Theorising a Sustainable Computer Aided Architectural Education Model

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The dogmatic structure of architectural education has meant that the production and application of new educational theories, leading to educational models that use computer technology as their central medium of education, is still a relatively under-explored area. Partial models cannot deliver the expected bigger steps, but only bits and pieces. Curricula developments, at many schools of architecture, have been carried out within the closed circuit manner of architectural education, through expanding the traditional curricula and integrating computers into them. There is still no agreed curriculum in schools of architecture, which defines, at least conceptually, the use of computers within it. Do we really know what we are doing? In the words of Aart Bijl; ‘If I want to know what I am doing, I need a separate description of my doing it, a theory’ [Bijl, 1989].

The word ‘sustainability’ is defined as understanding the past and responding to the present with concern for the future. Applying this definition to architectural education, this paper aims to outline the necessity and the principles for the construction of a theory of a sustainable computer aided architectural education model, which could lead to an architectural education that is lasting.

Keywords: Architectural education, educational theories, computers, sustainable models.

Introduction

According to some historians, we are already in the third millennium, due to some miscalculations and time arrangements made in the past. The reality is that, the thoughts brought about by ending one millennium and entering another, has caused everyone to look back and re-evaluate what has been done until now, and what will happen in the future. The discipline of architecture in general and computer usage in architectural education, in particular, is one of these areas. The use of computers in architectural education has reached a critical state and faces a serious re-evaluation brought about by entering a new millennium.

In recent years, we have observed different approaches and experimental developments concerning computer usage in architectural education. Some of these have failed and eventually been abandoned. Others are either still being evaluated or used with different degrees in different institutions. Although researchers have made many technical as well as methodological developments regarding the activities of education, we have seen a deficiency of more conceptual models, that is to say theories, dealing with educational aims and objectives. Whilst trying to solve the existing problems of architectural education, these experiments have added more
problems to the current curriculum, without being able to solve them. Changes that have taken place in other areas such as technology, information and society, have introduced new concepts into architectural education. Computers and related technologies have not only formed one of these major areas, but also have affected all the others to various degrees.

**The Structure of Education**

If we are to talk about education and understand what it is, instead of going through several descriptions of it – starting from Plato and coming to date – it could be more meaningful to look at and to understand the structure of education, that could enable us to develop our own definition. Moore defines this structure as a multi-storey building, where different floors define different parts of education:

*‘On the ground floor there are various ‘educational activities’ (e.g. teaching, learning, training, demonstrating, evaluating – the sort of activities to be found in classrooms everywhere). At the next higher level, say at the first floor level, there is educational theory, which may be understood as a body of connected principles, guidelines and recommendations, aimed at influencing what goes on at the ground floor level. At a higher level still, there is a philosophy of education, which has for its main tasks the clarification of the concepts used at lower levels, concepts like ‘education’ and ‘teaching’ for example, and an examination of theories which operate there, testing them for consistency and validity’ [Moore, 1974].*

The differences in the levels can be referred to as logical differences, where the formation of each level is dependent upon and in relation to the ones above and below.

The philosophy of education, first aims at defining the concepts used in the theory of education. At this level, the concepts starting from psychology, sociology and so on up to teaching, learning, knowledge, education, student, etc. are all philosophised and understood with their relation and feedback to the formation of an educational theory. No theory can exist without assigning clear definitions to each of these concepts. Secondly, the philosophy of education handles the examination of theories and tests them for consistency and validity. The consistency and validity of a theory depends on the consistency and validity of the definitions made about the concepts used in them. If the meaning or the content of any of the concepts defined in the philosophy of education changes, then a redefinition comes into consideration, which gives way to a redefinition of the theory of education. If for example, the empirical knowledge coming from areas such as psychology and sociology results in a change in the body of knowledge for these areas, they have to be redefined in terms of their relationship to educational theory. These changes go from the upper levels of the structure of education.
and affect all the levels coming after it.

As one definition of theory is ‘an instrument for reasoned explanation and prediction’, educational theory formed on the basis of the concepts discussed in the philosophy of education, tries to explain itself with the outcomes of these conceptual discussions and tries to predict the future. The distinction between a practical and an explanatory theory must be made here. In contrast to the descriptive and explanatory manner of explanatory theories, an educational theory is a practical theory, which is more prescriptive and recommendatory. People involved or concerned with educational practice use an organised body of principles and recommendations within an educational theory to design educational activities; that is the practice of education. Educational theories, then, become a more or less worked out body of prescriptions for the guidance of the people involved in the practice of education. The aims and objectives of education as well as conceptual questions like, why to teach, what to teach and how to teach are asked, discussed and answered within the theory of education.

Educational activities cover the whole range of activities designed and applied in order to be able to achieve the aims and objectives of education. In other words, the means to achieve the ends defined within the theory of education. Prescriptions of a pedagogical kind, about the most effective ways of teaching, about the conditions of teaching as well as recommendations for producing a certain type of person, sometimes even a certain type of society, come from the theory of education, and are converted into the activities of education. In other words, the activities of education test the ends to be achieved presented by the theory, and, while doing this, assumptions made by the theory about the means to achieve that end are used.

The scientific content of an educational theory comes from related disciplines such as psychology and sociology. For example, the nature of student, their development, the way they learn and the way they react to social influences are the scientific components of an educational theory. New findings in these areas go into the process from the philosophical level and are converted to first concepts for theories and then meaningful activities of education.

The Structure of Architectural Education and its theory

Although every academic knows that there are several methods and pedagogical issues used in architectural education to achieve objectives or aims related to the formation of students of architecture, the theoretical background or definitions that are giving way to the formation of such issues are usually unarticulated or rarely discussed. They are some kind of discourses, which are formed through definitions of profession-related establishments or a discourse handled dominantly by the profession.

According to Stevens, the structural formation of architectural education starts with the Ecole Polytechnic (Stevens, 1995). The method of pedagogy devised within this institution was preserved by Ecole des Beaux-Arts and passed down to modern American and then to a lesser extent British schools. Between 1920 and 1955, the Ecole’s philosophy was imported to the United States and Canada, and most architectural schools then had at least one Paris trained professor. Over 500 students from the United States went to the Ecole des Beaux Art for at least a year between 1850 and 1968 when it was closed. Then came another corner stone, the Bauhaus school from 1919 to 1934, whose influence was felt throughout the world. Most of the academics who were educated under the dominant influence of these institutions are now retired or about to leave the universities. The theory of education, as well as the methods and understanding informed or formed by these theories have been used until relatively recently, with the intuitive formation of these individuals. The transition brought about by these institutions has often been characterised as a paradigm shift from one kind of knowledge and pedagogical system to another. In general, architectural education and its theory have
stayed within the inheritance of this paradigm shift. Everything changed. Societies, technology, practice, knowledge has changed enormously. Although the way we teach architectural education has also gone through changes, we still feel deeply that there is a lack of a theory for the future of architectural education.

‘In the forties, Joseph Hudnut, from Harvard, made a list of all the subjects that he deemed essential for a sound and complete architectural education. When the list was complete, he calculated the length of time it would take to learn all of them – 22 years’ [ACSA, 1999].

This cannot even be contemplated today. One of the greatest changes occurred in the accumulation of knowledge. If the content of what you teach is directly related with how you teach it, even with this example, one would expect another paradigm shift, which never came to architectural education, except with some partial theories mentioned above.

Today, if we search for the ideal structure of education described above within architectural education, we see that some parts are missing, hidden, blurred or mixed up. At the philosophical level, the concepts that are related to architectural education are more taken for granted or accepted as existing more than being discussed and updated. Although these concepts, such as education, training, student, knowledge, information, technology, etc. are discussed by individuals and go round within the discourse of architectural education, they are rarely institutionalised. This is mostly due to the disorganised structure of architectural education, when compared to the structure defined above.

When the theory of architectural education is considered, we see that there exist no conceptual theories that generate the design of activities mentioned in the ground floor of the structure of education. Instead of making future projections starting from discussing the philosophy of education and then forming a theory for it towards the design of the activities, most research and applications are made from the bottom up. Teymur explains this as:

‘Architectural Education can justifiably be called a practice without a theory. The discourse on Architectural Education is full of myths and unarticulated assumptions which cannot of course be substitutes for theory’ [Teymur, 1996].

Although all research aimed at bringing about changes to the way education is processed bears a theory; these are only limited theories of education involving prescriptions of a mainly pedagogical kind. For example, the way we should teach a specific content or the importance of hands on experience on a specific course, are all limited theories of education. Architectural education is full of such limited theories, research as well as activities designed in relation to the outcomes of this research. These limited theories form only a part of the individual who is to be educated. If there aren’t any general theories, such as in architectural education, education becomes an ad-

**Philosophy of Education:**
- Limited discussions of concepts used at lower levels
- No examination or testing of theories / no theories...

**Educational Theory:**
- A discourse full of myths and unarticulated assumptions instead of theories...

**Educational Activities:**
- Teaching, learning, training, demonstrating, criticising. Sort of activities in classroom and in school (plenty of them).
hoc process. But the whole of architectural education is greater the sum of its parts.

Computers in Architectural Education and Research

Without doubt, the appearance of computers and related technology in architectural education is one of the greatest events in the history of architectural education. They are not only the most important contemporary concern, but also the one with the highest potency to transform architectural education to where it belongs. The relation of computers to architectural education must be handled under two different but related headings. One of these is the use of computers in architectural education towards the aims and objectives of education, that is to say, pedagogy, methods or the activities of architectural education. Another is the consideration of computers and related technologies while defining these aims and objectives of architectural education. If the first one is the lower level activities in the structure of education, the second is the upper level of the same structure.

i. Computers in the lower level activities of architectural education

If we are to have ideas about computers and their use in architectural education, we can start by looking at the research made in this area within universities. As this is a complex and time-consuming study, we can simply take conferences and the papers presented at these conferences, as a reflection of what is going on in schools of architecture. Some of the most important ones are eCAADe, ACADIA and CADRIA. When we take a section through these conferences, we see that the use of computers in architectural education occurs most commonly through the lower level activities within education. Within 422 randomly selected abstracts, the percentage of the topics dealt with is shown in figure 3. Although developments in hardware and software introduced new topics to this research through the history of computer usage in architectural education, 97% were all lower-level activities based on partial theories defined previously. No one can deny the changes brought to the methods of teaching architecture or the pedagogy of it, but the percentage of studies directly related to the theory of architectural education (general theories) is only 2.36%.
The same distinction and emphasis on lower level activities could be found in the RIBA and the ARB’s Criteria for Validation. The following quotations were taken from the publication of the panel [RIBA ARB, 1997]. Although defining the outline syllabus in detail (with objectives of each course and learning outcome) the RIBA suggests that they ‘provide assistance to Schools in achieving their objectives’. Two of these quotations are;

‘Part 1: ... it recognises that some significant additional areas should be better addressed:
- bringing CAD into the mainstream of acquired skills’.

‘Part 2: teaching in areas of architectural management, conservation, CAD and environmental strategies should be strengthened’.

Both of these definitions refer to CAD as a skill to be gained. A more detailed definition of CAD courses is given within the communication section;

‘All students should be computer literate and their basic skills should be upgraded during their course of study to take account of the particular needs of the course in the environmental and architectural technologies. Students should also have experience of computer draughting techniques and have skills in the use of computers in the development and presentation of their design. The learning objectives should be:
• To give students a basic understanding that will enable them to use the computer creatively;
• To understand the use of the computer as another design tool and communication skill;

<table>
<thead>
<tr>
<th></th>
<th>Design process / Studio / methodology</th>
<th></th>
<th>81</th>
<th>% 19.19</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Teaching methodology</td>
<td></td>
<td>60</td>
<td>% 14.21</td>
</tr>
<tr>
<td>3</td>
<td>Theory of Computer aided design</td>
<td></td>
<td>48</td>
<td>% 11.37</td>
</tr>
<tr>
<td>4</td>
<td>Network / Collaborative design</td>
<td></td>
<td>38</td>
<td>% 9.00</td>
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<tr>
<td>5</td>
<td>Multimedia / Hypermedia / Hypertext</td>
<td></td>
<td>34</td>
<td>% 8.05</td>
</tr>
<tr>
<td>6</td>
<td>Other courses / Services</td>
<td></td>
<td>27</td>
<td>% 6.39</td>
</tr>
<tr>
<td>7</td>
<td>Modelling</td>
<td></td>
<td>26</td>
<td>% 6.16</td>
</tr>
<tr>
<td>8</td>
<td>Curriculum</td>
<td></td>
<td>22</td>
<td>% 5.21</td>
</tr>
<tr>
<td>9</td>
<td>Representation of Knowledge</td>
<td></td>
<td>19</td>
<td>% 4.50</td>
</tr>
<tr>
<td>10</td>
<td>Expert Systems</td>
<td></td>
<td>18</td>
<td>% 4.26</td>
</tr>
<tr>
<td>11</td>
<td>Presentation / representation</td>
<td></td>
<td>16</td>
<td>% 3.79</td>
</tr>
<tr>
<td>12</td>
<td>Virtual Reality</td>
<td></td>
<td>12</td>
<td>% 2.84</td>
</tr>
<tr>
<td>13</td>
<td>Others (visualisation / interface / grammars)</td>
<td></td>
<td>11</td>
<td>% 2.60</td>
</tr>
<tr>
<td>14</td>
<td>Educational Theory</td>
<td></td>
<td>10</td>
<td>% 2.36</td>
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<tr>
<td></td>
<td>Total</td>
<td></td>
<td>422</td>
<td>% 100</td>
</tr>
</tbody>
</table>

Table 1 (right). Distribution and ‘%’ of Research for Different Categories Related to Computer Usage in Architectural Education.
• To introduce students to the range of computer software available to aid the practice of architecture.’

All these definitions could be classified as definitions of CAD as an outcome of the education. In other words the outcome of the lower level activities. Neilson et al questions this in their following quotation;

‘The importance of some degree of computer literacy to the practice of architecture is constantly being emphasised yet what constitutes computer literacy in the context of architectural education has yet to be defined and appropriate guidelines for the teaching of CAD established. Currently the course structure of a CAD option is simply decided by the staff involved in teaching the option. Many course designs are possible, not all of which are likely to give equal educational returns’ [Neilson, I., Tweed, C. and Vergopoulos, S., 1991]

ii. Computers in the upper level activities of architectural education
The studies about the effect of computers on the upper level activities of architectural education such as philosophy or theory of architectural education are the least researched areas. The discussions in this section (with a percentage of 2.36%) is coming and going at different intervals without leaving considerable outcomes. For example, in 1994, some papers, which discussed educational theories and CAD, were published only in the summary section, while more technical papers were selected to be published in full [A, Bridges, J. Lowe, G. S. Yakubu, E. Fantacone. L. Millard, etc.]. These limited works usually deal with at least one of the upper level areas but their relation or feedback to the other levels within the whole is neglected. Changes brought to the concepts in philosophical level for example, changes about the definition of knowledge / accumulation of information and knowledge / changes in society / epistemology etc. due to computer technology is rarely re-evaluated and brought to education from top to bottom. A. Bridges emphasises this lack.

‘Many papers at previous eCAADe conferences have discussed CAD curricula, but few have questioned the educational objectives of teaching CAD. … not only what should be taught, but why and how it should be taught’ [Bridges, 1994].

Again R. Coyne in one of his papers recommends that;

‘CAAD teaching move away from conservative concepts of teaching, design and technology to integrate it into the studio’ [Coyne, 1996].

Another one from D. L. Mackey;

‘A pragmatic model for the building of an electronic architectural design curriculum which will offer students and faculty the opportunity to fully integrate information age technologies into the educational experience is becoming increasingly desirable. … Computer technology is not a “topic”, but rather the medium. Such a viewpoint urges the development of a curricular structure, through which the impact of computer technology may be understood as that medium’ [Mackey, 1992].

If we are to conclude about the research on computer usage within architectural education, we can say that there is a high tendency of attempting to apply computers to the realisation of the aims and objectives of architectural education, but a lower tendency towards exploring the importance of computer technology in defining these aims and objectives.
Simply the distinction between upper level activities and lower level ones becomes obvious.

**The structure of a sustainable theory for AE**

The sustainability of a theory comes from the concept of its being consistent as changes occur in the definitions of the concepts that defined the theory. As the only thing that is not changing is the change itself, we have to consider change as an issue that is taken for granted within such a definition. Before that, we have to have a structure to start with. The formation of such a structure can borrow from already existing structures of education in general, re-defining them to fit architectural education and its specific properties.

Such a structure should start with the clarification of the concepts we will use in the formation of a lasting theory of architectural education. The effect of computer technology on these concepts must be made clear to begin with. Education, knowledge, training, learning as well as feedback from psychology and sociology must all deal with the effect of computer technology. Assumptions about the person who is to be educated, their relation to the changes brought about by the computer technology, through society, psychology etc. must be made at this level. The clarification of these concepts is essential for the next step, which is the formation of a theory, a prediction for the future of architectural education.

The practical theory of architectural education must begin with the aims and objectives of education. The philosophy of the concepts will also define the place of computers in these aims and objectives as well as the secondary effects of computers in defining them. The new advances in computer technology will be handled from the top level and then reflected back into the theory. The theory should consist of a set of recommendations supported by reasons. The nature of knowledge and the methods considered appropriate to teach it are some of the kind of assumptions which are constructed here in relation to their clarified definitions at the philosophical level.

The activities of education (methods and models of teaching, pedagogy, etc.) will be designed according to what, in the given circumstances, were the best means of bringing about this desirable end. The theory does not only consist of the presentation of the ends to be achieved, but also recommends the various means as ways of realising them. We have now got enough experience of this kind when we look through the history of research on the use of computers in architectural education.

All of these assumptions and recommendations are liable to change, but the structure is not. These changes about the detailed contents, including recommendations for the practice of education, must be derived from contemporary material, value

**Figure 4 (right). A Sustainable Structure for Architectural Education.**

**Philosophy of Education:**
- Philosophising concepts for use in the construction of theories.
- Examination and testing of theories for consistency and validity

**Educational Theory:**
- Reasoned explanation and predictions (theory) aimed at influencing what goes on in educational activities.

**Educational Activities:**
- Teaching, learning, training, demonstrating, criticising. Sort of activities in classroom and in school, as well as research.
judgements of the people designing these activities and up to date knowledge.

‘The knowledge, skills and attitudes we now think valuable may not always be thought so. New forms of knowledge, new skills, different attitudes, may emerge to give a different content to what is regarded as the mark of an educated man’ [Moore, 74].

The changes within philosophical definitions will test the theories of the second level and check them to see if they are still consistent after these changes. The tested and approved or changed and modified theories will in turn test the activities for their consistency of new material, new knowledge and changed notions of value. Any section failing in this ordered relationship will have to be replaced with a more appropriate one for the consistency of the whole structure. This cycle from top to bottom and then up again will form the sustainability of the structure of architectural education.

**Summary**

The ideal of an educated person held by a given era, as Derrida points out, is always predicated on the basis of a theory of truth [Ulmer, 1985].

More research about the general theories of architectural education that use computers and related technology must be made and discussed in order to have a complete picture of architectural education and the place of computers within it. Existing accumulated research and the results of this research must be used to construct this structure and give way to the future of this research. Once more, if we want to know where we will go, we must make a separate description of our going there, a theory for the future. This is not a conclusion; we wish it to be the starting point.

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