SUSTAINABLE ARCHITECTURAL EDUCATION: PEDAGOGICAL LEARNING OUTCOMES OF SUSTAINABLE ENVIRONMENTAL DESIGN

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ABSTRACT
Since the role of architects in mitigating Carbon dioxide (CO₂) emission to curtail climate change has been emphasised to be significant, sustainability in architectural education has placed a high demand on architectural educators. This paper aims at examining Sustainable Environmental Design (SED) issues with the view to recommending ways architect-educators can create pedagogical learning outcomes to promote best practices in Nigeria. The approach for this study is the review of the European Qualification Framework (EQF) for Lifelong Learning in which learning outcomes are structured in terms of knowledge, skills and competence considered at eight qualification levels of Education. Findings indicate that the last three levels of EQF correspond to the three architectural qualification levels in Nigerian Universities and can be used to define a progression of abilities in environmental sustainability that students should gradually attain in design. This paper has demonstrated ways as practical guide architect-educators can focus their pedagogical learning outcomes in SED to aid learning among students. The paper also recommends ways the EQF can be contextualised to create pedagogical learning outcomes of SED to improve sustainable architectural education in Nigerian Universities.

Keywords: architectural education, learning outcomes, sustainability, sustainable architectural education, sustainable environmental design.

INTRODUCTION
Knowing that buildings are responsible for about half of world’s energy consumptions; educators, students, and professionals in disciplines of the built environment are faced with new demands (EDUCATE, 2012; and Hassanpour et al, 2010). As a result, there was a general consensus for the need to incorporate sustainability into the core aspects of architectural curriculum in Nigeria (Dauda, Sanusi, & Ajufoh, 2010). Recently, the Architects Registration Council of Nigeria (ARCON) has issued a directive to all the accredited schools of architecture in Nigeria to incorporate sustainability into their curriculum. As a result, virtually all the schools of architecture in Nigeria have introduced two or more courses in their curriculum to deal with the issues of sustainability. A great deal of papers have been published in the area of sustainable architectural education, but little has been done to demonstrate the most appropriate ways pedagogical learning outcomes of SED can be created to support learning among students in Nigerian Universities.

For architect-educators to consistently consider such priority in curriculum development, their pedagogical objectives should build on the most recent and verified knowledge available and on the results of research and built practice in order to define the learning outcomes in sustainable environmental design (SED) that students should acquire at each level of progression towards responsible practice (EDUCATE, 2012). This paper aims at examining Sustainable Environmental Design (SED) issues with the view to recommending appropriate ways architect-educators can create pedagogical learning outcomes to promote best practices in Nigeria.

Yannas (2011) concisely describes sustainable environmental design as follows:

“Over the last 30 years it has become technically and economically feasible, as well as socially and environmentally necessary, to replace the use of non-renewable energy sources and conventional building services engineering with self-sustaining processes that are inherent in the built form, elemental specification and operational schedules of buildings. It is this approach that
we describe with the term sustainable environmental design, that is the knowledge that allows us to invent and develop self-sustaining processes and embed them into buildings using nature’s energy sources and sinks by means of architecture”.

It is in this light that this paper focuses its argument in order to show how architect-educators can create pedagogical learning outcomes of SED. Architect-educators in Nigeria should consider using the EQF’s learning outcomes structured in terms of knowledge, skills and competence with varying complexities at eight different qualification levels in which the last three correspond to undergraduate (bachelor’s) degree, postgraduate (master’s) degree and postgraduate (doctorate) degree levels respectively to create pedagogical learning outcomes of SED.

STRUCTURE OF THE EUROPEAN QUALIFICATION FRAMEWORK

The European Qualifications Framework for Lifelong Learning (EQF) is a common EU reference framework to link countries’ qualifications systems together and act as a translation device to make qualifications more readable and understandable across different countries and systems in Europe (EC, 2008 cited in EDUCATE, 2011). “The EQF is a ladder in the sense that from level 1 to level 8 the associated learning becomes more complex and makes greater demands on the learner or worker” (EC, 2008).

In Nigeria, architect-educators should use the EQF to create pedagogical learning outcomes as its structure is compatible with the structure of qualification levels in Nigerian education system. Since SED is taken at the tertiary level, this paper focuses on EQF’s levels 6, 7 and 8 which correspond to bachelor’s degree, master’s degree and doctorate degree qualification levels respectively in Nigeria. In the EQF, learning outcomes are described in terms of three dimensions – knowledge, skills and competence (KSC).

KNOWLEDGE DIMENSION

EC (2008) defines knowledge as “the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study”. Table 1 shows each of the 8 levels as defined by a set of descriptors indicating the learning outcomes, in terms of knowledge, relevant to qualifications at that level in any system of qualifications.

Table 1: Descriptors Defining Levels in the EQF – Knowledge Dimension

<table>
<thead>
<tr>
<th>Qualification Level</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>basic general knowledge</td>
</tr>
<tr>
<td>Level 2</td>
<td>basic factual knowledge of a field of work or study</td>
</tr>
<tr>
<td>Level 3</td>
<td>knowledge of facts, principles, processes and general concepts, in a field of work or study</td>
</tr>
<tr>
<td>Level 4</td>
<td>factual and theoretical knowledge in broad contexts within a field of work or study</td>
</tr>
<tr>
<td>Level 5*</td>
<td>comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge</td>
</tr>
<tr>
<td>Level 6*</td>
<td>advanced knowledge of a field of work or study, involving a critical understanding of theories and principles</td>
</tr>
<tr>
<td>Level 7*</td>
<td>highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research</td>
</tr>
<tr>
<td>Level 8*</td>
<td>knowledge at the most advanced frontier of a field of work or study and at the interface between fields</td>
</tr>
</tbody>
</table>

Source: EC (2008: 12)

*Note: These qualification levels are compatible with the Nigeria’s University education qualification levels.

SKILLS DIMENSION
Also, EC (2008) defines skills as “the ability to apply knowledge and use know-how to complete tasks and solve problems”. Table 2 shows, defining skills in the context of EQF, each of the 8 levels as defined by a set of descriptors indicating the learning outcomes (in terms of skills) relevant to qualifications at that level in any system of qualifications.

**Table 2: Descriptors Defining Levels in the EQF – Skills Dimension**

<table>
<thead>
<tr>
<th>Qualification Level</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments). The learning outcomes relevant to respective Levels are as follows.</td>
</tr>
<tr>
<td>Level 1</td>
<td>• basic skills required to carry out simple tasks</td>
</tr>
<tr>
<td>Level 2</td>
<td>• basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools</td>
</tr>
<tr>
<td>Level 3</td>
<td>• a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information</td>
</tr>
<tr>
<td>Level 4</td>
<td>• a range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study</td>
</tr>
<tr>
<td>Level 5</td>
<td>• a comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems</td>
</tr>
<tr>
<td>Level 6*</td>
<td>• advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study</td>
</tr>
<tr>
<td>Level 7*</td>
<td>• specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields</td>
</tr>
<tr>
<td>Level 8*</td>
<td>• the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice</td>
</tr>
</tbody>
</table>

**Source:** EC (2008: 13)

*Note: These qualification levels are compatible with the Nigeria’s University education qualification levels.

**COMPETENCE DIMENSION**

Competence is defined as “the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development” (EC, 2008). Table 3 shows, defining competence in the context of EQF, each of the 8 levels as defined by a set of descriptors indicating the learning outcomes (in terms of competence) relevant to qualifications at that level in any system of qualifications.

**Table 3: Descriptors defining levels in the EQF – competence dimension**

<table>
<thead>
<tr>
<th>Qualification Level</th>
<th>Competence</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>In the context of EQF, competence is described in terms of responsibility and autonomy. The learning outcomes relevant to respective Levels are as follows.</td>
</tr>
<tr>
<td>Level 1</td>
<td>• work or study under direct supervision in a structured context</td>
</tr>
<tr>
<td>Level 2</td>
<td>• work or study under supervision with some autonomy</td>
</tr>
<tr>
<td>Level 3</td>
<td>• take responsibility for completion of tasks in work or study</td>
</tr>
<tr>
<td></td>
<td>• adapt own behaviour to circumstances in solving problems</td>
</tr>
<tr>
<td>Level 4</td>
<td>• exercise self-management within the guidelines of work or study contexts that are</td>
</tr>
</tbody>
</table>
usually predictable, but are subject to change
• supervise the routine work of others, taking some responsibility for the evaluation
and improvement of work or study activities

| Level 5 | • exercise management and supervision in contexts of work or study activities where there is unpredictable change
• review and develop performance of self and others |

| Level 6* | • manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts
• take responsibility for managing professional development of individuals and groups |

| Level 7* | • manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches
• take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams |

| Level 8* | • demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research |

**Source:** EC (2008: 13)

**Note:** These qualification levels are compatible with the Nigeria’s University education qualification levels.

Having clearly identified the EQF’s qualification levels that correspond to the University qualification levels in Nigeria, architect-educators can easily adopt this framework to create their pedagogical learning outcomes of sustainable environmental design (SED).

**PEDAGOGICAL LEARNING OUTCOMES OF SED**

The knowledge triangle as modelled on the cognitive structure of curriculum development has given a framework to categorise knowledge associated with SED under three distinct domains – issues and principles, applications and case studies, and analytic tools (EDUCATE, 2011 and Yannas, 2011). “Each of these domains has its own distinct character and purpose while also being an essential constituent of the other two” (EDUCATE, 2011). They should be relevant at each stage of curriculum progression, although the form that each may take, the pedagogical learning outcomes created and the level of competence acquired can vary in complexities and improvement in qualification levels.

**BACHELOR’S DEGREE QUALIFICATION LEVEL**

At this level of education, the main issues and principles of sustainable environmental design should be taught as drivers of architectural form, transferring enthusiasm and commitment to opening the gates of the skills needed to creatively explore ideas (AA, 2011). Emphasis should be laid on the knowledge domain where issues of sustainability are taught in order to equip the students with critical understanding of theories and principles, and their applications. This can be complemented with analysis of case studies. The learning outcomes relevant to Bachelor of Science (BSc) in architecture or Bachelor of Architecture (BArch) that can be adopted as stated by EDUCATE (2012) are as follows.

On completion of this programme, students should exhibit knowledge of:

- key values and principles of sustainable environmental design
- precedents and environmental attributes of historic and contemporary buildings and urban spaces
- the potential offered by traditional and new materials and technologies to inform design
- benchmarks and environmental standards at national and international level
- the relation with other disciplines concerned with the construction sector
- the opportunities afforded by the procedures of the building industry and the control of project budgets

Students should also demonstrate appropriate skills to:
• take a critical position in relation to wider issues and objectives of sustainability and its expanding boundaries (including environmental, socio-cultural, political and economic responsibility)
• formulate appropriate environmental design strategies for new or existing buildings and urban spaces informed by climate, site, culture, construction, materiality, building type, and occupancy
• communicate their design explorations and solutions to a specialist and non-specialist audience

**MASTER'S DEGREE QUALIFICATION LEVEL**

At this level, Architect-educators should induce the students to develop autonomy in design investigations. They should also develop competence in researching questions to be resolved by appropriate techniques to yield knowledge that can be analysed quantitatively and qualitatively (EDUCATE, 2012). The students should be taught highly specialised knowledge of issues and principles, applications, and analytical tool in SED. They should also be made to be critically aware of knowledge issues that transcend and interface between different fields that deal with sustainability issues (EC, 2008).

The learning outcomes relevant to Master of Science (MSc) in architecture or Master of Architecture (MArch) can be created after EDUCATE (2012). Students should exhibit knowledge of:

• the legislative framework and building practices that include awareness of costs and complexity of execution within creative architectural and urban design

Students should also demonstrate appropriate skills to:

• identify, compare and assess environmental impacts and performance of buildings
• make use of on-site observations and measurements, as well as interpretation of performance data and calculated results, to inform design solutions
• recognize the contribution of architecture and urban design in shaping sustainable environments, societies and economies
• develop understanding and ability to interface with other professions within the design process

And competence to:

• promote the pro-positive nature of design as a generator of new knowledge
• embrace a multi/inter/trans-disciplinary approach in tackling issues of sustainable environmental design

**DOCTORATE QUALIFICATION LEVEL**

At the third level of university education, Architect-educators should encourage students to deepen and specialise their interests individually or as a leader or key member of a multi/inter/trans-disciplinary team by critically linking learning with its applications to professional advancement, and committing to cutting-edge scholarly and/or design research. The students should reinforce and utilise the range of abilities acquired at the first two levels of university education to look comprehensively at the built environment. While advocating lifelong learning, they should be also engaged with continuing professional development in research and design. “Courses could clearly differ according to their specific streaming of specialisation, therefore promoting differentiated knowledge, skills, and competence” (EDUCATE, 2012). The students should acquire the most advanced and specialised skills and techniques required to solve critical problems in research and/or innovation, and to extend and redefine existing knowledge or professional practice. They should demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of environmental sustainability including research (EC, 2008).

Students need to develop reflection and originality in tackling design issues, and this can be supported by the direct measurement and/or verification of built case studies that can inform the development of innovative ideas of design and research. (EDUCATE, 2012). At this level, much emphasis is laid on the skills and competence dimensions with little reference to the knowledge dimension in the context of SED.

The learning outcomes relevant to Doctor of Philosophy (PhD) in architecture or any other qualification after master’s degree can be created after EDUCATE (2012) as follows.

Students should exhibit skills to:
• Take informed and holistic judgements and think critically about the nature of knowledge and how it is produced, validated and expanded
• Relate the knowledge acquired to professional development at the various scales of architectural and urban design
• Analyse and originally interpret environmental codes and performance targets so as to lead to innovative design and/or research solutions

And competence to:
• Commit to cutting-edge scholarly and/or design research, investigating aspects of sustainability individually or as a key member of multi/inter/transdisciplinary international teams
• Engage in life-long learning and continue expanding the boundaries of the existing knowledge of sustainable design

CONCLUSIONS
This paper has explained the central importance of the European Qualification Framework (EQF) in creating pedagogical learning outcomes of Sustainable Environmental Design (SED). In this study, the aim was to examine SED issues with the view to recommending appropriate ways architect-educators can create pedagogical learning outcomes to promote best practices in Nigeria. The following conclusions can be drawn from this study. The last three qualification levels of the EQF correspond to the degree qualification levels in Nigerian Universities. Learning outcomes structured in terms of knowledge, skills and competence (KSC) provide grounds for comparing qualifications across different countries. This paper suggests that the EQF can be adopted in creating pedagogical learning outcomes of SED in order to make architectural qualifications in Nigeria more readable in relation to other countries, most especially European countries. The study has gone some way towards enhancing our understanding of the EQF structure and how it can be used to create pedagogical learning outcomes of Sustainable Environmental Design for Sustainable Architectural Education. Adopting the EQF or any similar framework, there is a definite need for Nigerian architect-educators to design a framework for Sustainable Architectural Education to be used in creating suitable learning outcome to aid learning among students.

REFERENCES