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## **Dialectical methodology : the impact of incorporating a neo-Vygotskian approach to design and technology**

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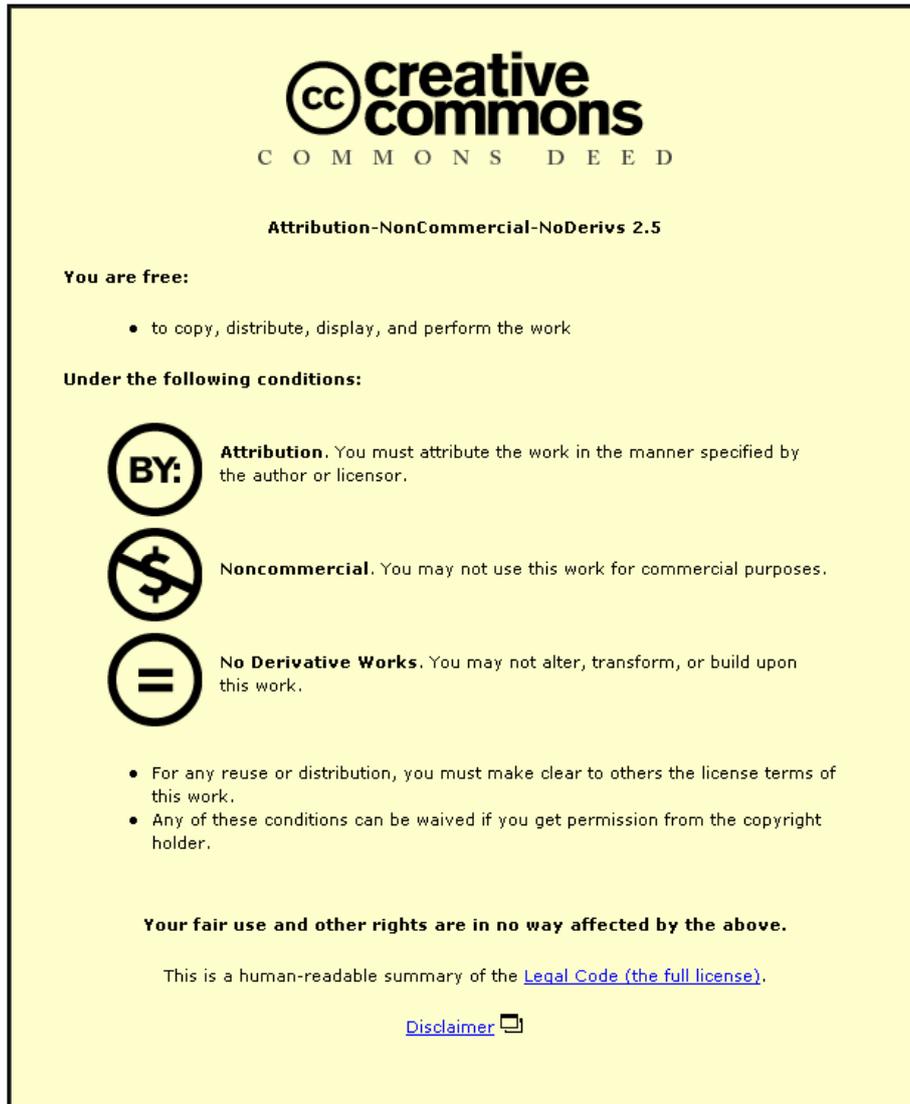
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# Dialectical methodology: the impact of incorporating a neo-Vygotskian approach to design and technology

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## Abstract

*This paper seeks to investigate how the incorporation of dialectical methodology, as part of an inquiry based pedagogy, can increase technological understanding within the design process. Vygotsky sees the development of society as a synthesis of life experience with taught concepts. Technology and its relationship with society will be considered in a case study carried out within the Scottish technology curriculum, where the concept of ergonomics was studied. Current practice in Scotland is explored, and a neo-Vygotskian approach is discussed.*

## Keywords

*Vygotsky, dialectic, contextualisation*

## Introduction

Vygotsky saw human development as an interaction between the social and the material environment. Significantly, he saw this environment as constantly changing. This state of change was due to a fusion between past and present, and the present is seen in light of history. 'To study something historically means to study it in the process of change; that is the dialectical method's basic demand.' (Vygotsky, 1978: 64-65, original emphasis.) Human beings are not limited to their biological inheritance, as other species are, but are born into an environment that is shaped by the activities of previous generations. In this environment, they are surrounded by artifacts that carry their past into the present. (Cole, 1996) The dialectic method involves teachers and pupils, developing together in a community of understanding which investigates, amongst other things, 'how inventions and innovations have evolved and how they in turn produced the world as it exists today'. (ITEA, 2000: 79) In this way, understanding of the design process can be taken forward in an informed and meaningful way, rather than the abstract 'make up a problem' paradigm.

Central to Vygotsky's theory of cognitive development is that a child's metacognitive, or intrapersonal processes have their roots in interactions with others. They learn by internalising external dialogue. For Vygotsky, language and thought are intimately and inextricably related. (Sternberg and Williams, 2002)

The development of technological literacy, as well as life skills, will be accelerated through the use of language skills such as debating, justifying an opinion, weighing up conflicting points of view and analysing disagreements. These skills which are linked to problem solving skills, can be assessed, formatively, in dynamic and exciting ways, such as observation, interaction, group work and challenge from the teacher. Furthermore, learning and understanding the design process, is not seen as the acquisition of isolated skills, or as items of information transferred from an expert and deposited, or 'banked' into the pupil. (Freire, 1970) It is seen as involving an interactive process where concepts are deliberated in a safe, social context, which encourage a synthesis between opposing views and perceptions. Using the dialectical methodology, a preconceived ideology which is challenged, will be either confirmed or altered to a new, more informed state.

If truths or concepts, whether based on cultural heritage or new thinking, are accepted or rejected on the basis of evidence, argument and construction, and not by dint of authority, then education must be 'dialectical, more concerned with interpretation and understanding, than in the achievement of factual knowledge or skilled performance.' (Olson and Bruner, 1996: 19)

Vygotsky sees concept formation, or making sense of the world, as a synthesis between Piaget's 'constructivism' on the one hand, and Skinner's 'behaviourism' on the other. School-based instruction involves initial verbal definitions which are of themselves, initially, abstract constructions. When applied systematically, they gradually become more concrete in formation. Spontaneous learning, on the other hand, can be seen as the reverse. It goes from the child's everyday concrete experience of its environment, where thought is non-deliberate and unconscious of itself, moving towards a state where it can develop an evermore articulate understanding of its environment. (Vygotsky, 2000)

This paper will argue that an understanding of the way humans interact with their built environment is a necessary imperative in human development. It will do this by investigating, qualitatively, the way student technology teachers in Scotland teach the concept of ergonomics to craft and design pupils in S3 (Key Stage 4).

The relationship between humans and their built environment is, by its very nature, full of dichotomies which have been affected, are affected now and will continue to be affected in the future by generations to come. This relationship is an historical progression of generations through time, where each generation reconstitutes both itself and its technology, thus constantly developing beyond its antecedents.

These issues and more can be explored through the study of ergonomics. The Chambers dictionary defines ergonomics as, 'the study of man in relation to his working environment, the adaptation of machines and general conditions to fit the individual so that he may work at maximum efficiency', and anthropometrics as, 'measurement of the human body'.

However, the direct teaching of ergonomics as an isolated concept:

'... is impossible and fruitless. A teacher who tries to do this usually accomplishes nothing but empty verbalism, a parrotlike repetition of words by the child, simulating a knowledge of the corresponding concepts but actually covering up a vacuum.'

(Vygotsky, 2000: 150)

The concept of ergonomics must be connected in some way to the everyday concrete experience of the child. This relationship with the child's prior experience with its environment will serve to make more concrete the relationship of humans to their built environment. An understanding of the improvement technology bestows upon society, in a contextual sense rather than the purely functional aspects of the technology itself, will aid technological literacy.

### **The Scottish system**

It is perhaps useful at this point to make clear the distinction between the Scottish education system and the English model. Education in Scotland has been organised separately from that in England and Wales since the Union of 1707. There were separate Acts of Parliament up until 2001 when the recently devolved Scottish Parliament introduced a new Education Act. The curriculum in Scotland is not prescribed as it is in England, but purports to guide the educational process. The reality is, however, that the technology curriculum is delivered in a very prescriptive manner.

The technology subjects on offer do not feature in the primary school sector at present, although there are moves to address this. Technology education tends to adopt a fresh start approach in the secondary sector which covers the ages from 12–18 years. The subjects on offer start with a basic technology course for the first two years followed by a choice of craft and design; graphic communication; technological studies; home economics; and practical craft skills.

These subjects have no common core and must be treated quite separately from each other. The subjects, for a number of reasons, are taught in a didactic fashion with the greater emphasis being placed upon the learning of technological processes, such as craft skills and technical drawing. Teachers tend to specialise in subjects which reflect their own expertise.

### **Craft and design as a skill based subject**

An attempt to analyse aspects of technology from a purely functionalist point of view, decontextualises the technology into a configuration of objects seen only in technical terms. An example may serve to illustrate this point.

A first year (Key Stage 3) secondary class in Scotland was observed where the first lesson was in a woodwork workshop. It should be stressed that the example given is not an isolated occurrence in Scottish secondary schools. (Dakers and Dow, 2001) The students were starting their first project, a wooden pencil case. The justification given by the student teacher to the researcher for this lesson was that it was in accordance with departmental policy and that there were certain required skills that the

students would develop. The teacher introduced the lesson to the students and asked the class to start by marking out the wood. At this point, approximately one third of the class produced from their satchels a wooden pencil case identical to the one about to be manufactured. It had been handed down from elder siblings or friends who had previously attended the school. The class comprised of 20 pupils who were all making the same pencil case as the rest of the current year group and which pupils at the same stage had made for years before. The object of the lesson was skill procurement. Discussion on the role of a pencil case did not take place, nor was the aspect of size and shape considered. No design process had been undertaken prior to manufacture. Indeed, this would, under the circumstances, have been pointless, considering the fact that the pencil case had already been designed. The whole process was entirely prescriptive.

Thus the learning process has been reduced to the proposed mastery of a set of decontextualised skills. Furthermore, the idea that technology subjects are for less able pupils and of little utility, is perpetuated by methods such as these. This idea received further reinforcement in a written assignment by a PGCE student on the topic of what makes an effective curriculum in a secondary school. The student, who was not studying towards becoming a technology teacher, wrote the following:

‘If the curriculum were to be thinned, how would it be decided which subjects were to be included? Possibly we should ask the question, *are all the subjects being taught really necessary for life?* Take technical, for example. This was compulsory when I was at school, yet I have never found it to be useful to me in life. And I doubt that I ever will ever again need the skill of making a plastic key ring. I think, perhaps subjects like technical, which may be irrelevant to the pupil, could be omitted from the slimmed down curriculum.’

This has disturbing implications for the perceptions this beginning teacher will convey to her pupils of the future, regarding technology education. There remains, moreover, a steely determination by a significant number of technology teachers in Scotland to hang on to the model where technical education is seen as skill procurement in the absence of any contextualisation.

### **Learning as a social process**

There is a growing recognition that for children to learn, they have to be actively involved in the learning process. They construct meaning through the process of interaction and inquiry, which involves communicative action.

Learning, however, does not take place in a vacuum. Children do not learn simply by constructing their own realities in isolation from the cultural, historical, and social environment into which they were born. Without those factors there is no conceptual framework to work from.

Kimbell makes the case for a ‘... progression – from the general to the particular – [which] is nothing more than a recognition that all particular tasks exist somewhere in more generalised contexts’. (1997: 56) This supports Vygotsky’s notion that generalisation is a superordinate concept which is developed through a series of subordinate, particular concepts which form a ‘hierarchy of concepts of different levels of generality.’ (Vygotsky, 2000: 172)

Human development, then, is a process of socialisation. Humans are not born in isolation but into communities, or cultures. These cultures, together with their technologies, have evolved and developed over time. Vygotsky (1978) sees this development as a sociocultural historical process.

### **The importance of contextualisation and relevancy**

Whilst observing student technology teachers during their school placements, several lessons introducing ergonomics and anthropometrics were observed. After an initial introduction on the subject by each of the student teachers respectively, the classes were arranged into groups of around four. Each group was given a different artefact to study. They were also given worksheets upon which to record their deliberations about the artefact with respect to its ergonomic and anthropometric properties. Whilst this study observed several different lessons in a variety of schools, one in particular will be considered. This lesson was representative of all others.

In this class the student teacher had gone to considerable trouble to find old versions of the modern artefact which was to be considered by the class. This, he explained, gave an interesting dynamic to the process whereby the children could study the improvements, if any, in the ergonomic features of each. The four sets of artefacts were:

- a stainless steel kettle from the Sixties, compared to a contemporary plastic cordless upright kettle
- a leather ski boot with laces, dating from around the Seventies, compared to a high tech composite one buckle boot from today
- a power hand drill from the Seventies compared to a cordless multi-function power hand drill from today
- a computer joystick from the Seventies, with four functions, compared to a contemporary hand held multi-function ‘PlayStation’ handset.

The artefacts were to be studied and discussed. After a short period, these were alternated amongst the groups until each group had studied each combination. All members of each group had some interaction with each of the artefacts. Interest, however, was not sustained for any significant length of time. Work by the groups quickly deteriorated into off-task activities and any subsequent interaction with the artefacts took on imaginative non-practical roles. Power drills, for example, metamorphosed into guns, and kettles transformed into spaceships. It is worth noting here that although different artefacts and teaching methodologies were employed on other occasions observed elsewhere, similar processes were in evidence.

The only artefact that induced any meaningful discussion was the multi-function 'playstation' handset. Discussion with the pupils revealed that not one of them knew what the Seventies joystick was! When told, they all displayed a renewed and somewhat fascinated interest in what was to them, an antique.

The ski boots are highly specific to their purpose. Here again, not one of the students had ever been skiing, and as a consequence had no contextual framework from which to work. The provision of kettles and power tools were seen as items which were the responsibility of significant others. In a world of computer games, boyfriends and skateboards – kettles and power drills, it would seem, are not high priority subjects for study.

This class experienced only the briefest introduction to a quite complex area of the technology curriculum. Thereafter, pupils were left to construct their own meaning without any mediation and were, as a consequence, unable to construct any meaning either in terms of the subject of ergonomics and anthropometrics, or in terms of the relationship of the objects to the subject, or the object's intended purpose. The pupils in this class were left with objects, which had no context within their cultural framework, and without any mediation from the teacher, the subject content was consequently rendered an abstraction.

A number of factors emerge from this study. This area of the curriculum was, in all cases, being taught as a stand alone component. It was apportioned a total of two lessons in the craft and design Standard Grade curriculum which covers two years. Student teachers when questioned about this, expected pupils to be able to transfer these learned skills into other areas of the design process. Vygotsky (2000) saw social, cultural and historical influences as being paramount in human development. Kimbell (1997) sees the

design process as having relevance only when set within a real world context.

Matusov (1998) postulated two models for human development. He considered a model of internalisation which emphasised the transformation of social functions into individual skills. In this model, the transfer of skills from one activity to another suggests that skills exist outside activity. His model of participation, on the other hand, emphasises the transformation of individual participation into sociocultural participation. In this model, skills are embedded in social and cultural activities where meaning is interpreted and re-negotiated (Matusov, 1998) as determined by examining its context. (Kimbell, 1997)

The model adopted by the student teachers in this study is clearly that of internalisation. This model however, is adopted from the different schools and departments in which the students are placed. In every case when this lesson has been observed, it has followed an almost identical format. This suggests that departments follow a prescriptive routine in the delivery of the craft and design curriculum.

Another factor that emerges from this study, is the distinct lack of cultural significance that the artefacts had for the children. Whilst they could identify most of the objects, they could not identify *with* the objects. This was clearly demonstrated in their collective interest in the 'PlayStation' handset, which bore cultural significance for their sociocultural group. Their understanding of the generalised context of the handset, allowed them more readily to map onto the abstract concept of ergonomics. The other objects had varying degrees of generalisability for the pupils, although less than for the 'PlayStation'.

A third emergent factor was the abstraction for the pupils arising from the necessity of testing the ergonomics of an artefact that was designed to do something, whilst being denied the opportunity of making the object do what it is supposed to do. The objects were merely to be examined by the pupils. They were not to be switched on, worn, as in the case of the boots, or used for their intended purpose. When the pupils questioned what they were supposed to do, the teacher prompted the pupils by asking them to consider if the object could be held comfortably or if it could be put to right or left handed use. This whole teaching methodology reduced the concept of ergonomics to a meaningless abstraction which involved pupils interacting in a purposeless way with objects completely outwith the pupils' cultural framework.

## Conclusion

Vygotsky saw teaching and learning as a sociocultural, historic process, where direct instruction must articulate with life experience before it can become meaningful. It must have cultural significance and, for technology especially, it must have a real world context set within the conceptual framework of the learner. The design process acts a mediator between specific technological skill procurement, such as tool use, drawing ability, materials knowledge etc. on the one hand, and the benefit that the technology bestows upon society.

The lesson described above on ergonomics, and others for that matter, would engage pupils' learning if some form of synthesis took place between classroom learning and the child's life experiences set within its own sociocultural domain. These 'spontaneous' life experiences are not necessarily going to be recognised by the child as relating to the concept of ergonomics. Vygotsky sees the child becoming conscious of spontaneous concepts relatively late. The child may be aware of the object to which the concept refers, but lack any meaningful understanding of it. (Vygotsky, 2000) Where children are able to 'spontaneously' identify with their built environment through direct experience, they lack any deep understanding about the various reasons as to why that environment is shaped the way that it is. They passively interact with their environment, allowing it to shape their lives without any conscious act of thought.

It is the bringing together of the spontaneous life experiences and the conscious acts of thought that must be mediated through teaching and learning. The teacher must act as mediator between the concept and the object, between the notion of ergonomics and its relationship with the built environment.

All interactions the child has with the built environment can be drawn upon to add significance to the concept. Moreover, if the life experiences are particular to the individual child, and perhaps more importantly, of particular interest to the individual child, they are more likely to hold the child's attention, thereby creating an already motivated baseline from which to promote further learning.

The 'playstation' handset was seen to have cultural significance to the pupils in the lesson described. The introduction of the concept of ergonomics may have been better served by some form of dialogue set within the classroom, followed by a request that the pupils should bring an artefact, which they owned and used, to the class next time, in order to discuss their ergonomic properties.

An initial exploration of the concept of ergonomics within the classroom setting, which is recognisable

and socially significant, might involve a discussion about the chairs in the classroom. Discussions about the size of the chairs in relation to the desks and the users could be explored. The construction of the chair and the materials used in its production might be discussed. The social status of chairs could be considered – is the teacher's chair different? Would a businessman have a chair like the classroom one, and if not, why not? Pupils could be encouraged to suggest what kind of chair they would like to have in the classroom and justify their reasoning. This introduces initial verbal definitions that are for the pupils, initially, abstract concepts. However, by involving the class in a dialogue, which is instigated by the teacher, the pupils begin to interpret meaning about the concept of ergonomics in a social setting.

Further lessons might be used to reinforce the concept of ergonomics, by using artefacts that the pupils bring to class. The pupils can then discuss, with some authority, the ergonomics of something which they know and use. This newly acquired knowledge, which has as its formation the synthesis of abstract to concrete, can now be utilised in more complex and abstract concepts involving ergonomics. The ergonomics of mass production and its impact on cost and labour might be considered.

It is also important that the subject matter, in this case ergonomics, is not treated as a separate 'module' set within the design and technology curriculum. This pedagogy requires pupils to study disparate subject areas within the curriculum and then integrate the various 'modules' into a meaningful 'whole' in any given design process. The concept of ergonomics should permeate all aspects of the design process on a continuing basis and span all age groups.

The impact of incorporating this methodology within a design and technology setting will require a major pedagogical shift. Observations in Scottish schools demonstrate that whilst technology curriculums are stated as being guidelines, their delivery is mostly very prescriptive. Design tends to follow manufacture and specific skill procurement is seen as more important than concept formation. The delivery of the technology curriculum tends to follow the transference model rather than models of social constructivism. Teaching tends to be a monologue rather than a dialogue.

In a technological society where technology advances at an exponential rate, it is inconceivable that a teacher can be an expert on all technological matters. Pupils today are quite often more expert when it comes to computers. In these circumstances, teachers often learn from their pupils through dialogue with them. Teaching and learning becomes a joint

responsibility. The pupils and teachers are no longer seen as mere 'objects' in the classroom with specific roles to follow, but become 'subjects' of their own learning.

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