

Authentic learning environments for teaching and learning sustainable development in the built environment

MARUŠKA ŠUBIC KOVAČ

Faculty of Civil and Geodetic Engineering

University of Ljubljana

Jamova 2, 1000 Ljubljana

SLOVENIA

maruska.subic-kovac@fgg.uni-lj.si <http://www2.fgg.uni-lj.si>

MATEJA KOVAČ

Faculty of Architecture, student

University of Ljubljana

Zoisova 2, 1000 Ljubljana

SLOVENIA

matejavonkovic@gmail.com <http://www.fa.uni-lj.si>

Abstract: - The balancing of man's needs for conservation of the natural and built environments in the present and future is understood in conjunction with the concept of sustainable equilibrium, or the development as such, with the concept of sustainable development. This study focuses on built environment, and in particular, on the quality of existence and on providing the quality of existence in conjunction with sustainable development. The study analyses in detail the positions of the Vič – Ljubljana Secondary School students in relation to sustainable development in the built environment. Results of analysis of their positions may constitute a framework for curriculum renewal at secondary- and high-school levels in the Republic of Slovenia. Based on analysis of data gathered within a survey, we arrived to a conclusion that most students included in the survey had been familiarised with sustainable development in the built environment, however, on the average, their responses deviated by 23 % from an ideal solution. As every intervention which is not compatible with sustainable development in built environment, may have permanent, or even irreparable consequences for the development of the existing and future generations, such a result is not assessed as favourable. They lacked, however, the requisite knowledge concerning the placing of different buildings into space and conservation of cultural heritage. Differences in positions between the sexes, by the place of residence, type of building they reside in, and by their respective predispositions, were not observed within the research study. However, differences in students' positions exist between the particular study-years. Secondary school students of higher study-years tend to support more the decisions, which are in compliance with sustainable development in the built environment, as compared to the students of lower study-years. Renewed curricula in the Republic of Slovenia should, from the point of view of substance, include the issues of sustainable development in built environment in an integral, terminologically standardised and appropriately educational level. Active involvement of teachers and students in formal and informal space regulation procedures at different levels should be envisaged. In addition, education should be focused on authentic learning environments assisted by information communication technologies. Information communication technology increases the efficiency and flexibility of the learning and training systems, which can be implemented in employment environments, connecting formal learning with non-formal. At national level, an agency for the formation and monitoring of coherent education system in the field of sustainable development, and a school of architecture and spatial planning as non-profit organisations intended for education of the general public should be set up.

Key-Words: - Sustainable development, built environment, positions of secondary school students, engineering education in sustainable development

1 Introduction

In Dakar Framework for Action, Education for All [1], education is regarded as the key “to sustainable development, peace and stability”, along with the stimulation of social cohesion and by enabling persons to be actively involved social changes. The United Nations General Assembly, at its 57th Session in December 2002, adopted resolution 57/254 to start the Decade of Education for Sustainable Development 2005 - 2014 [2], pointing out that upbringing for sustainable development is a lifelong effort, stimulating individuals, institutions and societies to consider the tomorrow as a day that belongs to us all — or it shall not belong to any of us. In the Republic of Slovenia as well, the need to create an upbringing and educational concept in the spheres of built environment and sustainable development is ever more present. Resolution on National Environmental Action Plan 2005-2012 [3] envisages the environmental upbringing and education, which are based on lifelong learning and are brought to effect at all the levels of upbringing and education. Guidelines on upbringing and education in sustainable development from preschool upbringing to under-university education - VITR [4] were drawn up which, among the key areas of sustainable development cite the rural and urban development, as well as the Proposal of architectural policy of Slovenia [5], which focuses on all the aspects of sustainable development in the built environment, and the research titled the Education in built environment for sustainable development of Slovenia [6], which provides an analysis of the state and proposals for supplementing the VITR Guidelines on education in built environment. Schools, which in the past decided on the intensive integration of sustainable development substances into the implementing curricula, were supported by the competent Ministry and by other services. In addition, Quality criteria for schools involved in upbringing and education for sustainable development [7] were set up.

Findings of the R.A.V.E. Space [8] research show that Slovenian teachers are aware of the meaning of “sustainable” substances, but that they feel a lack of their own competences for quality discussion, they predominantly show man as devastator of his own environment, whilst co-natural management, spatial management and landscaping are presented in rather a declarative manner only. Research study titled Education in built environment for sustainable development of Slovenia [6] finds that the issue of relevant substances in school curricula has been “resolved” in a merely fictitious way in the Republic of

Slovenia. It is therefore necessary to present the substance in a more or less concrete way, taking into account the capabilities of target audiences at the different levels of formal education. Dealing with the abstract (conceptual) aspect only of sustainable development is more distant to children and teenagers than dealing with the concrete, empirical aspect of sustainable development.

Education of all the players (including the potential ones) on the built environment for sustainable development represents one of the important factors impacting the realisation of legal and other regulations governing sustainable development. Naturally, it needs to be pointed out that “any sustainability is attached to a particular locality” [9], and that it is therefore delicate to simply transfer any extraneously won experience into domestic environment. Likewise, no unique “recipes” are desirable, either, and therefore, the relativity of the term of sustainability and of sustainability dimensions in the different natural, economic, cultural and social environments, as well as at the different points in time, for the different target groups and for the different decision-making levels, needs to be presented by making use of case studies.

Analysis of position, in particular from the point of view of children and teenagers, towards sustainable development in built environment constitutes the basis for creating a new concept of education in the built environment for sustainable development of Slovenia. Results are most important for engineering education.

Ando et al. [2008] find that in the field of engineering education great attention had been devoted in the past years to theoretical and experimental training of undergraduates on: measurement methods,

- real instruments (features and working principle),
- virtual instruments and related environment,
- useful tools (advanced software and hardware) and
- distance learning.

Research of technical education has analysed issues, as:

- advanced hardware and related software,
- virtual instruments (LabVIEW™ environment), or
- basic subjects of electric and electronic measurement area.

However, as found by Bishop [2000] already in 2000, and retaining validity to date, engineering education has evolved into fairly segregated disciplines which focus on narrowly defined design

and manufacturing functions, often without consideration of the environmental consequences of these functions. In order to improve the relevant situation, we need to get familiarised with positions of secondary school students towards sustainable development in built environment, and create corresponding curricula in the field of engineering education.

2 Basis of research study of position of secondary school students on sustainable development in built environment, and method of work

Positions of secondary school students were analysed on the basis of a survey conducted at the Vič – Ljubljana Secondary School [10]. We asked the future players in space, how they would decide in life situations linked with construction in its more extensive sense, and consequently, with sustainable spatial development.

Survey was conducted on the basis of a questionnaire which had been prepared for the purposes of the Education in built environment for sustainable development of Slovenia [6] research study. This is a specific questionnaire, where questions in writing are supplemented by illustrations. Such “empirical” questionnaire is an antithesis to the “conceptual”, a more abstract one, as the human sensory-cognitive apparatus finds it more attractive and thus responds to it more spontaneously and intuitively. Namely, it represents an illusion of reality as known in the everyday life (first-person perspective, figurines of persons, trees and other materials), and therefore, responses may be expected which reflect a most realistic position of on the current issue of sustainable development the person surveyed.

Questions refer to placing buildings into space, their design, size, and to the relationship of persons surveyed towards the built cultural heritage and to the unbuilt land surfaces within settlements. The persons surveyed volunteered the diverse interventions into space (including the different types of building, green-plot creation or maintaining such surfaces in an unbuilt state) and chose between the different built environments for the performance of their daily activities (commuting, purchasing, spare-time activities).

The survey involved 221 secondary school students of a total of 787 students, which means 28 % of students from all the four study-years at the Vič – Ljubljana Secondary School. There were 44 % males, and 56 % females. The sample was

compiled by selecting at random any two classes of every study-year, and therefore, the representation by study-years is rather uniform (from 52 to 61 secondary school students within four study-years), where 35 % of students surveyed originated from Ljubljana, and 65 % of students surveyed originated from the greater Ljubljana region.

Analysis of positions of persons surveyed (hereinafter referred to as secondary school students) should show, whether sufficient activities had been done in the field of upbringing and education so as to stimulate secondary school students in accumulating knowledge and forming their approaches according to the sustainable development concepts. In measuring the positions we used the multi-attributive model of positions, i.e. the ideal point model, on which basis we aggregated the different convictions of the object of position into a global position. We assumed that a global position of a particular secondary school student was a sum of convictions of the object of position, depending on how important such convictions were to that particular individual [11][12].

Using the ideal point model, the entire position S_b of the secondary school student b equals:

$$S_b = \sum_{i=1}^n W_i(I_i - TC_{ib}) \quad (1)$$

, where:

iindividual response to an individual question
 W_i importance of an individual response (in our particular case, every response contributes equally to the end result),
 I_inumber of points if the response is an ideal one,
 TC_{ib} .number of points attained by secondary school student b with the response,
 n number of responses by a particular secondary school student b .

Based on this model (1) we assessed the entire position as a weighted sum of deviations of particular responses from the ideal point. As we were interested in the relative deviations, we presented deviations from the ideal point as percentages.

In addition to analysis of positions towards sustainable development in built environment we analysed also, whether there existed any differences in the relationship towards sustainable development in built environment as regards the sex, study-year, place of residence and types of buildings which the secondary school students resided in. This was

established on the basis of chi-square test: calculating the Pearson's chi-square value and the ensuing value of α (α represents the risk, i.e. probability that an envisaged event will not occur). We assumed that differences did exist in cases where $\alpha < 0.05$.

3 Results of analysis of positions of secondary school students towards sustainable development in built environment

Structure of particular responses was analysed and responses were weighted on the basis of predefined criteria as to the "more" or "less" sustainable responses. We found that, in particular cases, secondary school students more or less supported the sustainable development in built environment. However, they lacked knowledge in particular in the field of placing the different buildings into space. Study results show that secondary school students should be more motivated in recognising the cultural heritage and traditional knowledge of their own nation and humanity in general, and that they should be familiarised with the development-oriented conservation of cultural heritage.

Individual responses were weighted, and on this basis the relative deviations from the ideal point, i.e. the most favourable response for sustainable development in built environment, were calculated. The average deviation from the ideal point was 23.0 %. An average secondary school student included in the sample attained on the average by 23 % points less than the highest assessed response (weighted by 3 points for every response). One half of secondary school students deviated by less than 22.5 %, and three fourths of secondary school students deviated by less than 28.2 %. Standard deviation, showing variability within sample, equals 7.5 %. The maximum deviation is 40.9 %, and the minimum deviation is 7.5 %.

Secondary school students were divided into two groups depending on the deviation from the ideal point, as follows: Group 1: secondary school student is familiarised with sustainable development in built environment above average if his/her relative deviation from the ideal point is below or equal to the arithmetic mean, or Group 2: secondary school student is familiarised with sustainable development below average if his/her relative deviation from the ideal point is above the arithmetic mean. Groups created in this way were used for establishing differences in familiarisation with sustainable development in built environment with regard to

sex, study-year, the place of residence, or type of building in which every particular secondary school student resided.

Analysis showed no differences between sexes with regard to positions towards sustainable development in built environment (Pearson's chi-square value amounting 2.380, $\alpha = 0.123$). It cannot be asserted that women – female secondary school students reach more sustainable decisions in deciding for sustainable development in built environment than men – male secondary school students.

We found certain typical differences in deciding for sustainable development in built environment between secondary school students by study-years (Pearson's chi-square value 7.908, $\alpha = 0.048$). Secondary school students of lower study-years had accomplished less knowledge, skills and values concerning the possibilities of valuation of particular solutions, less capabilities of analysing the solutions, and similar, than the secondary school students of the higher study-years. This may be linked in part to the secondary-school educational system, and to the experiences which secondary school students accomplish through the years in their respective families, among their coevals and via the media.

We found also that there was no typical difference in positions concerning the sustainable development in built environment between the secondary school students residing in Ljubljana, and other secondary school students residing outside Ljubljana (Pearson's chi-square value 1.410, $\alpha = 0.235$). Similarly as there is no typical interdependence between the type of building which the secondary school students reside in, and their position concerning the sustainable development (Pearson's chi-square value 3.722, $\alpha = 0.714$). Thus, we may conclude that secondary school students do not perceive as yet the inadequate development in built environment as differently problematic neither in Ljubljana nor in the regions around Ljubljana, nor in relation to the type of building they reside in.

Results show that there is no typical interdependence between the positions of secondary school students concerning the sustainable development in built environment, and their most favoured school subjects (Pearson's chi-square value 17.136, $\alpha = 0.703$). Secondary school students do not link their own inclinations with sustainable development. We have namely expected that, for instance, students with predispositions for sports activities, who were most numerous, would support the sustainable development in built environment which enables them to perform their preferred sports

activities in a quality way.

4 Discussion on results

Research study results show that secondary school students are familiarised with the sustainable development in built environment. However, based on collected students' positions, it is rather difficult to find a response to the question, to what extent they are familiarised with the decision-making in favour of sustainable development. Deviation of their responses from the ideal choice that to a maximum degree supports sustainable development in built environment is 23.0 % on the average. Or, in other words: an average secondary school student included in the sample attains on the average by 23.0 % less points up to the top assessed point 3 in every response. Most secondary school students included in the sample collected an above-average quantity of points, i.e. their mean deviation from the ideal point was lower than average.

Though one half of secondary school students deviates from the ideal point by less than 22.5 %, and three fourths by less than 28.2 %, the two extreme values raise concerns. Namely, the maximum deviation is as high as 40.9 % and the minimum deviation as low as 7.5 %. This means that no secondary school student included in the survey circled the most favourable solution in all responses, or took into account to the maximum extent the sustainable development in built environment. Decisions reached as to encroachments upon space are mostly entailed by long-term and lasting consequences. Costs for eliminating such consequences of inappropriate decisions may be high, and in certain instances, the consequences of bad decisions even cannot be eliminated. Bad decisions may substantially affect the quality of life of the existing and future generations. In such cases, even average deviations of 23.0 % from the ideal point may be fatal.

Based on the above results it cannot be asserted that secondary school students are well familiarised with sustainable development in built environment. Similar results were obtained within a Slovenian project of "Incorporation of elements of sustainable consumption and sustainable development into the school curriculum" [13]. It was found that the term of sustainable development in the Slovenian realm has not been sufficiently known. The general public is found to be inadequately familiarised with sustainable development. This term is most frequently mistakenly understood in conjunction with climate change, decrease in biotic diversity, destruction of natural environment and similar.

Thus, it may be inferred that the term of sustainable development in built environment has to date not fully been established in everyday life, which applies also to secondary school students. And consequently, they do not have sufficient knowledge, skills and values required for the decision-making on sustainable development in built environment.

5 Comparison of pilot study results with the entire study

The study presented in the preceding chapters constitutes a pilot study for the study titled "Education in built environment for sustainable development of Slovenia" [6], which incorporated a questionnaire. The entire research study incorporated in addition to the secondary school presented (Vič – Ljubljana Secondary School) also two other secondary schools (from Kamnik and Grosuplje) and three elementary schools (from Ljubljana, Kamnik and Stranje). Schools were selected as representatives of schools and students from areas in Slovenia that are most typical from the point of view of architecture and urban-planning. A total of 2333 students (47 % males and 53 % females) from these schools were involved in the study.

On the overall, the researchers have taken as basis in the study a thesis that spatial planning in developed countries depends on the quality of educated experts, sound legal basis, quality practice, and last but not least, on users. In the period of schooling, the users need to acquire at least the general education in the field of spatial planning and sustainable development in built environment, respectively.

Results of the entire study, as well as of pilot study, show that the level of awareness of students of sustainable development in built environment has been increasing with age. Older students come up with more prudent and rational solutions, which show better perception of space and built environment, and resolution of different situations. This was most prominent with simple questions which offered answers in themselves.

Within both the studies, we found most conspicuous the fact that students answering the questionnaire recognized best the classical "bio"-issues that were clearly defined and incorporated in the curricula. It may be inferred therefrom that students respond to such issues in a studied, trained, principal manner, whilst in other circumstances (responses to questions without classical "bio"-

issues) they do not show the ability of transferring the system of values to a concrete situation. It is rather alarming that students attain worse results in recognising the everyday elements of space and that they link them less frequently with the quality of living.

Thus, in the pilot study as well as the entire study, the level of awareness of students from the point of view of cultural dimension of sustainable development (attitude to cultural heritage, informal types of cultural heritage, shopping malls, and similar) and their inability of transferring the declarative and formally defined contents of cultural stability into the concrete everyday situations is most alarming. They would prefer pulling down an old building, constituting cultural heritage, and constructing a new, modern building in its place, which may be explained as aversion to everything "old" and linked to the past. It needs to be pointed out that the questionnaire itself did not explicitly state that the old house belonged to cultural heritage, and the students under survey failed to recognize the building as cultural heritage in the photograph attached. And it can be inferred from the second part of the response (the question was "why") that most students had never thought of cultural heritage.

The study as a whole included elementary and secondary school students. We anticipated greater increases and leaps in understanding certain contents of sustainable development in built environment, in particular on account of presence of such contents in the curricula at certain levels. However, study results do not show this. On the one hand, this finding puts at issue the effectiveness of curricula, and on the other hand, the indistinctiveness of leaps may be explained by the inadequate maturity of students surveyed, which affects the less complex view of reality and perception of issues of sustainable development in built environment.

Within the study as a whole, the positions of teachers were analysed as well, regarding teaching competences in the field of sustainable development and culture of living. A sample of 33 teachers is a small one, however, the results focus our attention on the reality of certain our anticipations. The teachers pointed out that they lacked the subject-specific competences in the field of built environment and culture of living in conjunction with sustainable development. General competences in this field are, according to teachers, linked to their own interest, and to cultural environment they ensue from. Teachers perform much self-training through the Internet, fairs and literature; however,

they do not have at their disposal any organised forms of education and training in sustainable development in built environment. In addition, most teachers think that the term of sustainable development in general is deficiently or inappropriately defined in the curricula.

Important for revision of curricula is also the indication by teachers surveyed that elementary and secondary school students are most interested in those themes, where they may actively cooperate, create and design in the discussion of the theme. Learning contents are interesting to them if they are presented in a historic perspective. In such cases the interest of elementary and secondary school students in dealing with sustainable development is relatively high.

Results of the pilot study and of the entire study are identical at the level of basic analysis, despite the fact that they include the different levels of education from different cultural environments in the Republic of Slovenia. It may be concluded that the results of measuring global positions by help of a multi-attributive model of positions would be identical as well. Thus, based on pilot study alone, certain directions for curriculum improvement in the Republic of Slovenia may be given in relation to the contents of sustainable development in built environment.

6 New teaching and learning approaches

Teaching and learning of sustainable development in the built environment have to prepare students for autonomous decision making and participations in participatory processes. Teachers would motivate the students in sustainable development in built environment more in the Republic of Slovenia if they had been incorporated in the formal and informal procedures of spatial planning at the different levels. Partnerships between the educational, research and economic sectors need to be created:

- in the short term, as individual visits of experts at certain subjects in school, or in the form of seminars;
- in the long term, in the form of a school for architecture and spatial planning as a non-profit organization for education of general public.

From the point of view of contents, the issues of sustainable development in built environment should be accessed in an interdisciplinary and integral way. As sustainable development in natural environment is conditioned by different factors

which do not function separately and independently of the other factors, also sustainable development in built environment is a result of operation of different factors. Thus, Snow [16] proposes for climate change a comprehensive approach to an ecological education to address numerous environmental issues beyond climate change, which may be transferred, *mutatis mutandis*, also to the field of incorporation of contents of sustainable development in built environment into the curriculum. The students should be familiarized with the general and concrete contents of sustainable development in built environment, including:

- natural systems ecology,
- law and policy,
- history and philosophy,
- environmental leadership & community involvement and
- global issues in the field of built environment.

Renewed curricula in the Republic of Slovenia should, from the point of view of contents, incorporate the issues of sustainable development in built environment not only integrally, but also uniformly as regards the terminology, and uniformly structured in relation to level of education. An agency for designing and monitoring the uniform system of education in the field of sustainable development, set up at national level, would best contribute to this end.

Education in built environment should be focused on authentic learning environments assisted by information communication technologies [17]. Web-based simulations preserve real-life authenticity, providing active learning, connecting partners from industry and schools for sustainable development of professionals [18]. Information communication technology increases the efficiency and flexibility of the learning and training systems, which can be implemented in employment environments, connecting formal learning with non-formal. Simulations and games are becoming widely spread source of authentic learning for study courses as for continuous professional development. They support learning by doing, experiential learning, problem based learning, and learning without risk. Teaching and learning approaches are oriented towards integration of authentic working environments and practical work in diverse ways in order to support practical application of theoretical knowledge [19].

7 Conclusion

Secondary school students in the Republic of Slovenia should be better stimulated to critical and

creative thinking concerning the sustainable development. They should be familiarised with the democratic values and methods of impacting the entire social and economic development. They should be aware of the fact that by personal decisions and small steps in the right direction they may contribute greatly to sustainable development in built environment.

In the long run, education of young people is a most effective measure in concretising the paradigm of sustainable development in built environment. Values of quality of living environment need to be imparted to juveniles ever since early childhood, improving later their awareness of possibilities of being incorporated in the decision-making and co-decision procedures as regards encroachments upon space. Decision-making in compliance with sustainable development cannot be learned on the basis of a single recipe. Secondary school students should be familiarised with approaches that enable the identification of short- and long-term consequences, as well as the national and global, ecological, social, cultural and political consequences of conflicts of interests of individuals and groups, and of decisions and actions.

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