles of communication and in establishing easier and more effective communication among individuals (Ozkara, 2012).

Humor strengthens the spirit of sharing, synergy, sincerity, friendship and fellowship of students, and it contributes towards them learning cultural values and how to socialize (Ergun, 2004). Humor motivates the students for the course (Akun, 1997), and it may undertake the role of a channel for different cultures to understand each other. Humor teaches children the spirit of sharing, fellowship, friendship, tolerance, sincerity and empathy. It shows the entertaining aspect of an incident, and provides a humane personality to the individual because individuals, who realize the aspects of incidents that make anyone smile, try to solve the future problems with a more amicable method.

The research done on the subject of humor shows that using humor in education is extremely important. Thus, it is required to use humor in the education of children – who are the grown-ups of the future-, to concentrate on the types of humor in textbooks, and to use the elements of humor in books prepared for children (Eroglu, 2008).

While it is possible to use humorous elements for both the social and personal development of the individual, throughout history humor has not got the attention that it deserves either in the aspects of our social life or in educational institutions, and this indifference to humorous elements is still continuing today. This condition may be explained by the deeming of humor as a disgrace and unnecessary, and by not taking it seriously (Tanribuyurdu, 2007).

The formation of the learning and teaching environment in the classroom is among the main objectives of education. It is possible to use humor in the realization of these objectives. However, the fact that teachers were not willing to use humor in their lessons can be explained through their intention not to lose authority in the class and not to use too much energy (Savas, 2014).

Attention was paid to the study being original. In a literature scan, no published study could be found related to the opinions of the teachers about the usage of humor in their lessons.

Objective of the study

The aim of this study was to determine the secondary school Turkish teachers' humor usage levels in their lessons, their attitudes, and opinions about humor.

Problem statement

“Determining the usage level of humor by secondary

Table 1. Chart showing the gender distribution of Turkish teachers.

Variable	Frequency	Percentage	Valid percentage	Cumulative percentage
Women	56	43.8	43.8	43.8
Men	72	56.3	56.3	100.0
Total	128	100.0	100.0	-

Table 2. Seniority of Turkish teachers in their profession.

Years	Frequency	Percentage	Valid percentage	Cumulative percentage
1-5 years	84	65.6	65.6	65.6
6-10 years	26	20.3	20.3	85.9
11 years and over	18	14.1	14.1	100.0
Total	128	100,0	100.0	-

school Turkish teachers and their attitudes and opinions regarding humor and revealing whether humor is important for Turkish education or not in the direction of the opinions of teachers” is the problem sentence in this research.

Sub problem statement

1. At which level are the teachers using humor in Turkish courses?
2. What are the opinions of teachers regarding the effect of “humor” on the educational environment and on the attitudes of students towards the course?
3. Does humor allow the realization of a learner focused process?
4. What is the attitude of teachers regarding the use of humor by the students on Turkish courses?
5. As per the opinions of the teachers, are the humorous elements used in the Turkish textbooks sufficient, and are they interesting for the students?
6. As per the opinions of teachers, what is the contribution of humor in enrichment of the vocabulary and development of the linguistic and communication skills of the students?
7. As per the opinions of teachers, is the use of humorous elements in the courses effective in the academic success and social and psychological development of the students?

METHODOLOGY

This research was designed using the scan model. Karasar (2000) defines the scan model as portraying an old or still existing situation as it is.

The population and sample of the study

The population of this study was the Turkish teachers group (Türkçe Öğretmenleri) established for information and document

sharing on the Facebook social networking website. The sample consisted of 128 Turkish teachers who were randomly selected from this group by the convenience sampling method and the ones that could be reached.

This study was performed in the first term of 2015 TO 2016 academic year. The teachers on whom the attitude scale was applied were serving in the provinces of Adana (2 persons), Adiyaman (1 person), Afyon (1 person), Agri (18 persons), Aksaray (2 persons), Ankara (5 persons), Ardahan (2 persons), Aydin (2 persons), Bingol (2 persons), Bitlis (1 person), Bolu (1 person), Bursa (4 persons), Canakkale (1 person), Corum (1 person), Denizli (2 persons), Diyarbakir (1 person), Edirne (2 persons), Elazig (1 person), Erzurum (1 person), Eskisehir (1 person), Gaziantep (2 persons), Hatay (1 person), Igdir (3 persons), Istanbul (13 persons), Izmir (3 persons), Kahramanmaras (1 person), Kars (2 persons), Kastamonu (2 persons), Kirikkale (1 person), Kocaeli (3 persons), Konya (6 persons), Malatya (1 person), Manisa (1 person), Mardin (3 persons), Mersin (6 persons), Mugla (2 persons), Mus (1 person), Rize (1 person), Sakarya (2 persons), Samsun (1 person), Sivas (2 persons), Sanliurfa (6 persons), Tekirdag (2 persons), Tokat (1 person), Trabzon (1 person), Van (6 persons), Yozgat (2 persons) and Zonguldak (2 persons).

According to Table 1, the attitude scale was carried out with 128 Turkish teachers in total 56 (43.8%) of them being women and 72 (56.3%) being men. According to Table 2, 65.6% (84) of the Turkish teachers responding to the attitude scale had served between 1 to 5 years, 20.3% (26) of them had served between 6 to 10 years, and 14.1% (18) of them had served for 11 years and more.

Data collection tool

The survey developed as a data collection tool in the research, which consisted of two sections. The first section is of 4 articles regarding the personal information of the Turkish teachers. The second section is the four point likert attitude scale prepared in the form of 16 articles in order to measure the opinions and attitudes of the Turkish teachers regarding the use of humor in the courses.

In the research, the four point likert scale –which was developed by Rensis Likert in 1932, and which was named after him- was preferred as the attitude scale (Koklu, 2009). While preparing the attitude scale, the opinions of four Turkish teachers and a doctoral student -working in the field of Turkish education- were asked. Moreover, “Development of Humor Attitudes Scale: Validity and Reliability Study” developed by Cemaloglu et al. (2012) was used.

In the first section of the attitude scale prepared by the researcher, the genders of the subjects were scored as “female =1”

Table 3. Agreement degree and level range of attitude scale.

Agreement degree	Level range
I don't agree	1,00-1,74
I sometimes agree	1,75-2,49
I agree	2,50-3,24
I definitely agree	3,25-4,00

and "male =2". The second article is relevant to the educational levels of the subjects, and it was scored as "undergraduate=1", "postgraduate, and doctorate=2". The seniorities of the subjects in the profession were scored as 1 to 5 years (1), 6 to 10 years (2), and 11 years or over (3). The 4th article relevant to personal information is relevant to the place of duty of the subjects. The level ranges of expressions in the attitude scale were graded from 1 to 4. The expressions being closer to 1 specify the most negative ones, and the ones closer to 4 specify the most positive ones. The limits relevant to the levels in the subject are given in Table 3.

Analysis of data

A part of the attitude scale applied in the research was given as a printed copy, and a part of it by using the Google survey tool. The printed copy of the survey was handed over to, and collected from the subjects, and the Google survey was applied to the subjects by using electronic mail.

The research data was analyzed in the statistical package for social sciences "SPSS 13.0" packaged software. The number of subjects, arithmetic mean of responses for the articles, and their percentages were determined in the research. The genders of the teachers and their seniority in the profession were assessed as independent variables. As the number of samples in the attitude scale was larger than 30, the "single sample kolmogorov-smirnov test" was used in order to measure the conformity of the data to the normal distribution. The skewness and kurtosis values of this test changed between -1 and +1, and the values of the attitude scale applied on the sample group showed a normal distribution. Thus, parametric tests were applied in the research.

Percentage, frequency, arithmetic mean and standard deviation, were applied in the analysis of the data obtained from the sample group. In order to determine the differences of the sample group's responses -for the attitude scale- as per their genders, "independent sample t test" was applied. As the sample group responding the attitude scale was generally homogeneous in respect of educational level (113 undergraduate, 15 postgraduate), no operation was carried out regarding that. And in order to determine the differences in the sample group's responses -for the articles of survey- as per their seniority in their profession, the "one way ANOVA" test was applied.

The factor number of the scale was 4, and its variance was 61.929%. The results of the KMO and Bartlett's tests were 0,888, $df=120$ $p=.000$, and it was statistically significant. The Cronbach's Alpha reliability coefficient of the scale was calculated as 0.880. According to these results, the reliability of the scale was very high.

FINDINGS

The teachers' opinions regarding humor usage in Turkish lessons, and the situation of these opinions according to

gender and seniority variables were calculated.

Teachers' opinions regarding humor usage in Turkish lessons

According to Tables 4 and 5, the arithmetic mean of the responses given for articles 2, 5, 10, 12, and 13, of the attitude scale varies between ($\bar{X}=3,257$) and ($\bar{X}=3,375$). The agreement degree of these numeric values is in the form of "I definitely agree". These results indicate that the teachers are positive regarding the use of humor in courses, and regarding its contribution to the linguistic skills and socialization of students.

According to the results of the research, humor enriches the linguistic skills (article 10) and vocabulary (article 11) of the students. The results obtained by Yalcinkaya (2015) through his research also support the study findings. According to majority of the subjects, humor is an effective communication and socialization (articles 12 and 13) tool. This opinion is also supported by scientific research made regarding humor. Because humor strengthens the fellowship relations among individuals, it removes the rigidity in social life (Sahin, 2014).

The arithmetic mean of responses given for articles 1, 3, 4, 6, 9, 11, 14, 15 and 16, of the attitude scale vary between ($\bar{X}=3,054$) and ($\bar{X}=3,234$). The agreement degree of these numeric values is in the form of "I agree". These results indicate that the teachers are positive regarding the contribution of humor to the learning environment, and to the vocabulary and communication of the students. This supports the results obtained from the research study entitled "Is Humor an Appreciated Teaching Tool? Perceptions of Professors' teaching Styles and use of Humor" (Torok et al., 2004).

For the 1st article of the attitude scale which is "deeming the use of humor for having a nice time and for educational purposes as positive", 53.1% of the subjects responded as "I agree" and 29.7% of them responded with "I definitely agree". The positive opinions of teachers regarding the use of humor in education are also confirmed by the results of some research made in this field. Hence, in a research done regarding the "functional use of the Karagoz shadow play in Turkish education", it was concluded that humor is a significant educational tool regarding the communication of language and national culture (Bulut, 2014).

According to the results of this research, the majority of the teachers think that humor positively affects the educational environment (article 2), that it is an effective learning tool (article 3), that it may be effective in student focused teaching (article 4), and that it will assist the students to be interested in the courses. This supports the results obtained from our research study with the subject of "Effect of use of humor in Turkish courses on

Table 4. KMO and Bartlett’s test.

Kaiser-Meyer-Olkin measure of sampling adequacy		0.888
Bartlett's Test of Sphericity	Approx. Chi-Square	812.728
-	df	120
-	p	0.000

Table 5. Frequency, percentage, arithmetic mean and standard deviation results regarding opinions of teachers relevant to use of humor in Turkish courses (first 8 articles).

The articles	The survey	Participation level	Frequency	Percentage (%)	\bar{X}	S
1.	I do find it positive to use humor on Turkish courses for educational purposes besides laughing and having a nice time	2.00	22	17.2	3.125	0.67579
		3.00	68	53.1		
		4.00	38	29.7		
2.	“Humor” positively affects the educational environment and the attitudes of the students towards the course	1.00	1	0.8	3.328	0.66533
		2.00	11	8.6		
		3.00	61	47.7		
		4.00	55	43.0		
3.	I think humor is a permanent and effective learning tool in education	2.00	17	13.3	3.234	0.66976
		3.00	64	50.0		
		4.00	47	36.7		
4.	Humor allows the realization of a learner focused learning process	1.00	1	0.8	3.070	0.66621
		2.00	21	16.4		
		3.00	74	57.8		
		4.00	32	25.0		
5.	Humor increases the interest and attention of the student and enables their active participation in the course	2.00	15	11.7	3.335	0.67901
		3.00	55	43.0		
		4.00	58	45.3		
6.	I do find it positive for the students to use humor in my courses	2.00	28	21.9	3.054	0.70217
		3.00	65	50.8		
		4.00	35	27.3		
7.	I use humor in my courses	1.00	6	4.7	2.164	0.69619
		2.00	63	49.2		
		3.00	43	33.6		
		4.00	16	12.5		
8.	I find the humorous elements used in Turkish textbooks sufficient	1.00	89	69.5	1.343	0.55327
		2.00	34	26.6		
		3.00	5	3.9		

the attitudes of students” (Savas, 2014).

According to Tables 6 and 7, the majority of the teachers think that humor may be effective for the students to overcome their fears and shyness (article 14),

for developing the comprehension, interpretation and solution generation skills of the students (article 15) and for improving their academic success (article 16). And the results of the research with the heading “Examination

Table 6. The frequency, percentage, arithmetic mean, and standard deviation results regarding the opinions of teachers relevant to the use of humor in Turkish courses (last 8 articles).

The articles	The survey	Participation level	Frequency	Percentage (%)	\bar{X}	S
9.	The texts in Turkish textbooks including humorous elements (anecdotes, rhymes, shadow shows, riddles, comics etc) attract the attention of the students more	1.00	6	4.7	3.171	0.78479
		2.00	12	9.4		
		3.00	64	50.0		
		4.00	46	35.9		
10.	I think humor is effective in the development of linguistic skills (reading, visual reading and presentation, listening, speaking, and writing)	2.00	11	8.6	3.257	0.60505
		3.00	73	57.0		
		4.00	44	34.4		
11.	The use of humorous elements in Turkish courses enriches the vocabulary of the students	1.00	1	0.8	3.148	0.65316
		2.00	16	12.5		
		3.00	74	57.8		
		4.00	37	28.9		
12.	I establish easier communication with the students when I use humorous elements in my courses	2.00	15	11.7	3.257	0.65504
		3.00	65	50.8		
		4.00	48	37.5		
13.	I think humor is an effective communication tool enabling the socialization of students	2.00	15	11.7	3.375	0.68734
		3.00	50	39.1		
		4.00	63	49.2		
14.	I think humor is important for the students to overcome their emotions such as fear and shyness	2.00	28	21.9	3.062	0.70711
		3.00	64	50.0		
		4.00	36	28.1		
15.	Humor improves the comprehension, interpretation, and solution generation skills of the students	2.00	20	15.6	3.171	0.67706
		3.00	66	51.6		
		4.00	42	32.8		
16.	Humor positively affects the academic success of students	1.00	1	0.8	3.062	0.61157
		2.00	17	13.3		
		3.00	83	64.8		
		4.00	27	21.1		

of the motivation levels of teachers as per the humor styles of school managers” also support the positive opinions of the teachers regarding humor. According to the results of the relevant research, the use of humorous elements at schools increased the motivation and success of the subjects (Recepoglu et al., 2011).

For the “I use humor in my courses” article of the attitude scale, 49.2% of the teachers had scored at the level range of “1.75 to 2.49”. The arithmetic mean of

responses for this article is $\bar{X}=2,164$, and the agreement degree is “I sometimes agree”. According to the results in the tables, the responses given for article 7 are generally negative. The arithmetic mean of the responses for article 8 of the attitude scale (I find the humorous elements used in Turkish textbooks sufficient) is $\bar{X}=1,343$. This result corresponds to “I don’t agree” (69.5%) article in respect to agreement degree. According to this, the majority of

Table 7. “Independent sample t test” results of attitudes of Turkish teachers towards humor (first 7 articles) as per gender.

Articles	Gender	Levene's test for equality of variances		t-test for equality of means		
		f	p	t	df	p
1.	f	0.046	0.830	-1.055	126	0.293
	m	-	-	-1.047	114.673	0.297
2.	f	2.601	0.109	-0.100	126	0.920
	m	-	-	-0.098	104.960	0.922
3.	f	0.582	0.447	0.232	126	0.817
	m	-	-	0.230	114.861	0.818
4.	f	0.369	0.545	1.087	126	0.279
	m	-	-	1.095	121.228	0.276
5.	f	5.419	0.107	-2.243	126	0.568
	m	-	-	-2.261	121.633	0.577
6.	f	3.142	0.079	0.999	126	0.320
	m	-	-	0.987	112.297	0.326
7.	f	0.388	0.534	-1.593	126	0.464
	m	-	-	-1.603	121.001	0.469

the teachers deem the humorous elements in Turkish textbooks insufficient.

Throughout history, humanity has deemed humor as an unnecessary, unserious behavior, and even as a behavior that should be condemned. For instance, Aristotle and Plato deemed humor as a kind of mockery removing the dignity of man and harming his character. Basseut accused the comedies of Moliere, and claimed that laughing was the devil's work. George Vasey, the author of the book entitled “A Philosophy of Laughing and Smiling”, tried to prove that laughing was something harmful from a moral, aesthetic and medical point of view. Thus, it is possible to explain the insufficiency of humorous elements in Turkish textbooks by the negative approaches of individuals and society towards the concepts relevant to humor (Saglam, 2010)

Teacher opinions related to humor usage in Turkish lessons according to the gender variable

Data obtained from teacher opinions related with humor usage in Turkish lessons according to the gender variable were interpreted (Tables 7 and 8).

In Table 7, the “p” values in the equality of the variables test (Levene's Test for Equality of Variances) change between 0.830 and 0.079. According to this result, as the “p” values in the table are larger than 0.05, the variables of the group show a homogenous distribution. These

values are statistically significant. Thus, it is required to consider the results of the “independent sample t test”. The p value in the test ($p > 0,05$) varies between 0.276 and 0.922. According to this, there is no significant difference between the gender (male and female) variables. In other words, according to the gender factor, the teachers do not think differently regarding the effect of humor on the classroom environment.

In Table 8, the “p” values in the equality of the variables test (Levene's Test for Equality of Variances) change between 0.065 and 0.938. The “p” values in the table are larger than 0.05. Thus, the distribution of the group's variables is homogenous. These values are statistically significant. Thus, it is required to consider the results of the “independent sample t test”. The p value in the test ($p > 0,05$) changes between 0.069 and 0.797. According to this, there is no significant difference in between the gender (female and male) variables. When the arithmetic mean of responses for the attitude scale is considered, it can be understood that the teachers provided positive opinions regarding the effect of humor on Turkish courses as per the gender factor.

Teachers' opinions related to humor usage in Turkish lessons according to the seniority variable

The data obtained from the teachers' opinions related to humor usage in Turkish lessons according to the seniority

Table 8. “Independent sample t test” results of attitudes of Turkish teachers towards humor (last 9 articles) as per gender.

Articles	Gender	Levene's test for equality of variances		t-test for equality of means		
		f	p	t	df	p
8.	f	1.344	0.248	-1.047	126	0.297
	m	-	-	-1.043	116.504	0.299
9.	f	0.001	0.971	0.993	126	0.323
	m	-	-	1.011	124.518	0.314
10.	f	0.194	0.661	0.753	126	0.453
	m	-	-	0.755	119.239	0.452
11.	f	0.006	0.938	0.732	126	0.466
	m	-	-	0.741	123.227	0.460
12.	f	0.105	0.746	1.801	126	0.074
	m	-	-	1.837	124,910	0.069
13.	f	0.332	0.566	-0.258	126	0.797
	m	-	-	-0.260	120.719	0.796
14.	f	1.554	0.215	1.649	126	0.102
	m	-	-	1.642	116.298	0.103
15.	f	2.508	0.116	1.153	126	0.251
	M	-	-	1.188	125.994	0.237
16.	f	3.476	0.065	1.612	126	0.109
	M	-	-	1.602	115.147	0.112

variable was interpreted (Tables 9 and 10).

In Table 9, the “p” values (0.261 and 0.866>0.05) in the homogeneity of the variables test (Test of Homogeneity of Variances) are greater than 0.05. According to that, the distribution of the group’s variables is homogenous. These values are statistically significant. Thus, it is required to consider the results of the “one way ANOVA test”. The p value in the test ($p > 0.05$) changes between 0.113 and 0.956. According to this, there is no significant difference between the attitudes of the teachers towards humor and their seniority in profession. However, the p ($0.047 < 0.05$) value of article 7 of the attitude scale is lower than 0.05.

According to the data in article 7, there is a significant difference among the Turkish teachers in respect to “seniority in profession” variable. The arrangement of events through humorous elements by the Turkish teachers in their courses (1- to 5 years: 2,1786; 6 to 10 years: 1,9231; 11 years and over: 2,4444) is at the level of “I sometimes agree”. The teachers with a service at the range of 6 to 10 years organize fewer events with humorous elements in Turkish courses.

In Table 10, the “p” values in the homogeneity of the variables test (Test of Homogeneity in Variances) change between 0.423 and 0.984. As the “p” values in the table are greater than 0.05, the variables of the group show a homogenous distribution. These values are statistically significant. Thus, it is required to consider the results of the “one way ANOVA test”. The p values in the test ($p > 0.05$) change between 0.172 and 0.912. According to this, there is no significant difference regarding the attitudes of the teachers towards humor as per their seniority in profession.

DISCUSSION

According to the opinions of the teachers, the following conclusions were obtained regarding the use of humor in Turkish courses. According to the data in Table 5, it is possible to use humor in order to improve the communication skills of the students, to enable them to socialize, and to overcome their fears and concerns. Humor has helped to humanize, illustrate, defuse,

Table 9. One way ANOVA test” results of attitudes of Turkish teachers towards humor (first 7 articles) as per seniority in profession.

Test of homogeneity of variances							
Articles	Gender	N	p	Sum of squares	\bar{X}	df	p
1.	1-5 years	84	0.261	1.992	3.0357	2	0.113
	6-10 years	26		56.008	3.2692	125	
	11-years and over	18		58.000	3.3333	127	
	Total	128		-	3.1250	-	
2.	1-5 years	84	0.745	1.729	3.2500	2	0.142
	6-10 years	26		54.489	3.5385	125	
	11- years and over	18		56.219	3.3889	127	
	Total	128		-	3.3281	-	
3.	1-5 years	84	0.865	0.478	3.1905	2	0.591
	6-10 years	26		56.491	3.3077	125	
	11- years and over	18		56.969	3.3333	127	
	Total	128		-	3.2344	-	
4.	1-5 years	84	0.866	0.041	3.0595	2	0.956
	6-10 years	26		56.326	3.0769	125	
	11- years and over	18		56.367	3.1111	127	
	Total	128		-	3.0703	-	
5.	1-5 years	84	0.748	0.631	1.9762	2	0.704
	6-10 years	26		112.2911	2.0769	125	
	11- years and over	18		2.930	1.8333	127	
	Total	128		-	1.9766	-	
6.	1-5 years	84	0.477	0.101	3.0714	2	0.904
	6-10 years	26		62.516	3.0000	125	
	11- years and over	18		62.617	3.0556	127	
	Total	128		-	3.0547	-	
7.	1-5 years	84	0.758	2.943	2.1786	2	0.047
	6-10 years	26		58.612	1.9231	125	
	11- years and over	18		61.555	2.4444	127	
	Total	128		-	2.1641	-	

encourage, reduce anxiety and keep people thinking (Torok et al., 2004). The results of research performed by Hackman et al. (1993) coincide with the results obtained from this study. Humor makes the learning environment interesting, and it enriches the linguistic skills and vocabulary of the students. Magden and Tugrul (1994) and Ozkara (2013) concluded in their study, that humor is important in the linguistic development of students.

According to Table 5, it is possible to use humor in order to attract the attention of the student and in order to enable his active participation in the course. These results obtained by the research have showed parallelism with the research entitled "The effect of use of humor in

Turkish courses on the attitudes of students" (Savas, 2014). According to the data in Table 5, humor may be effective for improving the comprehension, interpretation and solution generation skills of the students, and for their academic success. The results of the research entitled "Teaching and Learning with humor: Experiment and Replication." (Ziv, 1988) showed that is important for the academic success of humor.

Similar results were obtained by the research entitled "The effect of the use of humor in social sciences education on the academic success and attitudes of students" (Oruc, 2010). The results in this research reflect parallelism with the research called "The Relationship of

Table 10. One way ANOVA test results of attitudes of Turkish teachers towards humor (last 9 articles) as per seniority in profession.

Test of homogeneity of variances							
Articles	Gender	N	p	Sum of squares	\bar{X}	df	p
8.	1-5 years	84	0.504	0.327	1.3452	2	0.590
	6-10 years	26		38.548	1.2692	125	
	11-yıl and over	18		38.875	1.4444	127	
	Total	128		-	1.3438	-	
9.	1-5 years	84	0.738	0.115	3.1548	2	0.912
	6-10 years	26		78.103	3.2308	125	
	11-yıl and over	18		78.219	3.1667	127	
	Total	128		-	3.1719	-	
10.	1-5 years	84	0.503	0.975	3.2024	2	0.266
	6-10 years	26		45.517	3.4231	125	
	11-yıl and over	18		46.492	3.2778	127	
	Total	128		-	3.2578	-	
11.	1-5 years	84	0.423	1.493	3.0714	2	0.174
	6-10 years	26		52.687	3.2692	125	
	11-yıl and over	18		54.180	3.3333	127	
	Total	128		-	3.1484	-	
12.	1-5 years	84	0.978	1.234	3.2143	2	0.239
	6-10 years	26		53.258	3.2308	125	
	11-yıl and over	18		54.492	3.5000	127	
	Total	128		-	3.2578	-	
13.	1-5 years	84	0.603	0.683	3.3452	2	0.489
	6-10 years	26		59.317	3.3462	125	
	11-yıl and over	18		60.000	3.5556	127	
	Total	128		-	3.3750	-	
14.	1-5 years	84	0.876	0.996	3.0357	2	0.372
	6-10 years	26		62.504	3.0000	125	
	11-yıl and over	18		63.500	3.2778	127	
	Total	128		-	3.0625	-	
15.	1-5 years	84	0.959	1.048	3.2024	2	0.321
	6-10 years	26		57.171	3.0000	125	
	11-yıl and over	18		58.219	3.2778	127	
	Total	128		-	3.1719	-	
16.	1-5 years	84	0.984	1.318	3.0833	2	0.172
	6-10 years	26		46.182	2.8846	125	
	11-yıl and over	18		47.500	3.2222	127	
	Total	128		-	3,0625	-	

Teachers' Use of Humor in The Classroom to Immediacy and Student Learning" (Gorham and Christophel, 1990). The study prepared by Cornett (1986) supports the results of the research which can be summarized as the importance of the use of humor in linguistic education (Turkish education).

The teachers are not given sufficient place for humor on Turkish courses, and they hold very few events with humorous elements. It is possible to explain the indifference of teachers towards humor by reasons such as the use of humor in courses not being a widespread implementation, the fact that the teacher will consume

more energy in the class, the thought that the discipline in the class may be lost, and that the planning may not be completed on time.

The results of this research show that humorous elements used in Turkish textbooks are wholly insufficient. Kutlu (1999) reached similar results in his study prepared regarding Turkish textbooks. In the study that he did in 1998, he determined that the texts including humor in Turkish textbooks indeed could be counted on one hand. He specified that while humor is important in the improvement in the ability of thinking, there was no reading relevant to humor in the Turkish textbooks of 1st and 8th grades in the relevant year, and that for instance, there was no text including humorous elements other than the "Swing The Lead" anecdote of Nasreddin Hodja in the Turkish textbook of 2nd grades (Kutlu, 1999).

In respect to the gender variables (male and female), the Turkish teachers do not think differently regarding the effect of humor on the classroom environment. The opinions of teachers regarding the effect of humor on Turkish courses are generally positive. There is no significant difference between the attitudes of the teachers towards humor and their seniority in profession.

Conflict of Interests

The authors have not declared any conflict of interests.

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