Project Schools for Built Environment Education

Felix le Roux
University of Pretoria, South Africa

An almost unique problem situation applicable to construction education exists, namely: The industry is so interlaced that students cannot begin to comprehend their own built environment discipline before they can appreciate all the other built environment disciplines and they cannot become familiar with the other disciplines unless they have mastered their own discipline.

To address this problem at the University of Pretoria a "project school" has been instituted where similarly structured teams are assembled that include at least one student from each of the disciplines of architecture, landscape and interior architecture, town and regional planning, quantity surveying and construction management, with the aim of submitting feasible property development proposals.

The salient points are: (1) the short period of execution, (2) no formal lectures, (3) immediate assessment, (4) utilization of students' competitiveness, (5) learning from their peers, (6) learning through problem-based, project-based, collaborative, action, self directed and reflective learning styles, (7) learning about and experiencing the use and value of Communities of Practice (CoP), (8) receiving individual attention, assistance and guidance, (9) meeting and interacting with senior practitioners and (10) enjoy an unforgettable experience. Faculty gains the added benefit of personal feedback for future curriculum adjustments and development.

This article investigated the perceptions of construction management graduates regarding their expected and resultant knowledge, skills and competencies.

Key Words: Education. Built Environment. Multi-disciplinary. Project based.

Introduction

A dilemma that most educators face and need to address, is reminiscent of the Catch-22 rule as depicted in Joseph Heller's famous novel. Heller stated that during wartime conditions, pilots are considered to be insane to take part in bombing raids. The rule is that pilots can apply to be excused from such duty on grounds of insanity, but, when they do apply it means that they are concerned about their safety and is therefore considered sane and cannot be excused. Should this rationale be applied to education in the built environment, one would probably conclude the following: The industry is so interlaced that you cannot begin to comprehend your own discipline before you appreciate all the other construction disciplines and you cannot become familiar with the other disciplines unless you are the master of your own discipline. This is of course true to a certain extent.

Another consideration might be that educators are confronted by a Catch-22 rule of their own making. It has been indicated (at least suggested) that built environment educators complicate the issue to avoid the ultimate duty (responsibility) of providing practical examples of what they teach. This situation is probably not due to negligence, but rather caused by important restrictions, such as: under-staffed and over-extended faculty (Bilbo, 2000), over registration of student numbers, incomplete range (compliment) of built environment professional courses, or shortage of faculty members and/or funding (Wynn, 2005).

Learning styles, knowledge, skills, and attitudes

In recent years an avalanche of knowledge, styles, methods, etc. has reached the built environment. Usually built environment educators are firstly built environment professionals and secondly educators and should therefore seriously consider that students in the built environment could benefit from learning and teaching styles such as: problem based, project based, collaborative, self-directed, action, and reflective methods (Kolmos et al, 2007).

Lave and Wenger (1991 ; 1998) initiated the use of "Communities of Practice" (CoP) which refers to "groups of people who share a concern or a passion for something they do or learn how to do it better as they interact regularly." Although the learning that takes place is not necessarily intentional it requires three components: (1) the domain, (2) the community, and (3) the practice. It should be seriously considered for reflection, development and guidance of teaching and curriculation of subjects.

Students in the built environment study non-isolated professional skills and competencies in isolation. The result is that they find it hard to grasp, master and develop knowledge, skills and competencies that are deemed essential for future success in the construction industry. Regardless of how knowledge, skills and competencies are viewed by any of the disciplines in the built environment, the ultimate test lies in the application of those abilities to determine whether the educational process has had a successful outcome for each student.

Students in the built environment are expected to master skills and competencies ranging from 20 (Lei, 2004) up to 75 (Egbu, 1999). Edum-Fotwe and McCaffer (2000) listed the primary and secondary knowledge and skills elements for developing construction project management competencies and divided it into a percentage contribution by academic courses, formal training and job experience. Crawford (2005) added additional aspects from management's point of view. According to Weber and Hauck (2001) they examined the three broad skill sets of (a) architectural skills, (b) construction management skills and (c) general business skills where they found design-builders to possess skills more similar to construction managers than to architects. Recently Pavez and Alarco'n (2007) added Lean Construction Professional Profile (LCPP) to the already saturated mix of skills and competencies.

The comment by Love, Haynes and Irani (2001) that to all extent and purposes graduates in construction management are well received by construction managers regarding their expectations and observations, needs further research and consideration as to specific country and application in practice. Mills and Beliveau (1999) used teaming in capstone simulations as teaching strategy in a vertical integration experience. Elzarka, Suckarieh and Uwakweh (2002) expressed a desire and readiness for redesigning capstone courses in the U.S.A. Septelka (2002) focused on multidiscipline team collaboration as an educational model. According to Kolmos and Kolfoed (2003) as far as problem-based and project-based learning are concerned, competencies change from personal to process competencies. "When we talk about process competencies it includes, on a concrete level, learning to learn, creativity, co-operation, communication, independent work, behavioral changes, self-management and self-evaluation. But when we choose the concept of competencies, it also indicates that on a general level we are talking about an individual's potential capabilities." Bullen and Davis (Unknown) states that: "Active learning exercises, based on actual scenarios, enable students to quickly develop problem-solving skills that can satisfy practicum requirements."

A solution: The Project School (its content and rationale)

Since 1999 the Built Environment students of this institution are taken to a neutral and isolated "holiday type camp" where they spend four days attending the Project School. They arrive on "site" on a Monday afternoon, are briefed and have their first "site meeting" soon thereafter. The students are divided into teams consisting of architects, landscape architects, interior architects, quantity surveyors, construction managers and town and regional planners. Yearly approximately 150 students attend. They are divided into 12 teams to facilitate the assessment process (refer assessment section). Each team is issued the same project brief and uncertainties are clarified. They submit their proposals at 07:00 am on Thursday morning and presentations and assessment are concluded before 12:00 am.

At this institution undergraduate construction management is a full time, three year BSc. degree. Thereafter follows a two year, part time honours degree to register as a professional construction manager and/or construction project manager. As a prerequisite to qualifying, students are required to work for an employer, registered as a built environment professional, during non-lecture working hours. Students attend the project school during the second week of the second semester during their final year BSc. Honours degree. The Project School is a once-off requirement and experience.
The Project School is structured according to the natural flow of property development activities. Before commencement of the school the town and regional planning (T&RP) students are entrusted with the responsibility to motivate the development of any building site. Graduate T&RP students working for the local city planning department have, in the past, been allowed to use the opportunity for idea generation and publicity purposes by asking the students to make the school a community project. Lecturers and practitioners informally adjudicate the initial feasibility and decide on the site best suited. The size of the site is a major concern in the

decision as it dictates the amount of detailed work that can be done during the time available. The T&RP students then accumulate all the necessary information from what are deemed public documents. They are allowed to do this as a separate team or as individuals. Their lecturers monitor the process. T&RP students are then instrumental in "educating" their eventual team members, from the other disciplines, when the rest of their team is announced.

The amount of information available does not seem to influence the quality of the eventual proposals. Students are resourceful and information spread faster than wildfire, thanks to cell phones and wireless internet. A dedicated lecturer must be available on a 24 hour basis for the length of the project. The students set up rules and plan and control their own team programs. The dedicated lecturer vetoes any decisions that are not contributing to the learning experience.

The projects differ each year and will typically be on a site in an area equally (un-)familiar to most of the students. All the students should preferably have more or less the same background knowledge of the site. The students gain experience by arguing every stage of the development proposal (Kennedy, 1993) on equal footing. Their own input of specific knowledge and skills should be the only difference. Marks obtained for the project form part of each individual student's year mark.

The end result is a comprehensive proposal containing the input of each of the participating disciplines with the final test being the demonstration of the overall feasibility of the project. All aspects of project feasibility and project administration must be addressed, i.e. socio-economical, marketing, physical/legal and financial aspects and minutes of meetings, decisions, etc. The incorporation and application of the principles of sustainable development (environmental, social and economic impacts, use of renewable resources, energy and water efficiency, etc.) are expected.

Teaching strategies and intended outcomes

The project school is primarily aimed at the introduction of cross-disciplinary group work, the encouragement of individual participation through communication of theoretical knowledge and the enhancement of practical experience in simulated circumstances. The neutral and isolated environment contributes to the participation of students in a situation where they can assess their own professional readiness when they are required to use their acquired skills to think on their feet. It is further expected of students to attend all lectures, tests, and evaluation and feedback sessions as if attending real project meetings, doing presentations and being evaluated by clients. All existing university regulations apply.

Students debate and discuss aspects such as: their own discipline in relation to the other disciplines, the other built environment disciplines, in relation to their own, why their discipline is needed by other built environment disciplines, why their discipline needs the other built environment disciplines, career opportunities presented to them by their own chosen discipline, career opportunities presented to them by connected disciplines and career opportunities presented by combinations of disciplines.

During the course of the school the students are "visited" by their respective lecturers and specifically invited practitioners. The students are allowed to consult them in a sound board fashion rather than in an advice seeking capacity. Lecturers act as facilitators of the learning processes and experience that are taking place and should be trusted to exercise their discretion in maintaining the balance between "steering" and "contributing", to team proposals.

Resources

Accommodation, food and workrooms with chairs, tables and power outlets suitable for electronic equipment, computers, etc. are provided by the organizer. All other equipment necessary for drawing and model building, calculators, computers, printers, etc., as well as materials usually required in compiling similar presentations, are to be supplied by the students, or make do without.

A model for improvement of construction education assessment

During stage one of the assessment teams are expected to do a presentation by way of a power-point presentation and/or manual methods of presentation, such as: models, sketches, etc. The project material must be transferable and transportable, electronically and in hard copy. Eighteen practitioners are divided into three

assessment panels (one per discipline involved). The assessment is done in the manner depicted in figure 1, by way of a fixed memorandum as displayed in table 1. The disciplines are assessed individually and as a team. Consistency of assessment is difficult to control and therefore a lecturer needs to oversee the process. The aim is to appoint a winner per group. Each team is allowed 40 minutes for presentation, after which the panels have 20 minutes for questioning. The panels are encouraged to ask questions trans-disciplinary, inter-disciplinary and or cross-disciplinary to the team as a whole or to any individual member. Certain aspects of , for instance, the design aspects of the project, could be critical for the construction manager and quantity surveyor to understand and the question would then be directed at the latter two disciplines. Panel members follow this line of questioning to determine whether activities, on the project, took place in isolation or as a team. The team is expected to demonstrate "unconditional consensus". If not, they fail the project outright. They are notified of this vital aspect at the advent of the project to ensure that no one student dominates the other team members in their discussions and decisions.

During stage two of the assessment a new panel is selected consisting of members of all three of the panels in stage one. It allows busy practitioners to leave early. The requirement of one practitioner per discipline is adhered to, but if more practitioners want to stay and participate they are welcome to do so. A final winner is selected by the panel. This process might not allow for selection of the overall second best project, as they might already have been eliminated in stage one. Although the assessment is done by appointing marks, it is still done on elimination bases. This ensures that the best project will go through. It is important to select the winners before the conclusion of the project school.

During stage three of the assessment lecturers form part of a new panel with the sole aim of debugging the assessment process of any inequalities in marks due to different compilations of panel members.

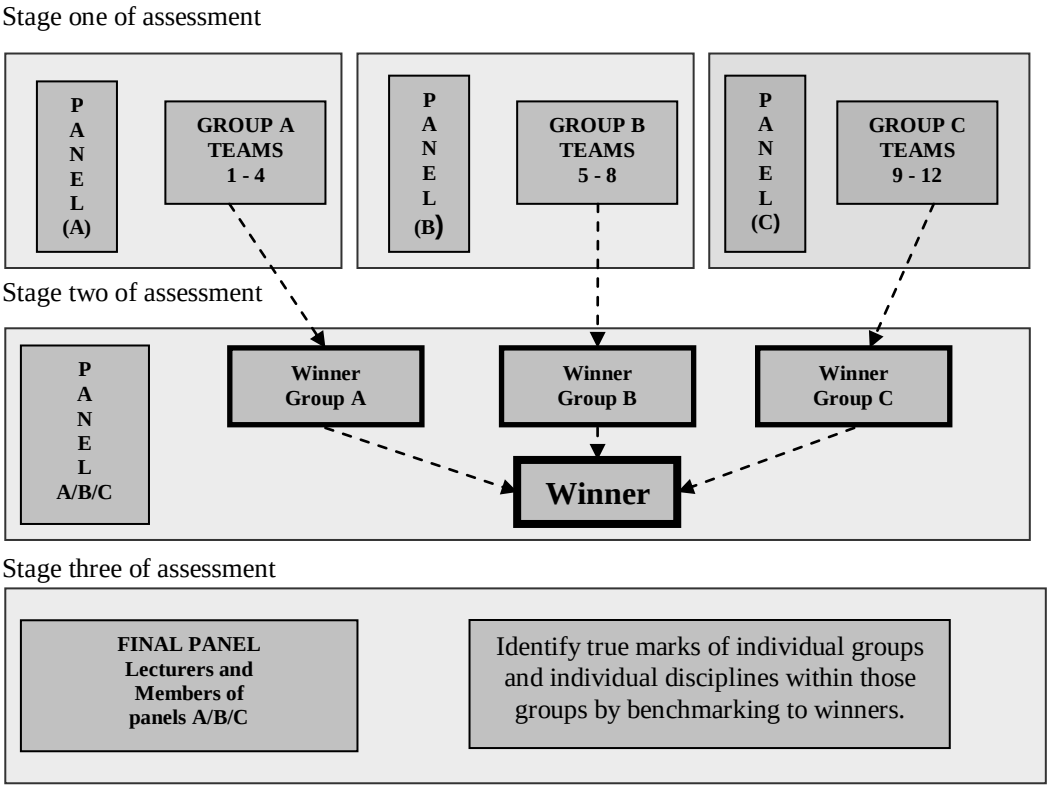

Figure 1: Assessment procedure

Table 1: Assessment criteria and deliverables for the project school (Mark plan).

DELIVER-ABLES	CRITERIA	ASSESMENT
Strategic Concept Development	• The quality and standard of the development concept • A well formulated and articulated development agenda • The expression of adopted outcomes, principles and objectives • Creativity and innovation • The extent of the developmental orientation of the concept • The expression of and consensus in the agreed upon development concept by the multidisciplinary team, in a collaborative spirit • Alternative scenarios and considerations	**Total marks 15%** Team effort
Strategic Development Framework	• Add new dynamic facets to livelihoods and activities • Support and enhance other activities in surrounding area • Alignment with and achievement of strategic vision and development objectives of the particular city as articulated in its strategic planning documents • Alignment with national and provincial development objectives and legal and policy directives • Marketability	**Total marks 15%** Town & Regional Planners
Design of Site and Immediate Surrounds	• Manifestation of strategic framework • Marketability • Futuristic design of buildings and spaces • Flexibility of design	**Total marks 36%** Architects 12% Landscape Architects 12%
Detailed Project Development	• Building and landscape design to fit into urban framework • Sustainable and appropriate technology use • Creation of space and place within city context	Interior Architects 12%
Viability Study and Project Planning	• Realistic rates, rentals and vacancies • Buildability • Profitability • Adaptability to future users • Social responsibility • Correlation between detail of the design and estimate • Correlation between time and cost planning	**Total marks 24%** Quantity Surveyors 12% Construction Managers 12%
Management Plan	• Retain high standard of development • Identification of key role players both in public and private sector to take responsibility for the site	
Presentation	• Group synergy • Clear communication of concept • Interaction with judges	**Total marks 10%** Team effort

Research Methodology

BSc. Honores (Construction Management) is a two year degree at this university. A questionnaire was handed to first and second year BSc. Honores (Construction Management) students. The first year BSc. Honores (Construction Management) students were questioned about their expectations of the project school planned for 2009. The second year BSc. Honores (Construction Management) students were questioned about their perceptions of their experience during the 2008 project school.

Table 2 : Construction management students' expectations and experience.

Questions to first year BSc. Honores students A. Do you expect the construction management students to: **Questions to first year BSc. Honores students** B. Did you experience construction management students to: **Answers:**		**1ST Year's expectations** **Percentage of students that agree**	**2ND Year's experience**
1	volunteer to be project manager?	94	74
2	be best equipped to be the project manager?	100	89
3	be able to estimate & control cost on projects?	81	56
4	be the discipline that is least knowledgeable on financial management?	0	0
5	influence project activities during the initial planning phase?	56	26
6	influence project activities and effecting changes?	6	19
7	be the decision makers to finalise / stop the project?	63	89
8	be best equipped to handle the presentation?	81	22
9	be the discipline with risk planning & management knowledge?	81	100
10	be the discipline with strategic planning & management knowledge?	100	59
11	be the discipline with working knowledge of health & safety issues?	88	89
12	correctly anticipate skills, competencies & knowledge of others?	100	93
13	be the least prepared for the project assignment?	13	7
14	indicate that they learned most from the project?	69	33
15	be the discipline with construction management knowledge?	94	89
16	be the discipline with construction project management knowledge?	81	93
17	be the discipline with knowledge of "Lean Construction" principles?	50	Unsure

Results

Table 3: Response indicating students' expectations and experience.

Results (from correspondence between an architecture student and lecturer)

Answer to Questions	**1ST Year - honores students expect:**	**2ND Year - honores students experienced:**
1 & 2	to be the project manager	that others are equally equipped
3 & 4	to be most knowledgeable on all aspects of financial management	that the expectation was warranted
5, 6 & 7	that they will play a major part in decisions from the start till the close of the project	that they were not the major decisions makers as anticipated
8	to contribute significantly during the presentation of the project	that they are not best equipped for presentation
9, 10 & 11	to be knowledgeable on all aspects of management. (Do not expect the other disciplines to equal their level of knowledge on the subject.)	that they are more knowledgeable on management aspects
12	to be able to predict the other disciplines' level of competence	that they know what to expect from the other disciplines
13 & 14	to be prepared and equipped for the project and to learn from their peers	that they were prepared but did not learn as much as they expected
15 & 16	to be knowledgeable on all aspects of construction and project management. (Do not expect the other disciplines to equal their knowledge.)	that the expectation was warranted
17	to be able to be innovative	that they were not innovative

Student's E-mail to architecture lecturer and fellow architecture students: "In regards to the past project school week, I must thank our lecturers for exposing us to the real world for popping our bubble of architecture school and allowing us the sobering slap of reality. Every imaginary client the architectural student has had to deal with so far has been idyllic, harsh criticism by peers and lecturers included. This week we were the ball and goals were scored by kicking us to the back of the net, over and over."
Architecture lecturer's reply: "Thanks for making us think... and (re-) consider our role as architects. The fact that we are having this discussion means that the school was very successful."
Architecture lecturer's E-mail to the author: "I am thinking you might enjoy this discussion that the project school triggered. What a successful experience if it is creating this much healthy debate!"
(Messages shortened)

Conclusion

On expectations and experiences of construction management graduates

The responses contained in table 3 indicate that construction management graduates of this institution:

- have confidence in their ability to act as project managers.
- have confidence in their general financial management capabilities and experienced that other disciplines are less capable. They expect landscape-, interior architects and town and regional planners to know very little of financial management and this is confirmed by the responses of the final year students. The financial management competencies of the other disciplines seem to be inadequate for project and business management purposes.
- expect that they will be more involved during the initial stages of a development project, but in reality they are more involved in/at the closure of projects.
- are of the opinion that they are better equipped than the other disciplines to present proposals to potential clients. After the project school, they realized that their perception was false.
- expect to know most about construction project management and they do, but detailed knowledge in some areas (e.g. strategic management, risk management, etc.) seem to be a problem, especially in terms of application.
- are correct in believing that they are the only discipline concerned with health and safety on site. The other disciplines never even mentioned health and safety issues.
- never thought it important to bring "Lean Construction" into the equation and therefore do not know the level of competence of the other disciplines on the subject. Students seem not able to apply theoretical concepts without guidance. This is a major concern.
- do not foresee that it should be normal to expect town & regional planners to dominate proceedings at the beginning of a project. Most built environment graduates seem to have limited access to the town planners. In practice the situation might be worse due to the habits of prospective clients in the property development sector. The entrepreneurial spirit of construction management students prevent them from recognizing that the latter makes perfect sense. The situation dictates that town planning takes place over an extended period and property developers therefore avoid engaging the other professionals to soon due to cash flow, and other cost implications.
- do not recognize or appreciate the abilities of other disciplines and therefore are probably misinterpreting their own abilities. The project is a huge boost to their self confidence.

The above indicated that correct assessment of learning outcomes and the quality thereof can only be determined by the application of theoretical aspects in practice. Lecturers responsible for the transfer of information are best suited to assess the level of conversion of the information to knowledge, skills and competencies. They are also responsible for any future adjustments to the transfer process, if needed.

On the value of the project school to education in the built environment

Over the years the project school has proved to be a valuable educational tool in the preparation, assessment and self-evaluation of construction management students. By reflecting on the previous year's project school, and planning for the next one, faculty is forced to acknowledge reasons for change and innovation.

To the graduates the value lies in working in teams and learning from their peers. The "secret" lies in project based, problem-solving by means of "unconditional consensus". To be able to do this the students are obliged to discuss debate, explain (argue excessively), and enquire (learn) from each other.

At the end of the project school some disciplines have serious doubts about their abilities while others have excessive confidence. Fortunately, these perceptions can be addressed and corrected.

The project school guarantees to expose strong and weak points in student competencies. It is a rewarding method of assessment for hard working, dedicated and innovative faculty members, but at the same time exposes members guilty of non-performance in students' preparation and education.

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