THE SCHOOL GARDENS IN PRESERVING BIOLOGICAL DIVERSITY FOR EDUCATION OF SUSTAINABLE DEVELOPMENT

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Abstract. In the teaching-learning process, a school garden allows to fully cover the contents of biology and environment protection curricular basic requirements. The role and importance of school gardens increased immediately after WW II but later the idea of these school structures waned. However, today we come back to the creation of school gardens and incorporating them in the educational process. A school garden fulfils a great didactic and tutorial function. At the same time, it allows to connect theory with practice. It enables teachers to conduct classes in the open air in "a green classroom". Didactic literature quotes that the use of school gardens in teaching and learning of biology increases the effectiveness of the educational process. The analysis of reports of students of IV Biology at the Natural Sciences Department of Szczecin University, who have conducted classes in a school Botanical Garden of Primary School No. 61 in Szczecin, shows the huge role of a school garden in the teaching-learning process. The students conclude that a school garden

gives them an opportunity for direct contact with nature. The garden develops pupils' talents and interests and teaches them to conduct ecological and phonological observations.

Keywords: school garden, plants, animals, phenology

Introduction

Collecting plants of various species is as old as human civilization. In the Ancient Times plants were grown for cultural and aesthetic reasons. In China the art of gardening was closely linked with the development of Buddhism (Buddhist temples were surrounded by beautiful, colourful gardens). In Egypt (in Thebes) one of the most famous construction of the Ancient World was created, the so called Queen Hatchepsut's gardens (it was a temple devoted to god Ra surrounded by a beautiful garden). In III BC, also in Egypt, another magnificent garden was started by the Greeks in Alexandria. Gardens as a symbol of power and kings' riches were created also in many other countries, e.g., in Turkey.

The first garden of scientific and didactic importance was a botanic garden which was located next to Aristotle Lyceum in a forest park in Athens. In the middle ages there were no proper conditions for creation of gardens. In the Renaissance a new type of garden appeared – a garden of collector-didactic profile. It was connected with the great geographic discoveries and the import of exotic plants to Europe at a grand scale. In the years of 1534 – 1621 gardens in Pisa, Florence and Oxford were started. The most turbulent period of gathering and collecting of plants is linked with the growth of the British Empire, e.g., Royal Botanical Garden in Richmond near London (Węglarski, 1997).

The Botanic Garden of Jagiellonian University in Krakow is the oldest one in Poland. It was founded in 1783 but the first idea of establishing a garden at Krakow Academy emerged as early as 1602, when the founder of the

first chair of medicinal botany in Krakow, Jan Zemełka, allotted a part of funds for the establishment of the garden. The botanic garden in Wrocław was set up in 1811 as an integral part of a newly founded University of Wrocław. The assumed date of the establishment of the Botanical Garden at the University of Warsaw is the year of 1818 when the garden existing at the Medical School since 1811 was moved to the area located within the-so-called Royal Garden, including the upper part of Łazienki. At that time the University of Warsaw took over the care of the garden (Teske, 1997).

Currently botanic gardens are dynamically developing all over the world and actively joining in the fight for the protection of the natural environment. In the era of total destruction of the plant world the creation of botanic gardens and arboretums constitutes a measure of civilization progress of societies (Węglarski, 1997).

The fundamental objectives of botanical gardens are: collecting plant material for scientific and didactic purposes, participation in the global programme of protecting vanishing, endangered and rare species as well as the dissemination of botanic knowledge, including the idea of environment protection (Teske, 1997).

A botanic garden is a living book and it constitutes a source of spontaneous motivation for and development of students' attitudes to nature. It facilitates teachers in covering material at various levels of teaching. Classes planned in a botanic garden, apart from their cognitive values, help young people to realize the global character of the environment, to acquire knowledge about the environment and problems related to it, to shape pro-ecological attitudes, to acquire the competence in identifying and solving environmental problems and they enable active participation in solving of environmental problems (Drapikowska, 1997)

The use of botanic gardens in teaching of biology at school can be done in various ways. It may be running field classes for a big group, but pupils are going to find classes in smaller groups much more beneficial because there

they can actively participate. It would be advisable to use guidebooks, folders and descriptions with regard to particular chapters and plants. A pupil who directly takes part in searching in a given guidebook or plan for plants, remembers them much better than in the case of his/her passive participation in classes (Dobrzycka, 1997).

Botanic gardens create great opportunities of educating a society. The sections set up in a garden (e.g., systematic, ecological, geographical, biological, variability and genetics of plants, crop plants, protected plants, decorative plants) enable to study the subjects of taxonomy, morphology, physiology, geography, ecology, genetics, pharmacy, environment protection, etc. Botanic gardens are of inestimable scientific and didactic value. They teach about the local and foreign flora, they stress the curiosities in the fields of biology, morphology, genetics, they familiarize with lowland, highland and mountain vegetation, the flora of lakes, peat, meadows, dunes, steppes, etc. Knowledge of plants can offer numerous benefits, and it is not limited only to the pleasure of watching beautiful flowers or the consumption of tasty fruit, but it makes one realize that one's existence is dependent upon nature (Więcław, 1997).

Content

The term school garden is understood as a patch of green land around a school (or area located in the vicinity of a school), typically surrounded by a fence or a hedge, which was planted with a variety of plants (orchard plants, decorative plants, vegetables, etc.) and used for animal breeding, equipped with various tools used for farming and animal husbandry. A school garden serves most importantly for conducting certain type of didactic and tutorial classes in a given school (Sawiński, 1991). The basic functions of school gardens include the following activities: tutorial; didactic; recreational; cultural; protective of the elements of biodiversity outside their natural habitat. A school garden works as a biology and environment laboratory. It influences: (a) the shaping of a co-host attitude, getting used to thorough and systematic

work for the school development of responsibility for results of one's actions; (b) appropriate attitude of a pupil to work, development of work planning and organisation, putting the pupils into a habit of team work; (c) development of aesthetic sensibility; (d) deepening of emotional link with nature; (e) understanding of rules and demands of nature conservation and environment protection. Classes conducted in a school garden help in revealing talents and biological interests and their development. They develop perceptiveness and abilities to: (i) conduct phenological, ecological observations and observations relating to nature conservation; (ii) recognise and mark plants and animals; (iii) use theoretical knowledge to solve practical problems; (iv) see dependence of an organism on the environment. Work in a school garden helps to familiarize pupils with: (1) working and fertilising the soil, growing and cultivation of plants; (2) gardening tools; (3) cultivated plants and weeds, their structure and biology; (4) protected plants; (5) plants of various adaptations (Stawiński, 2000).

Due to ever increasing environmental pollution, urbanisation, industrialisation and climatic changes that are associated with them, the danger to the environment has been growing dramatically in recent years. We mean here the danger to existing biological biodiversity, that is, in essence, to the entire variability of living organisms and ecological complexes linked with them. The term encompasses 3 levels of nature organisation: ecosystems, species and genotypes (populations).

In 1992 the United Nations Organization held an international conference in Rio de Janeiro (UNCED), called the Earth Summit, which was devoted to develop effective methods of protecting biodiversity with due consideration to the use of its elements and fair division of profit resulting from the exploitation of the so called genetic resources. The most important document of this conference was the Convention on Biological Diversity. The Parliament of the Republic of Poland ratified the Convention on Biological Diversity in 1996. The content of the Convention is of great importance to the development of

botanical gardens action programmes. The provisions of the Convention oblige the governments which were parties to the Convention to support the actions relating to the protection of biodiversity. The actions relate to the protection of elements of biodiversity outside their natural habitat. It is a complementing alternative to species and genotypes protection (Puchalski, 1997).

The threat to plant species in the world is very big. It is estimated that among approximately 260 thousand species of vascular plants appearing on the globe, as many as 60 thousand species are in danger of extinction within the nearest 20-30 years. It is estimated that on average one plant species dies out every day. The most endangered plants live in the tropical climate; it especially concerns the species occurring in humid tropical forests (Puchalski, 1997).

To maintain biodiversity it is necessary to develop forms and perfect methods of ecological-environmental education. National strategy for the protection of species' biological diversity assumes the engagement of greater proportion of the society into the issues and actions for environment protection (Fleszar, 2005).

School Botanical Garden in Szczecin has a variety of flora: trees, bushes and green plants. Plantings appear within the area of the garden, around the school and in front of the entrance. One can find here, among others: saucer magnolia (*Magnolia soulangeana*), common lilac (*Syringa vulgaris*), broad-leaved lime (*Tilia platyphyllos*), false acacia (*Robinia pseudoacacia*), siberian spruce (*Picea Obovata*), spruce (*Picea*) trailing variety, Austrian pine (*Pinus nigra*), dwarf mountain pine (*Pinus mugo*), common yew (*Taxus boccata*), sycamore (*Acer pseudoplatanus*), common juniper (*Juniperus communis*), pea fruited cypress (*Chamaecyparis pisifera*), common laburnum (*Laburnum anagroides*), almond tree (*Prunus amygdalus*), japan quince (*Chaenomeles japonica*), rhododendron (*Rhododendron*), common broom (*Sarothamnus scoparius*), weeping forsythia (*Forsythia suspensa*), sweet mock orange (*Philadelphus coronaries*), Lady's fingers (*Hibiscus esculentus*), snowstorm spiraea (*Spraea media*), holly mahonia (*Mahonia aquifolium*), Weigela Florida

(*Weigela florida*), common box (*Buxus sempervirens*), bigleaf hydrangea (*Hydrangea macrophylla*), clematis (*Clematis*), common honeysuckle (*Lonicera periclymenum*), Adam's needle (*Yucca filamentosa*), peony (*Peonia*), irises (Iris), forget-me-not (*Myosotis*), lily of the valley (*Convallaria maialis*), purple fox-glove (*Digitalis purpurea*), columbine (*Aquilegia vulgaris*), heartsease (*Viola tricolor*), peppermint (*Mentha piperita*), water plantain (*Alisma plantago-aquatica*) (in a small pond).

According to Kowalski's research (1989), schools founded before 1969 had a managed didactic garden, because it resulted form administrative obligation of utilising gardens in the teaching of biology (in the decades of the 1950s and 1960s). However, in a great majority of these schools the gardens have been closed down in recent years. Schools founded after the year 1970 have not had any school gardens. The most common reason being: lack of space to set up a garden; insufficient financial resources for the purchase of materials and tools, appropriate area for the set up of a school garden neighbouring the school has been destined for teacher's allotments. In a few cases lack of motivation to run a garden has been quoted. Classes in the garden are conducive to a better understanding of biology curriculum contents; they encourage better remembrance of the contents (Kowalski, 1989). According to Majecka & Nowak (1981) classes in the garden encourage adolescents to start thinking independently; they develop interests in agro-biology. During such classes pupils acquire skills and abilities to apply them in life. A school garden maintained in this manner fulfils a huge role in keeping biodiversity in the full sense of the word (Fleszar, 2005; Fleszar & Gwardys-Szczęsna, 2005).

Method

The method employed for the research was reports' analysis of students of IV Biology at the Natural Sciences Department of Szczecin University. The abovementioned tasks fulfilled by a school garden are confirmed by pupils'

reports from the School Botanical Garden at Primary School No. 61 in Szczecin.

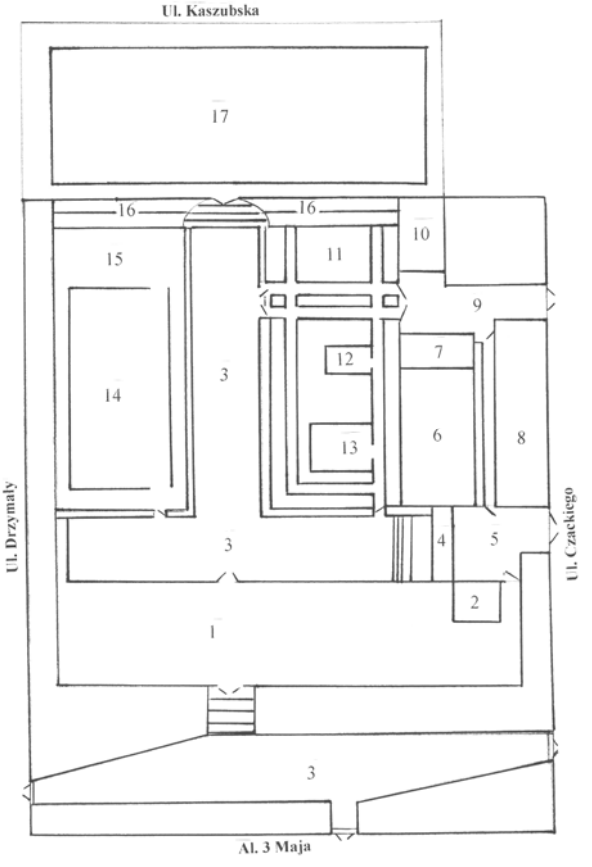

Fig. 1 Garden layout (1- school building; 2- garden workshop; 3- paving; 4- passage; 5-farmyard; 6- gym building; 7- teacher's flat; 8- orchard; 9- entrance gate; 10- garage; 11- vegetable experimental allotment; 12- garden pond; 13- garden classroom; 14- green gym; 15- rose garden; 16- Japanese terraces; 17- football pitch (ice rink in winter)

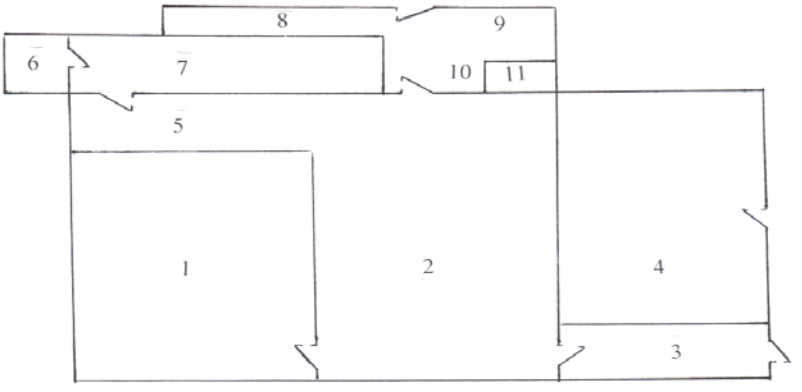

Fig. 2. Layout of garden workshop containing in school building (1- bright room with windows; 2- dark room, drying room; 3- vestibule I; 4- laundry; 5- small laboratory; 6- cold basement; 7- technical equipment, tool room; 8- big tools; 9 – vestibule II; 10- cloak room; 11- chimney [*cold room – basement*: a storeroom for keeping garden plants wintering in law temperatures in the basement, seeds, bulbs, rootstocks; small garden tools; crop protection chemicals, fertilizers; paints, solvent; small gardening accessories; *bright room with windows:* garden and pot plants' reproduction; storeroom for plant pots, vases and ikebanas; colorful photos – plant classification; classes with children adequate to the room function; *dark room – drying room:* storeroom for drying and storing plants for dry arrangements; exhibition room for plant display; classes with children adequate to the room function; *small laboratory:* plant preparation in higher temperatures strengthening colors in glycerine for dry arrangements, carried out on a gas stove; soil roasting in high temperature in order to decontaminate it from spores of fungal diseases, bacteria and removing seed from weeds (so prepared soil is used to grow healthy seedling of plants from seeds sowed in window boxes); accessories, containers for flower arrangements; sink; *vestibule I:* storeroom for dried plants; drying room for dry flower arrangements; *vestibule II:* tools for direct work in the soil – big rakes, spades, forks, hoes, etc.; garden hose; window boxes, buckets and other gardening containers; grinders for sharpening garden tools; cloakroom for a gardener – hangers, shelves and closets; *laundry:* washing a dirty clothes after gardening; washing, shower after gardening; washing of school personnel's clothes].

Results

Table 1. The results after the analysis of the stay of Szczecin University students in the School Botanical Garden

Contents analyzed	Y	2003 /24/		2004 /31/		2005 /83/		Total /138/	
	N	No of ans.	% ans.	No of ans.	% ans.	No of ans.	% ans.	No of ans.	% ans.
1. A school garden instills in pupils a habit of thorough and systematic work	Y	23	95,83	27	87,1	63	75,90	113	81,88
	N	1	4,17	4	12,9	20	24,10	25	18,12
2. A school garden develops responsibility for results of actions	Y	22	91,67	25	80,65	43	51,81	90	65,22
	N	2	8,33	6	19,35	40	48,19	48	34,78
3. A school garden develops a proper attitude to work	Y	20	83,33	23	74,19	16	19,28	59	42,75
	N	4	16,67	8	25,81	67	80,72	79	57,25
4. A school garden develops abilities of planning and organization	Y	15	62,5	25	80,65	40	48,19	80	57,97
	N	9	37,5	6	19,35	43	51,81	58	42,03
5. A school garden develops a habit of team work in pupils	Y	21	87,5	25	80,65	59	71,08	105	76,09
	N	3	12,5	6	19,35	24	28,92	33	23,91
6. A school garden develops aesthetic sensibility	Y	16	66,67	23	74,19	57	68,67	96	69,57
	N	8	33,33	8	25,81	26	31,33	42	30,43
7. A school garden helps to deepen an emotional link with nature	Y	13	54,17	19	61,29	48	57,83	80	57,97
	N	11	45,83	12	38,71	35	42,17	58	42,03
8. A school garden helps to un-	Y	20	83,33	28	90,32	79	95,18	127	92,03

derstand the rules and demands of nature conservation and environment protection	N	4	16,67	3	9,68	4	4,82	11	7,97
9. A school garden helps to reveal pupils' talents and interests	Y	18	75	22	70,97	67	80,72	107	77,54
	N	6	25	9	29,03	16	19,28	31	22,46
10. A school garden develops pupils' perceptiveness	Y	19	79,17	23	74,19	44	53,01	86	62,32
	N	5	20,83	8	25,81	39	46,99	52	37,68
11. Classes conducted in school garden help to develop phonological and ecological observation skills	Y	20	83,33	23	74,19	44	53,01	87	63,04
	N	4	16,67	8	25,81	39	46,99	51	36,96
12. Classes conducted in a school garden help in learning the recognition of plants and animals	Y	18	75	24	77,42	42	50,60	84	60,87
	N	6	25	7	22,58	41	49,40	54	39,13
13. Classes conducted in a school garden teach to apply theoretical knowledge in practice	Y	24	100	29	93,55	56	67,47	80	57,97
	N	-	-	2	6,45	27	32,53	58	42,03
14. Classes conducted in a school garden allow pupils to see the dependence of an organism on the environment	Y	18	75	25	80,64	66	79,52	109	78,99
	N	6	25	6	19,35	17	20,48	29	21,01
15. Classes conducted in a school garden familiarize pupils with the growing , fertilization and tending of plants	Y	18	75	21	67,74	60	72,29	99	71,74
	N	6	25	10	32,56	23	27,71	39	28,26
16. Classes conducted in a school	Y	20	83,33	21	67,74	63	75,90	104	75,36

garden familiarize pupils with garden tools	N	4	16,67	10	32,26	20	24,10	34	24,64
17. A school garden allows to cover the botany contents of the curriculum	Y	19	79,17	23	74,19	46	55,42	88	63,77
	N	5	20,83	8	25,81	37	44,58	50	36,23
18. A school garden allows to cover the zoology contents of the curriculum	Y	14	58,33	14	45,16	73	87,96	101	73,19
	N	10	41,67	17	54,84	10	12,04	37	26,81
19. A school garden allows to cover the ecology contents of the curriculum	Y	14	58,33	16	51,61	51	61,45	81	58,70
	N	10	41,67	15	48,39	32	38,55	57	41,30
20. A school garden allows to cover the environment contents of the curriculum.	Y	21	87,5	27	87,10	58	69,88	106	76,81
	N	3	12,5	4	12,90	25	30,12	32	23,19
21. A school garden allows to conduct a class in the open air, in the so called "green classroom"	Y	15	62,5	18	58,06	61	73,49	94	68,12
	N	9	37,5	13	41,94	22	26,51	44	31,88
22. Classes conducted in a school garden are more attractive to pupils than those in a school classroom	Y	15	62,5	17	54,84	73	87,96	105	76,09
	N	9	37,5	14	45,16	10	12,04	33	23,91

Abbreviations: Y – students mention this role / task / fulfilled by a school garden in the report; N – students do not mention this role / task / fulfilled by a school garden in the report; No of ans. – number of answers; % of ans. – per cent of answers

The research conducted shows that students value the role and importance of school garden. A school garden instills in pupils a habit of thorough and systematic work (the question 1 – 81,88%), develops responsibility for results of actions (the question 2 – 65,22%), develops a habit of team work in

pupils (the question 5 – 76,09%), develops aesthetic sensibility (the question 6 – 69,57%), helps to understand the rules and demands of nature conservation and environment protection (the question 8 – 92,03%) and helps to reveal pupils' talents and interests (the question 9 – 77,54%). Classes conducted in school garden help to develop phonological and ecological observation skills (the question 11 – 63,04%), allow pupils to see the dependence of an organism on the environment (the question 14 – 78,99%), familiarize pupils with the growing, fertilization and tending of plants (the question 15 – 71,74%) and familiarize pupils with garden tools (the question 16 – 75,36%). A school garden allows to cover the botany contents of the curriculum (the question 17 – 63,77%), allows to cover the zoology contents of the curriculum (the question 18 – 73,19%), allows to cover the ecology contents of the curriculum (the question 19 – 58,70%) and allows to cover the environment contents of the curriculum (the question 20 – 76,81%). Classes conducted in a school garden are more attractive to pupils than those in a school classroom (the question 22 – 76,09%).

Discussion

The analysis of reports of students of IV Biology at the Natural Sciences Department of Szczecin University, who have conducted classes in a school Botanical Garden of Primary School No. 61 in Szczecin, shows the huge role of a school garden in the teaching-learning process. The students conclude that a school garden: (1) gives them an opportunity for direct contact with nature; (2) develops their talents and interests; (3) teaches them to conduct ecological and phonological observations, teaches to recognize plants and animals, helps them to acquaint knowledge about growing, fertilizing and tending of plants.

To sum up, a school garden should constitute a part of a biology classroom in every school since in this way we ensure maintaining of biodiversity. Teachers ought to apply the principle created by Professor Bolesław

Hryniewiecki – a long-standing director of the Botanic Garden in Warsaw – "when learning about the plant world, we ought to study plants foremost, and not the books on plants" (Teske, 1997).

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APPENDIX. Graphical presentation of the results shown in Table 1: Diagrams 1-4 (2003, 2004, 2005, 2003-2005, respectively)

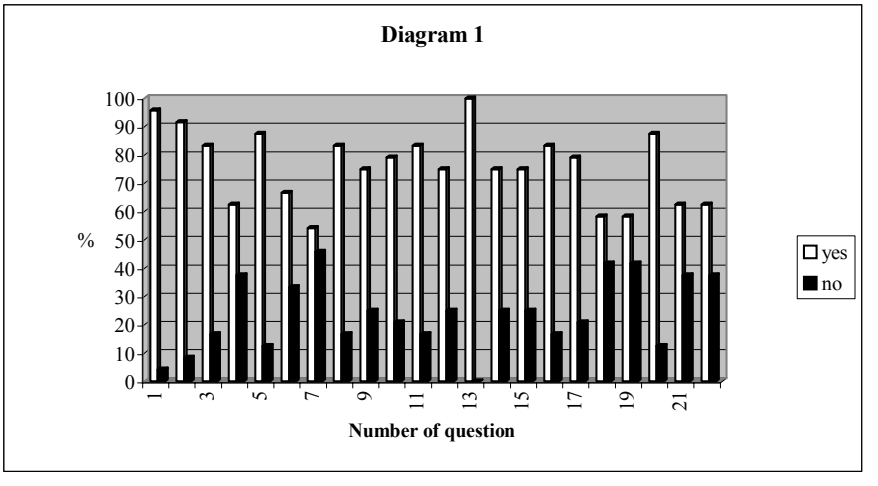
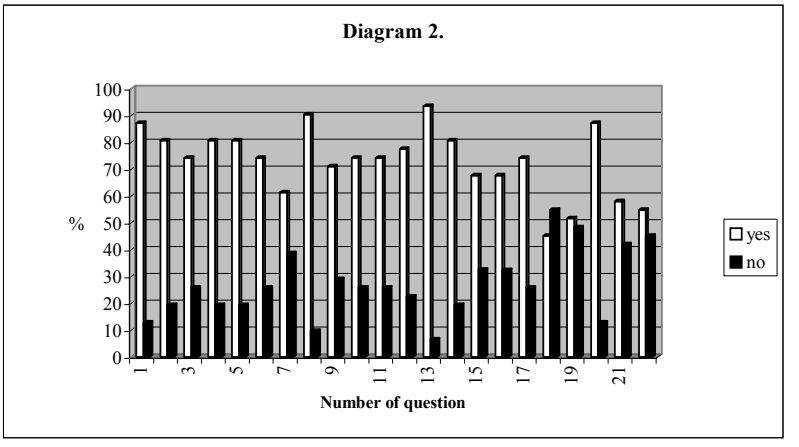


Diagram 2.



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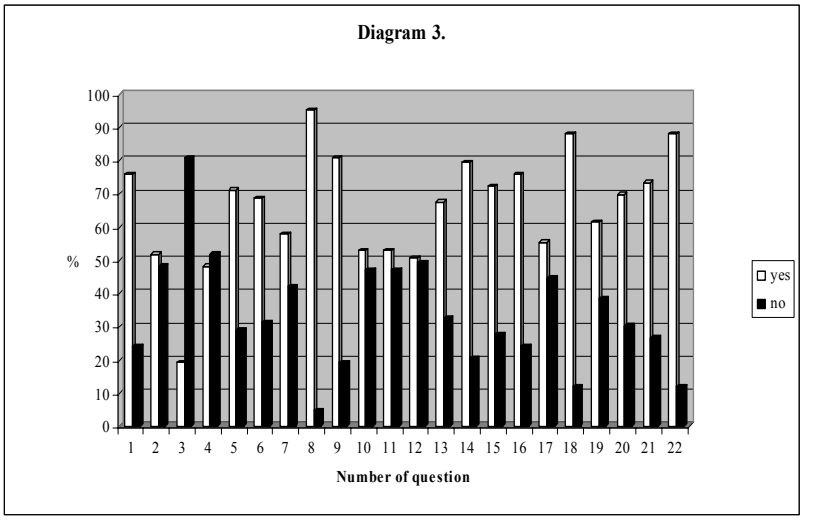

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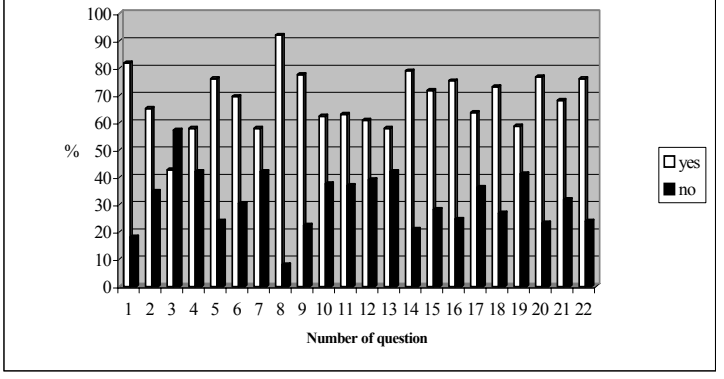
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