

THE ARCHITECTURE OF THE CLASSROOM: CHANGES AND CHALLENGES.

Túlio Tibúrcio,

The University of Reading, Reading, UK

ABSTRACT

The architecture of the classroom is facing changes due to technology. In this information and technology age many questions have been asked regarding the future of schools and the impact of technology in education. Changes are needed in the classroom environment due to advances in technology and it will demand more investment, maintenance and management.

This research examines hi-tech (technology-based) classrooms environment through observation techniques and questionnaires. Results have shown that the use of new technology-based environments has positive effect on the learning process. Pupils seemed stimulated by the new technology and also by the appeal of the classroom space. Interactions proved to be increased. Developments in classroom design needs to consider technology as a key element. Flexibility is another important guideline in classroom design and workspace design.

Keywords: school architecture, learning environment, classroom, interactions

INTRODUCTION

This research focuses upon new hi-tech classrooms and it aims to investigate the impacts of these new environments on pupils, whether pupils' behaviour is affected by the change of environment.

Technology is changing rapidly and it is permeating all workspaces. In a changing world characterised by the information and technology age many questions have been asked regarding the changes in schools and their architecture. What are the schools of the future going to be like? What will be the impact of technology in early education? What changes are needed in the learning environment? What implications do they have in the architecture of schools and in the design process?

Evidences show the architecture of the classroom is already facing these technological changes. The classroom space becomes more complex and needs to be understood, well planned and designed in order to meet the demands of teachers, pupils and the community at large. Designing a classroom becomes a bigger challenge for designers. It has implications in the design process, especially in the briefing stage. The design team needs to be aware of the technological advances and to acquire knowledge on the field. Pupils are no longer end-users, but are seen as the client. Sorrell (2005) sustains that *pupils are the consumers of education*. It is necessary to understand this new context we live in, to understand the new technology and to understand the new learning environment it is creating. It is not a matter of inserting computer equipment in the classroom. The current challenge is to investigate how this new information technology can be used for the

enhancement of teaching and learning. As stated by Bordwell, *“the challenge for educators, planners and architects to integrate instructional technologies is to recognize the magnitude of changes likely to occur over the next 25 years and to build schools that will meet these challenges.”* (Crosbie, 2001).

A clear understanding about the classroom environment is fundamental to understand these changes. A good definition of learning environment is given by Wilson (1995) saying that *“a learning environment is a place where learners may work together and support each other as they use a variety of tools and information resources in their pursuit of learning goals and problem-solving activities.”* This seems to be exactly what a classroom is facing now. A variety of new tools and information resources has been added to the environment since technology has been used to enhance access to information. In these terms a high-tech (technology-based) classroom used in this study is defined as an *intelligent classroom, which characteristically make extensive use of information technology and flexible environment* (Tiburcio & Finch, 2005). This latter definition suggests flexibility as another key element in classroom design.

Other questions might be raised regarding these changes in the classroom design. Are these changes really necessary? How do these changes affect the new architecture of schools and classrooms? What are the impacts on the pupils? Annesley (2002) argues that *“the design of a school affects the way pupils and staff interact, and their motivation and self-esteem”*. She continues by saying that *“these factors in turn have an effect on learning”*. Riggs et al. (2003) go further stating that *“students’ academic achievement is higher in newer and more attractive school buildings than in less attractive facilities”*. The environment does influence education. Designing a school today requires incorporating new technology and creating spaces that are imaginative and stimulating to help children to achieve more. The main question of this study is concerned with the impact of high-tech classrooms on pupils’ interactions. It is based on assumptions that relate learning to interaction.

Many Vygotsky “believers” argue children learn through interaction. According to (Doolittle, 1997) *“we learn through interaction with others and in doing so we create something qualitatively different from what we started with”*. Similar thoughts are presented by Littleton and Light (1999) when stating that *“Vygotsky (1978) saw these processes as highly susceptible of social influence and he focused mainly upon interactions between partners who differed markedly in their levels of ability”*. In another book (Light and Littleton, 1999) the same authors highlight that *“child’s interactions with other people serve to mediate between the child and the world-to-be-learned-about and so understanding learning depends upon understanding the particular types of interactions which serve to foster it”*. To summarize it can be said that learning happens when interactions occur, which is an assumption for this research.

It is not intended, in this study, to measure the performance of the students in these new high-tech learning environments. From an architecture background and interest it is understood that learning is a very complex issue to be investigated and measured. The first interest of this research is to analyse the architectural space and its features. This study investigates if interactions are increasing in high-tech classroom environments and

if there are connections with these technological changes. If interactions increase, it might indicate that learning will be improved, in other words, *more interaction more learning*.

CONCEPTUAL FRAMEWORK

Interaction is the behaviour aspect being investigated in this study. Three other factors that seem to influence it are also investigated: mobility of the teacher, flexibility of the room and the technology itself. With focus on pupils these interactions were classified in 5 categories (pupil-to-pupil, pupil-to-teacher, pupil-to-equipment, group interaction and no interaction) in order to be investigated and quantified. Observations indicated that relationships exist among these factors being investigated (Tiburcio & Finch, 2005). They are described below and grouped in a framework diagram (Figure1).

Technology and Mobility The new classroom has more equipment (laptops, web tablets, printers, interactive whiteboard, video-conference equipment, etc.) available for pupils to use and evidence suggested that it was being used. The teacher was significantly more mobile in the new environment.

Technology and Flexibility A relationship was observed between flexibility of the room and technology found with wireless technology together with movable furniture creating more flexibility in the observed new classrooms.

Technology and Interactions The technology available in the high-tech classroom allows more teacher-pupils and pupil-pupil interactions.

Flexibility and Mobility By comparing teacher's movement in the traditional and new classroom it was possible to identify greater support for mobility in the new classroom.

Flexibility and Interactions The flexibility allowed by the new classroom has encouraged meaningful interactions.

Mobility and Interactions It was found that the more mobility the teacher had, the more interaction occurred amongst pupils.

Figure 1 summarizes these relationships and shows that the technology in the classroom, the flexibility of the room and the mobility of the teacher have influence on the interactions that occur among pupils. It also shows that technology also influences the flexibility of the room and the teacher's mobility. In the same way, the flexibility of the room has a relationship with the mobility of the teacher. The diagram represents the conceptual framework for this research and it was the base for data gathering. These relationships suggest that more interaction is stimulated by the new technology-based classroom.

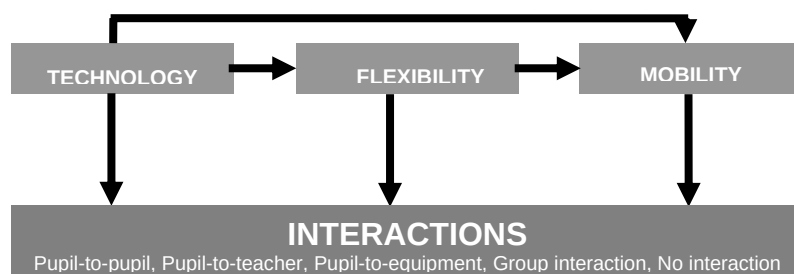


Figure 1 Conceptual Framework, adapted from Tiburcio and Finch (2005)

METHODOLOGY

Methods from environmental psychology underpin this research since they offer tools to analyse the space. This research is based on case studies constituted of two new classrooms and two traditional classrooms in different schools. Behavioural mapping (through class observation) and questionnaires (to validate some data) were the methods used in this study. This multi-method approach is suggested by Zeisel (1984) since each method has its own bias.

Behavioural mapping, which uses a plan to annotate observations (Tiburcio & Finch, 2005), was chosen and several graphic maps were produced during each observation session. Every 5 minutes a map of the physical space was produced and information was registered. This technique has been used for environmental psychologists such as Ittleson *et al* (1974), Zeisel (1984) and Horne (2002). The latter used behavioural mapping to examine the classroom focusing on the teacher. This study has the focus on pupils. Figure 2 shows a plan of the classroom extracted from one of the observation sheets with information recorded. The observations were mapped on floor plans of the classroom, annotating layout, teacher's movement, interactions among users (pupils and teacher) and with the environment, record of activities and their duration.

The use of questionnaire at the end of the observation process allowed the validation of the data (Horne, 2002) collected from observations. The focus of the questionnaires was the view of the users on their experiences in the new environment. All pupils in the classes were given a questionnaire. It was agreed with teachers that questionnaire would be a class activity, which produced a large number of responses.

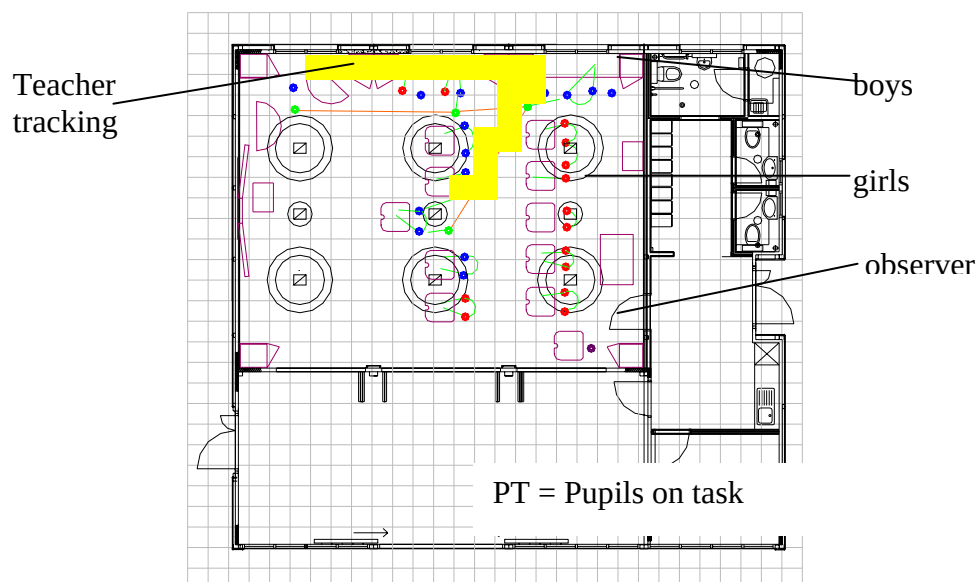


Figure 2 Five-minute behavioural mapping

EXPERIMENT

The research used case studies for data collecting. Two schools in Telford-UK, designed by INTEGER - Intelligent and Green (INTEGER, 2004) were chosen due to their new built high-tech classrooms. One primary school (Wrockwardine School) and one secondary school (Lord Silkin) were granted with a new “classroom of the future”, part of a Government initiative (DfES, 2003). Four classrooms were used for observation and comparison, two traditional classrooms (WTC and LSTC) and two classrooms of the future (WCF and LSCF). The same group of pupils (class), the same teacher and the same subject being taught in both traditional and new environment, were chosen in each school. It allowed, through comparison, to investigate whether interactions have increased in the new environment. Figure 3 represents the framework for the experiment explaining how the comparison was made. It guided data gathering and analysis.

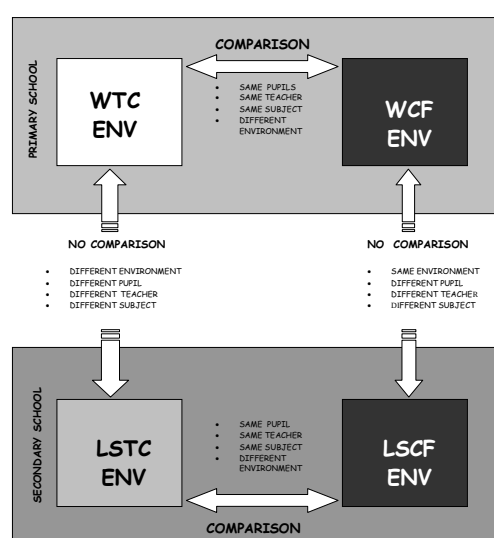


Figure 3 Framework for empirical studies

The traditional classroom environment in the primary school (WTC) is just like in many other schools. To attend 7-9 years old pupils the tables are arranged together for group activities, walls are used as information and work displays, and it also has got a blackboard, an interactive white board and some computers. The last ones were rarely used during the observation period. In the secondary school (LSTC), the traditional classroom has a horse-shoe shape layout that encourages the teacher to be on the front of the room and students sitting around the tables. Both classroom of the future (WCF and LSCF) have the same design, apart from the furniture in the conservatory space and the outside cladding. The classroom itself has top technology such as laptops, web-tablets, video-conferencing system, printers, interactive board, audio-video equipments and movable wheeled desks and chairs. It has got automation features for the building, green roof, light pipes, light sensors, since it was conceived as intelligent and green building (Dawson, 2004).

FINDINGS AND DISCUSSION

The flexibility of the classroom is higher in the new classroom. In both schools (W and LS) the classroom of the future have higher flexibility factor (Figure 4). In average the difference between old and new is 12% and it is considerably significant. The attitude of

the teacher is changed in the new classroom. The layout, for instance, was always changed, while in the traditional classroom it was kept the same most of the time. This flexibility seems to have fostered the teacher to be more mobile in the classroom. Figure 5 confirms that teachers have more mobility in the new classroom. In both schools the mobility factor of the teacher has doubled. By being more mobile teachers tended to interact more with pupils.

The number of interactions has increased in most of the five categories identified as pupils' interactions. This can be illustrated by Figures 6 and 7, for the primary and secondary school classrooms respectively. In pupil-equipment category it was expected that this number would be much higher since there are more equipment available in the classroom of the future. Pupil-teacher interactions show significant increase in the new classroom, confirming that higher mobility of the teacher would increase interactions with pupils. The pupil-pupil category also shows increase in the number of interactions in both new classrooms. Group interaction presents a lower value in the new classroom. When looking at the "no interaction" category it is clear that the overall number of interactions has really increased since there are much less *no interaction* in the new classroom.

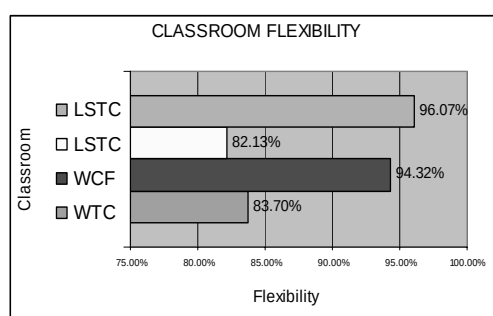


Figure 4 Comparison of flexibility of the classroom

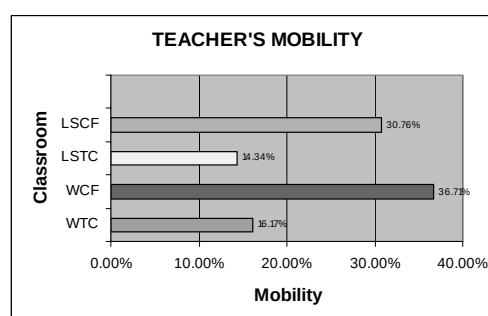


Figure 5 Comparison of the mobility of the teachers

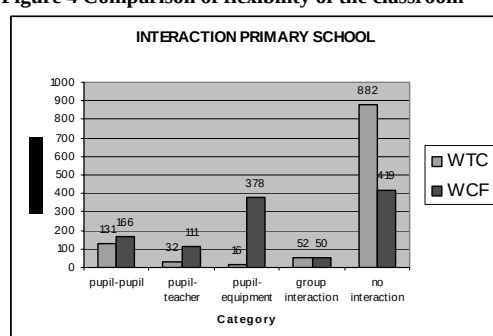


Figure 6 Interactions in the primary classrooms

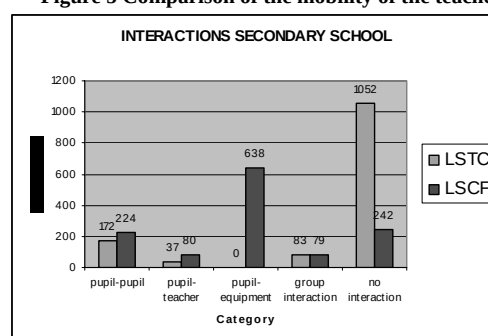


Figure 7 Interactions in the secondary classrooms

According to the questionnaires these findings discussed above were also perceived as positive by students and teachers. A total of 51 questionnaires were given out to students of both schools and a 98% response rate was achieved. This was guaranteed by using part of the lesson for the students to answer the questionnaires. 13 teachers were also asked to answer the questionnaire (85% responses). When asked about the technology in the classroom and the interactions that occur in it most of the answers were in the upper grades of the scale (agree and strongly agree).

Question 20 asked *if the pieces of equipment are helping them to learn more* and 28% of pupils agreed and 36% answered strongly agree. This means a total of 64% signalling positively for the use of technology in the classroom. Teachers confirmed these findings with a total of 82% who agree with that and 9% strongly agree. This indicates that learning might improve with the help of technology.

Regarding interactions, question 29 - *the classroom of the future allows you to interact more with your peers* – had 32% saying strongly agree and 24% agree, summing 56% positive against 16% who disagree or strongly disagree. The other 28% are neutral in the scale (neither agree nor disagree). Teacher had 73% positively agreeing that the new classroom fosters more interaction. 51% of respondents agree or strongly agree with the affirmation on question 38 – *I learn more when I interact more*. 5% were contrary and 44% neutral. By looking on teachers responses, 91% agree with this statement and 9% strongly agree. None of them were contrary to this idea.

Others responses also indicate that interactions have increased in the new classroom of the future. However they are not discussed in this paper. The relationships that occur in a high-tech learning environment presented in the diagram on Figure 1 are supported by positive answers.

CONCLUSION

Changes become clear in the classroom environment. Technology and flexibility are two main elements that designers must deal with when designing a classroom. The flexibility existent in these new classrooms facilitates interactions to occur and it seems to help group and independent learning. Regarding technology it is important to understand the spaces for learning and what are the impacts on pupils and consequently in education. It is not only a matter of building ICT suites in schools. The present challenge is to know how technology will help to improve learning acquisition.

The new approach points to bring technological tools into the classroom. In other words, instead of taking pupils to have lessons in a computer lab to learn about computers, teachers would have these tools in their classroom to facilitate access to information. The teacher becomes a facilitator in the learning process. More interactions will occur, as found in this research and consequently higher achievements might be reached.

These changes and challenges have new implications for those involved in the design of a classroom such as architects, designers and engineers. From the architecture point of view it suggests a new way of thinking, understanding and designing a classroom environment. In the field of architectural management, the briefing process, for instance, will require involvement of pupils playing a role of the main client. The classroom is designed for them. They are the target for learning and the space has to meet the new demands. Involving pupils in this stage will help to design innovative learning environments that can adapt to educational and technological changes.

The impact of technology in school buildings, as studied in this research, can be transferred to other typologies of building. Impacts on the architectural management field seem to initiate in the briefing process as suggested for school buildings. In this information age, technology is reshaping most of institutions and fostering buildings to

change. Consequently, the whole process of building changes and the management will be affected.

REFERENCES

- Annesley, B *et al.* (2002). *Learning Buildings*. School Works, London.
- Crosbie, M.J. (2001). *Class Architecture*. Images Publishing, Australia
- Dawson, S. (2004). Telford and Wrekin: Two flexible prefabricated prototype classrooms by Integer Consultants for school and community use. *The Architects' Journal* (20/05/04), 36-41.
- DfES (2003) *Classrooms of the future: innovative designs for schools*. The Stationary Office, London.
- Doolittle, P. (1997). Vygotsky's Zone of Proximal Development as a Theoretical Foundation for Cooperative Learning. *Journal on Excellence in College Teaching*, 8(1), 83-103.
- Horne, S M (2002). The classroom environment and its effect on the practice of teachers. *Journal of Environmental Psychology*. Volume 22, pp139-156.
- INTEGER (2004). *Classroom of the Future, Telford & Wrekin* URL: <http://www.integerproject.co.uk/cotf.html> [27.10.2004]
- Ittleson, W., Proshansky, H., Rivlin, L, Winkel, G., Dempsey, D. (1974). *An Introduction to Environmental Psychology*. Holt, Rinehart and Winston, New York.
- Littleton K, Light P eds. (1999). *Learning with computers: analysing productive interactions*. Routledge, London.
- Light P. Littleton K, (1999). *Social processes in Children's Learning*. Cambridge University Press, Cambridge UK.
- Riggs, P.R., Petreson, G.J., Stockburger, D., (2002). Building Schools that are Responsive to Student Learning. *Journal of Educational Leaders*. Volume 1, Number 2, Spring 2002, pp 21-43 available online URL: http://www.uiowa.edu/~jerl/Riggs_0109.htm [22/10/2003]
- Sorrell ,J., Sorrel, F. (2005). *Joined Up Design for Schools*. Merrel Pulishers Limited. London.
- Tiburcio, T. and Finch, E F. (2005). The impact of an intelligent classroom on pupils' interactive behaviour. *Facilities: Specialised Facilities*. Volume 23, number 5/6, 262-278
- Wilson, B.G. (1995). Metaphors for instruction: Why we talk about learning environments. *Educational Technology*, 35(5), 25-30
- Zeisel, J (1984). *Inquiry by design: Tools for environment-Behaviour Research*. Cambridge University Press, Cambridge.

Acknowledgement: *Research sponsored by CAPES, Brasilia, Brazil.*