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REVISION OF KERR'S MODEL OF THE CURRICULUM FOR A MORE EFFECTIVE AND DYNAMIC SCIENCE EDUCATION

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ABSTRACT

Kerr's (1972) model of the curriculum was an improvement over Tyler's (1949) model. It is, however, known that new concepts, knowledge and methods of teaching invariably influence the curriculum and hence its development. For example Shulman's (1986) concept of Pedagogical Content Knowledge (PCK) and van den Akker's (2004) concept of Levels of the Curriculum have greatly influenced curriculum development and implementation. For this reason this paper critically assessed Kerr's model of the curriculum in the light of emerging curriculum concepts and knowledge and how it could be modified to make it suitable for a more effective science education. The paper looked at the strengths and weaknesses of Kerr's model and proposed a new and simpler model of the curriculum. The usability of the proposed model is illustrated through specific examples that indicate how it can be adapted to various levels of the curriculum.

Key Words: Pedagogical, usability, competencies, multitudinous, constraints.

INTRODUCTION

According to Yakubu (1989), curriculum design is underpinned by four main principles or criteria as follows:

(i) Aims and objectives
(ii) Learning experiences and methods
(iii) Knowledge
(iv) Evaluation

These principles/criteria in turn, are influenced by issues emanating from philosophy, sociology, psychology and societal constraints among others.

Tyler (1949) on his part suggested that curriculum development could be regarded as consisting of four elements. He therefore proposed that curriculum planning should comprise:

(i) Objectives
(ii) Content or subject matter
(iii) Methods or procedures
(iv) Evaluation

This implies that in curriculum planning, a decision should be taken as to what is to be achieved, the ground to be covered to make the achievement possible, the kinds of activities and methods to be employed as well as the evaluation devices to be used. It is to be noted that this model of curriculum design is simple and suggests a linear relationship between the various components. This situation did not make allowance for the inter-relatedness of the components. Furthermore, this model left evaluation until the end of the curriculum

development process. This shortcoming perhaps provided the impetus for other educationists and researchers such as Lawton, Halliwel, Wheeler, Kerr, etc. to propose new models that depicted the curriculum development as a cyclic process. The main objective was to curb the incidence of unplanned drift which according to Hoyle (1969) characterized most of the changes of the previous decade.

One other characteristic feature of these models is that they conveyed (to various extents) the idea of continuous interaction among the various components of curriculum. These interactions are exemplified to a large extent by the components of Kerr's curriculum model shown in Figure 1.

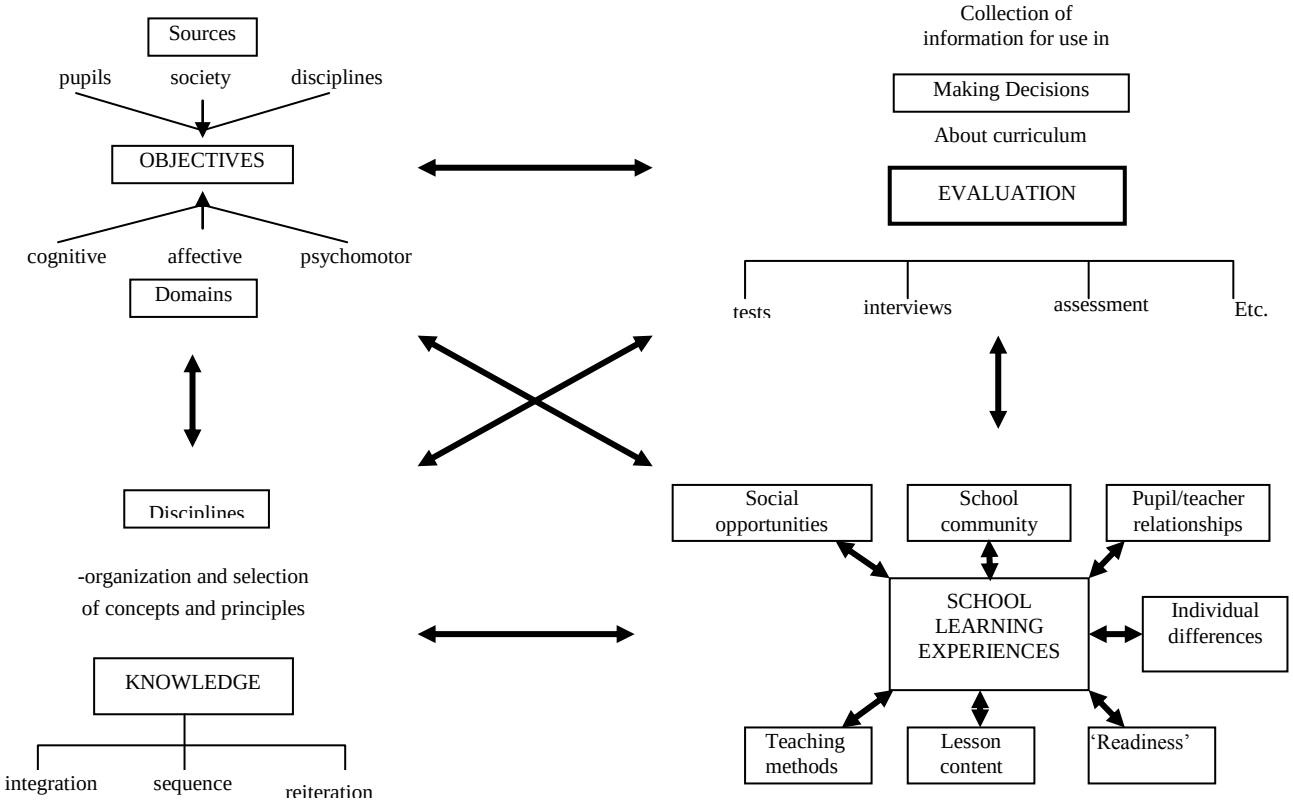

Figure 1: Kerr's Model of the Curriculum

Kerr's model of the curriculum is a vast improvement on the one proposed by Tyler. It starts with the specification of objectives followed by evaluation, knowledge and learning experiences in that order. Unlike Tyler's model, the relationships in Kerr's model are not linear but interactive. The idea of cross-checking to ensure conformity with original intentions and procedures is portrayed in the model.

Apart from demonstrating the interactions among the various curriculum components, Kerr's model also provides an insight into reliable sources of data for the four important components of the curriculum. Unlike Tyler's model, evaluation is not performed only at the end of the process. Kerr (1972) underscored the interactive nature of the components of his

curriculum model by noting that although objectives form the logical starting point in the process, in practice, one could break into the cycle of interrelated parts at any point (p.20-21). The model not only gives insight into how curriculum evaluation is to be conducted but also points out sources of curriculum objectives to make the whole exercise responsive and relevant to the needs of the child and society.

In spite of the apparent edge Kerr's curriculum model has over that proposed by Tyler, an in-depth analysis shows that certain critical issues have their been ignored or treated lightly. One possible reason for the weaknesses associated with Kerr's model is that most often, a lot more is expected of it than it can really offer. Some educationists perhaps forget that Kerr's format for the curriculum development process is no more than he intended it to be a model -nothing more, or less.

Just what is a model? To Dillard and Goldberg (1978), a model is a mental image, which is proposed to express ideas more easily. They observed that models may either be physical representations of structures or merely diagrams, graphs or mathematical equations. They stated further that models may of themselves have no physical reality but they facilitate the interpretation of real experiments and that in some cases models can aid in predicting new phenomena.

Marshall (2006), on his part pointed out that models are abstract concepts and seek to simplify phenomena as aids to conceptualization and explanation. Hence, however operational Kerr's curriculum model (in diagrammatic form) may seem, it still has as its source, theoretical principles embodying essential features of his ideas which may not be so obvious to others. Consequently, only blurred images of the reality he wishes to communicate are presented by his model.

The Role of the Teacher

Teachers have long been known to determine the direction and focus of curriculum activities and that failure to sensitize teachers appropriately may result in the derailment of curriculum intentions (Ivowi, 1984). Individual teachers have a "make or break" role (Kelly, 1983) in relation to the attempts by an outside body to bring about curriculum changes. They indeed have the task of bridging any gap that might exist between curriculum theory and curriculum practice. Evidence abounds that many teachers can and do sabotage attempts to introduce changes into the curriculum. It is believed that the resistance teachers' offer to educational innovations stems from their inability to cope with new curriculum demands. Other educationists are of the view that teachers stick to tried and tested methods because they wish to maintain those areas of knowledge and experience in which they have recognized expertise (Kelly, 1983).

It is reasonable to expect that curriculum efforts that are likely to yield positive results are those in which teachers are regarded as worthy partners (Kolo, 2007). Although Kerr's model has sub-components incorporating teachers' activities, they are not explicit enough, neither

do they give the teacher sufficient room to act according to local conditions. In Kerr's (1972) own words:

"Perhaps the professional autonomy of teachers should rest more on the freedom to decide how to teach rather than what to teach" (p. 27). This is a pointer to the fact that to Kerr, teachers could take decisions only on methodology but not on content. This, in the writer's view detracts from the professional autonomy of teachers. Besides, Shulman (1986) has brought to the fore the need for teachers to possess substantial subject matter knowledge and pedagogical knowledge. He noted that these two types of knowledge blend to form what he termed pedagogical content knowledge (PCK) which is the ability to instruct the learners appropriately on a given subject matter.

Teachers are required by training to perform multitudinous functions and to take on-the-spot decisions on what to teach and how to teach it. To suggest that teachers should concern themselves only with methodology but not with content is to create the impression that teachers are not competent enough to take such decisions. Borich (1977) has noted that three forms of competencies are usually required of teachers:

(i) Knowledge competencies, specifying cognitive understandings teachers are expected to demonstrate.
(ii) Performance competencies, specifying appropriate teaching processes teachers are expected to utilize during lessons.
(iii) Consequence competencies, specifying pupil behaviours that are viewed as evidence of teaching effectiveness.

To expect these competencies of teachers presupposes that they have been empowered to take certain minor decisions on content areas without official directives. It is wrong to suggest that when curriculum content is not keeping pace with the growth of general knowledge, teachers should continue to pass on old ideas to the learners. For example, while two additional states of matter have been discovered, some pre-university science books are silent about them - apparently due to the ignorance of the authors about the existence of the new states of matter. Additionally, scientists have discovered one other process by which increased levels of carbon dioxide in the atmosphere contribute to global warming. Once again, this bit of important scientific information is absent in pre-university science textbooks that contain information on global warming.

While teachers cannot be left alone to take major decisions on curriculum content, they should be empowered to influence it when it is obvious that the over-all aim of the curriculum is not going to be affected. Kanno (1989) opined that resourceful teachers always enrich their teaching with new materials instead of relying on old ones which may prove ineffective and unreliable with time. This apart, the Universities and Examination Bodies (national and international) may directly or indirectly influence what is taught in the schools. In such cases, teachers need not wait for official directives before including certain vital pieces of ideas, information, facts, etc. in their lesson plans.

Writing on effective classroom practices, Wise (1989) in McNeil (1990) stated that the definition of the effective teacher has changed of late. He noted that instead of the effective teacher universally moving through materials at a good pace and engaging mostly in direct instruction such as giving detailed explanations, providing examples and demanding practice, professionalization of teaching is the emerging trend. Under professionalism, teachers are free from the demands to teach a prescribed curriculum using stylized materials to prepare students for standardized tests. Instead teachers are required to teach students to:

(i) Acquire knowledge rather than simply acquiring testable reading skills.
(ii) Think mathematically rather than simply to work problems.
(iii) Question phenomena, situations, etc. rather than accepting them as inevitable
(iv) Think and write creatively.

It is thus obvious that the teachers' role is crucial to successful curriculum implementation. The central role of teachers in the curriculum implementation process is not apparent in Kerr's model of the curriculum.

The Dynamic Nature of the Curriculum

Society is not static. It is changing at a rapid rate as a result of global changes in education, employment opportunities and information and communication technology among other things. This implies the need for research and the development of better curriculum materials for use in the schools (Alli, 1988). This exercise emanates directly or otherwise from the objectives of the curriculum which must be reviewed periodically if they are to be relevant to societal needs.

It appears that Kerr's model does not make allowance for possible global influences on the society with its consequent effect on the curriculum. As Professor Agyepong, a former principal of the Methodist University College Accra, Ghana once noted in a T.V. programme, the emerging trend in education is for practitioners to think globally but act locally. The rationale behind this idea is the fact that no country can successfully insulate itself from happenings on the international scene.

Alli (1988) noted that two major world events hastened the urgency and need for curriculum development activities in the US in the 1960's. Notable among the events was the launching of the Russian Satellite, Sputnik 1 in 1957. Countless committees, conferences, research studies, workshops and seminars on curriculum development were held to enable experts deliberate on certain critical science curriculum issues (Alli, 1988; p.64).

It is always prudent to plan ahead. The curriculum should have feelers to sense emerging issues and so strengthen its capability to deal with problems before they become urgent. This is true, especially of basic level science which is meant to introduce the learners to the approaches scientists adopt in their quest for knowledge but which, unfortunately is taught mostly but non-science specialized teachers.

It is obvious from an examination of (the diagrammatic form of) Kerr's model that the effect of external (international) constraints on the curriculum was not taken into consideration when the model was designed. There is therefore the need for a sub-component (in Kerr's model) to cater for external (international or global) influence, on the curriculum. Such a sub-component could be subsumed by the objectives component of the curriculum. It could also operate as an appendage of the objectives component. Better still, since the curriculum itself is subject to external influences, all the components could operate under such influences in the form of different types of constraints as shown in Figure 2.

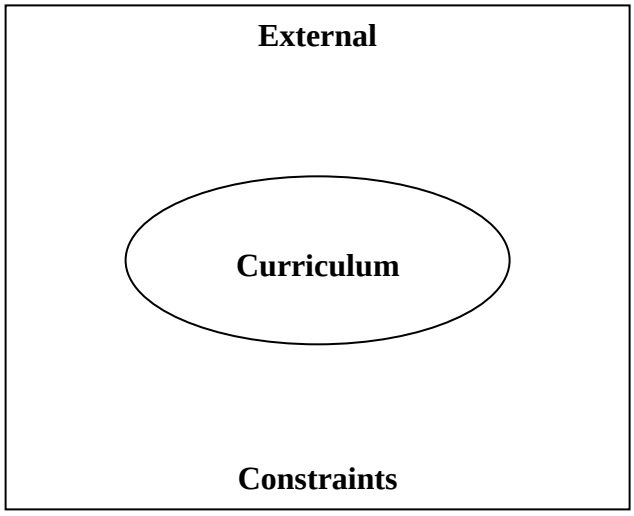

Figure 2: The curriculum and external constraints

OBJECTIVES AND SOURCES

According to Kerr curriculum objectives may be derived from three main sources namely, the needs of the children themselves, societal considerations and the nature of the subject matter.

Although there appears to be sound reasons for initiating curriculum development activities with objectives, in the writer's opinion, the method by which they are formulated needs to be reviewed. It appears that one important source of data for objectives formulation has been ignored and that is research activity. As Kerr (1972; p.21) himself noted, certain curricular decisions are too often reached on the basis of personal impressions or at best consensus of opinion. There is the need for a more valid and reliable data for objectives formulation since the end result may, in the long run, cause irreparable damage to the intended beneficiaries.

It also seems that philosophical considerations have been excluded as one other source of credible data. But as Marshall (2006) noted, focusing on philosophical issues would cause curriculum designers to ask questions about the nature of knowledge and understanding, process of concept formation, the relationship between theory and evidence, the place of values, the nature of motivation, the role of language etc. Properly considered, philosophical

issues will determine, to a great extent, the type of knowledge required to attain certain ends and how this knowledge is to be imparted.

One other issue about objectives is whether they can really be formulated and validated for so complex a process as curriculum development. Additionally, it is not practicable to cover every conceivable aspect of societal life that constitutes one of the foci of curricular activities. One other crucial issue is the degree of specificity required of curricular objectives. There is some evidence that irrespective of the clarity with which educational objectives are stated, some unintended outcomes cannot be ruled out altogether. These two important questions about curriculum objectives have not been clearly addressed in Kerr's model.

Kerr's Model and Evaluation

One of the major criticisms against Tyler's model of the curriculum is that evaluation of curricular activities is performed only at the end of the programme. In Kerr's (1972) model however, evaluation appears to be the second activity to be performed after the objectives have been formulated (pp. 20-22). According to Kerr, since without evaluation, we could not be sure that proposed objectives are attainable; the evaluation component of the curriculum is inseparable from the objectives component. He goes on to refer to "Learning Experiences" as the last major curriculum component.

What is not clear (from Kerr's description of his model) is whether the "objectives" are the only major curriculum component that should be evaluated. If Kerr's description of his model is to be taken at face value, then it appears that to him the evaluation of the objectives takes precedence over the evaluation of the other components. If that is the case then some of the interactive arrows in the model need to be removed or re-directed. It appears that Kerr's description of his model is at variance with the idea conveyed by the diagrammatic representation of it. This apparent mismatch may have resulted from Kerr's (1972; p.20) attempt to develop his model in specific operational terms rather than in conceptual terms. One other possible cause of the mismatch is Kerr's own admission that the infinitely complex nature of the curriculum with its many interdependent facets, made it impossible to produce anything but a blurred image of the reality to be presented.

The specification of evaluation instruments point to the need Kerr saw for curriculum designers to have some sound basis for curriculum evaluation decisions. The instruments he listed are objective-type and essay-type tests, attitude scales, interest inventories, interviews, multiple assessments, group observation methods and survey techniques – all of which can be used by teachers to obtain evidence of teaching effectiveness. Yet rather strangely, no direct reference is made to the important role teachers' play in the evaluation process.

Even if sound theoretical principles informed the design of Kerr's model, it seems that practical considerations did not influence it. But as Kelly (1983) noted, theory and practice should play complementary roles in curriculum development.

Interactive Arrows

Although the components in Kerr's curriculum model are supposed to be sequential from the point of view of both time and of the operations involved, each of them can be designed separately before being fitted into the cycle. The use of single and double-headed arrows in the model shows the interactive nature of the components.

It is however, not clear as to why Kerr used both broken and solid arrowheads in some of the interactions. For example, a broken arrow head points from the objectives component to the evaluation component. Similarly, the arrowhead pointing from the knowledge component to the evaluation component is broken whereas solid arrowheads connect the "objective' and the 'School Learning Experiences".

As was stated earlier, it is not immediately clear why two different arrowheads are used to connect the components of the curriculum. What is clear is that the model is not made any more comprehensible and simple than if solid arrowheads had been used throughout.

Based on the normal interpretation associated with solid and broken lines, one could hazard a guess that interactions involving broken arrowheads are either weak or optional. Consequently such interactions could be ignored without casting any serious doubt on the credibility of the curriculum development process. If that is the case, then Kerr's curriculum is not as interactive as it is presumed to be. Truly, interactive systems are dynamic in that there is constant cross-checking to ensure the conformity of each component to desired standards. It appears that this important characteristic of interactive systems does not fully permeate Kerr's curriculum model.

In-Built Barriers

Carpenter-Huffman et al (1974) have identified nine barriers that have been noted to hinder change in education. These barriers fall into three general categories:

(a) Social and behavioural barriers encompassing
  - (i) Ingrained patterns of behaviour that conflict with major changes in operating procedures.
  - (ii) The lack of professional incentives to sponsor and implement change.
  - (iii) The lack of competitive market forces compelling change.

(b) Systematic barriers encompassing the
  - (i) Difficulty in adapting proposed changes to existing school operations.
  - (ii) Difficulty in trying out new approaches to treat requirements for implementation fully.
  - (iii) Failure to consider the school system as an interacting whole.

(c) Information barriers encompassing the
  - (i) Lack of credible information on relative advantage.

(ii) Lack of sufficiently detailed information to guide implementation.

To Carpenter-Huffman et al., the importance of any the above difficulties is determined by the nature of the programme being implemented. They also noted that for some programmes some barriers seem to be more significant than others. This reasoning can rightly be applied to Kerr's model of the curriculum.

In the writer's view, two systematic barriers and one informational barrier are likely to impede the curriculum design model formulated by Kerr. There is no indication that Kerr's model of the curriculum was tried out to test its workability before being formally presented as an alternative to the existing models. Consequently, schools, districts, countries, etc. that adopt this model are not likely to meet the requirement for implementation fully since the relevant information may not be available. It is very likely that in his desire to present an alternative to the existing curriculum models he perceived as unsatisfactory, Kerr glossed over the limitations of his model to specific problems and situations. His model (in its original form), does not make any provision for possible strategies to deal with implementation barriers. The tacit assumption is that the phases of the curriculum development process are going to follow each other smoothly. Far from it. Curriculum development does not take place in a vacuum neither can it be assumed that the whole process is going to start from scratch unimpeded. The reality of the situation as was stated by Nimo (1992) is that certain vested interests in the society will oppose changes they perceive as threats to the status quo. In the writer's view Kerr's model takes many things for granted and does not possess the in-built capability to be self-sustaining.

Science Curriculum Design and the Needs of the Pupils

Kerr (1972; p. 22) contented that information about the level of cognitive development of the pupils, their needs and interest must be taken into account in the formulation of curriculum objectives. This view is also supported by Mallum and Haggai (2008). Some educationists and researchers argue that while consideration of the needs of the pupil may prove helpful in our attempt to decide on appropriate methods, the needs (in themselves) offer no rigorous criteria by which we can make choices of suitable content. Dearden (1968) is of the view that the use of the pupils' needs as a criterion of choice for curriculum planning is fraught with difficulties. In the first case, he argued that resolving questions of what anyone ought to have by reference to what they are seen to need involves an illicit process which can never constitute sound reasoning. According to Dearden, it may be claimed that the whole society is held together by the ability of most people to go without some of the things they might feel they need in the interest of social cohesion. In the writer's opinion what is important is the need of the society as a whole.

One other thorny issue is that of the identification of needs. Basing the pupils' needs on the criteria formulated by Maslow (1987) is fraught with practical problems since experience has shown that as the hierarchy is ascended problems arise as to how these needs are to be satisfied. The situation is likely to be compounded as far as science is concerned- due to its

nature and how it is to be taught effectively to learners at various levels of cognitive development.

Yet other educationists (e.g. Barbour, 1980) argue that a "need" is a value term and thus cannot in itself offer curriculum developers a firm criterion of choice. Consequently, there can be as many views and concerns on pupils' needs as there are experts working out a curriculum development process. Each group or individual will assess the pupils' needs in terms of their own criteria in ways that are likely to lead to ideologies or paradigms with proponents pushing for their adoption. In short, basing curriculum objectives on the perceived needs of the pupils is not as simple as it is presented in Kerr's model.

Science Curriculum Design and the Interest of the Pupils

On the surface, basing science curriculum objectives on what is known about the pupils' interest is a sensible approach. As Kelly (1983) noted, there is no doubt that pupils work better and learn more effectively when they are interested in what they are doing. Conversely, a lack of interest in the work teachers require of them is the cause of the failure of many pupils to learn (Mallum and Haggai, 2008).

The identification of the pupils' interest is not as straightforward as it is made to sound by some curriculum designers. It involves distinguishing between an abiding interest and a passing whim or an inclination.

Although there may be some sound theoretical principles underlying the use of the pupils' interest in curriculum planning, Wilson (1971) has raised some objections against this approach. He contended that use of the pupils' interest trivializes them by utilizing them as means to the achievement of our ends rather that recognizing them as having intrinsic values for the pupils. He suggests that instead of planning the curriculum by reference to the pupils' interest' to achieve our own purposes, we should rather use them to help the pupils to pursue their own interests more effectively. Furthermore, Wilson suggested that teachers, curriculum planners, etc. should help the pupils to organize their learning experience, in ways that extend and deepen these interests.

In summary then, curriculum planners should desist from taking decisions that will lead to the imposition of their values on the pupils. Such situations are likely to result if Kerr's curriculum model is implemented uncritically.

A Suggested Curriculum Model

From the foregoing discussion, it is evident that problems are likely to arise at each phase of Kerr's curriculum development process. In order to minimise the effect of potential barriers to the curriculum, a simplified and modified form of Kerr's curriculum model is suggested. This is shown in Figure 3.

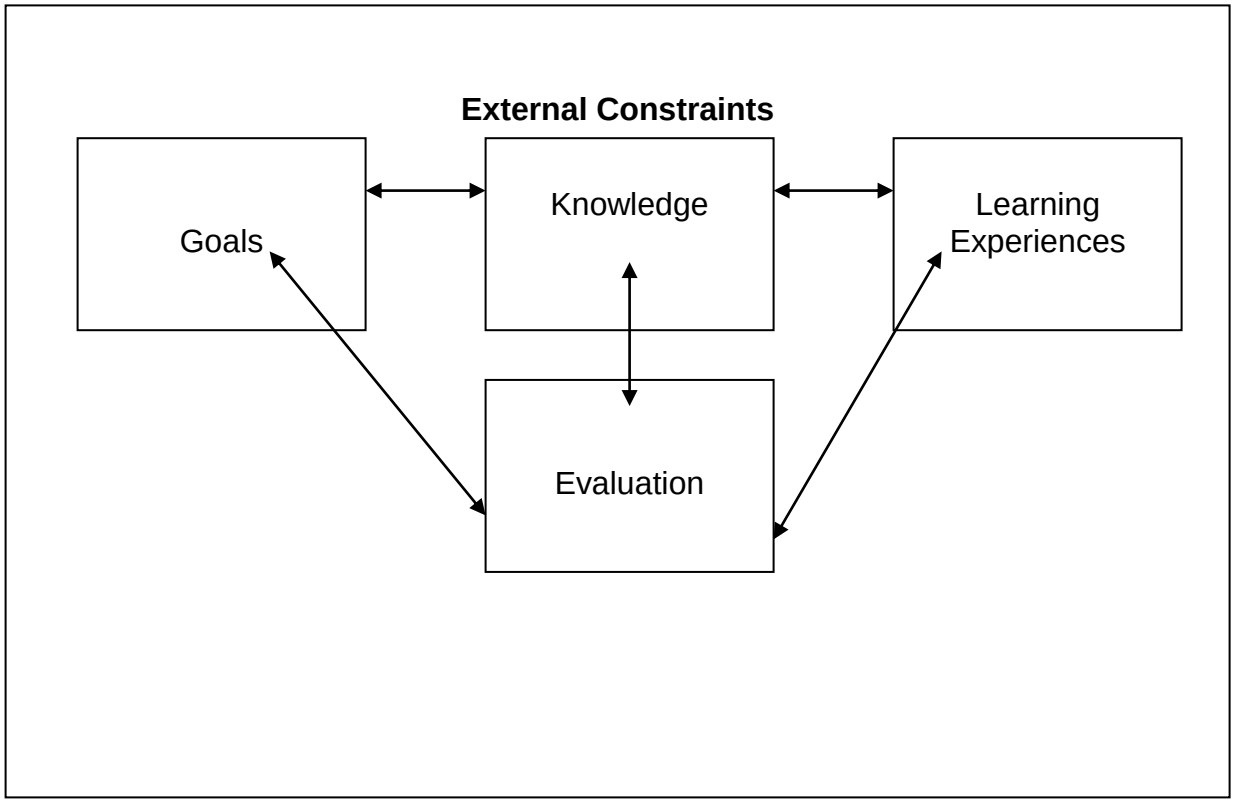

Figure 3: Proposed curriculum model

In the new model, goals (which describe the actual destination of learning) replace objectives (which are operational and quantifiable in nature) in Kerr's model and are formulated before the knowledge component (comprising knowledge of the subject matter and knowledge of the appropriate pedagogical approaches) is selected. The learning experiences by which the curriculum goals are expected to be attained are then specified. Each of these components is to be evaluated periodically to ensure conformity with agreed standards and procedures. A strong point in favour of this simplified version of the curriculum development process is that it can be modified to suit various levels of the curriculum- that is whether at the:

- Supra level(international)
- Macro level(national/state/society)
- Meso level(school/institution)
- Micro level(classroom)
- Nano level (personal/individual) (van den Akker, 2004).

Further proof of the flexibility of the proposed model is that at the Nano and Micro levels, curriculum goals become specific curriculum objectives while at the Meso and Micro levels curriculum goals can be reformulated as curriculum aims or general curriculum objectives. Furthermore, at the Nano and Micro levels, the evaluation of curricular activities can be replaced by the assessment and monitoring of the learner's changes in behaviour in relation to the specific objectives. On the other hand, at the Macro and Meso levels, curricular

activities can be evaluated as depicted in the proposed model. Implicitly, at the Supra level of the curriculum, curricular activities may proceed as shown in Figure 3.

The Universities, Examination Bodies, Research Institutions, Industry, etc. should be consulted to ensure the inclusion of their concerns in the curriculum. For example, the Biology, Chemistry, Integrated Science and Physics Chief Examiners' Reports that are issued annually by the West African Examinations Council can be used to address critical instructional, pedagogical and subject matter issues at different levels of the curriculum.
One important feature of the suggested model is that (unlike Kerr's model) the interactions among the components are indicated by solid arrowheads. While the curriculum goals determine the type of knowledge to be imparted, any change in the latter is expected to result in reformulation of the goals. Similarly, curriculum goals and learning experiences are expected to influence each other. While curriculum goals directly or indirectly influence the selection of the learning experiences, the evaluation of the latter will certainly inform the reformulation of the goals to make them more responsive to the perceived needs of the society as a whole. It is noteworthy that the suggested model recognizes the powerful external constraints wield over the curriculum.

CONCLUSION

That Kerr's model of the curriculum is an improvement over that developed by Tyler cannot be controverted. This admission notwithstanding, an in-depth analysis of Kerr's model revealed some structural weaknesses.

Some of the weaknesses (the obvious ones) have been discussed and a new model suggested. The new model takes into consideration the effect of external constraints on the curriculum since the reality of the situation is that no curriculum is developed in a vacuum. The changes suggested by the model are designed to enhance the workability of the curriculum development model originally designed by Kerr.

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