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NEWSPAPER-BASED MATHEMATICS FOR ADULTS IN SOUTH AFRICA[1]

ABSTRACT. This paper is drawn from a retrospective, illuminative case study of newspaper mathematics courses developed by the SACHED TRUST and published as part of a broader newspaper project in South Africa between 1977 and 1980. Background on the project as a whole is given briefly, followed by a discussion of research methodology. An overview of the operation of the mathematics component includes description of the aims, audience and newspaper materials. Research revealed both strengths and weaknesses in the programme. These findings are presented, culminating in some recommendations for the future use of the newspaper as a potentially effective medium for motivating adults to study mathematics.

INTRODUCTION

I am 47 years old and I work for a bus company as a clerk. I left school at the end of 1945 after passing Std 6. I did not do maths at school but was very good at arithmetic.

I have tried several times in the past to learn maths but the people who were helping could not make me understand the subject. In fact it became a puzzle to me. I must confess that I am amazed at the ease with which you have made me understand this intricate subject . . . your approach to the subject has really aroused my interest in it – even at this late age. I am already able to help my daughter who is in Std 5 with her homework . . . .

In my opinion, you have adopted just the right approach to the subject. Many people like myself who could not understand the subject, will now be able to follow it. I was really impressed when I saw my daughter able to follow your instructions. This is what teaching should be – to make your pupils understand you.

Vuki Shangani, SACHED Newspaper Project student, Soweto, 1977

The above comment was one reaction to a *newspaper-based* junior secondary mathematics programme in South Africa. The programme formed part of a broader newspaper project initiated by the SACHED TRUST[2] as a response to the growing education crisis which had crystallised in the Soweto Revolt of 1976.[3] The decade since Soweto has borne witness to escalating political, economic and, particularly, educational crises in South Africa. Schools in some areas have been the focus of intermittent protests and boycotts since 1976. Thousands of black South African youth have only a disrupted experience of school life. 1986 was another year with many classrooms and examination halls standing empty. The state's response to boycotts has been armed troops and barbed wire around some of the schools coupled with the closure of others. Further attempts by the state to force students to carry identity documents, and the refusal of students to accept this, have resulted in a decline of many many thousands in the student population, thousands that now add to the under-educated adult population. It is

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moreover iniquitous that personal lives so ravaged by apartheid and by disrupted and impoverished schooling are today faced with rapidly growing unemployment.

Empty schools and slogans like 'liberation now education later' recently brought all major political groupings together to intensify demands for equal, non-racial democratic education. Under the theme 'people's education for people's power', the National Consultative Conference of March 1986 advocated a strategy for developing alternative education that included a return to school and the transformation of the schools into sites for education for liberation.[4]

In January 1987, as the schools reopened and many students returned, motivated by a vision of 'people's education', the state responded by passing and enforcing stringent legislation 'prohibiting the offering on any school or hostel premises of any syllabus, work programme, class or course which has not been approved in terms of the Education Act'.[5] An uneasy calm prevails.

Despite growing repression, and shadowed perhaps by a spotlight which at present has shifted to the militant workers' movement, alternative strategies continue to be developed and launched in the struggle for a non-racial democratic education. An example pertinent to this paper is the specifically educational material published in the Church-backed newspaper, 'New Nation'. Because under-education in South Africa is a reality for so many, mass-media strategies need to be considered for future alternative thrusts. With radio and television under the official control of the state, and with the state embargo on the use of newly developed 'people's education' materials in schools, the newspaper remains the only mass medium with a potentially viable educational role in the present struggle for political and social change. This is so despite the recently published regulations aimed at, but as yet not applied to, the alternative press. In this context, SACHED's past experience with the newspaper as an educational medium remains relevant. It can contribute to the important debate on, and to the articulation of, 'people's education' now and for the future.

During 1981 and 1982, retrospective in-depth research was undertaken into the *mathematics component* of SACHED's newspaper project. This paper outlines the background to the research, its methods and findings and, hopefully, provides practical insights into the potential of the newspaper as a medium for mathematics education for adults in South Africa and elsewhere.

THE BACKGROUND

SACHED (South African Committee for Higher Education) is an independent, non-profit, educational trust which aims to provide effective educa-

tional assistance to the victims in the South African education crisis and to initiate alternative strategies. The organisation further tries to relate education to the process of social change in South Africa.

In March 1977, SACHED launched People's College (PC77). As a 24-page educational supplement to the weekly newspaper Weekend World, PC77 was innovative and unique in the South African context. The theoretical underpinning of the project was the democratisation of knowledge in South Africa. Education under apartheid in South Africa has meant both qualitative and quantitative inequalities. SACHED believed that a project which combined progressive educational methods within a mass medium could, in however small a way, challenge minority control of access to education.

The state's banning, in October 1977, of Weekend World and hence along with it, PC77, and the general political turmoil in the country over that period account for the disrupted life of SACHED's newspaper project. In all, three newspaper supplements were published between 1977 and 1980. Each was framed by the initial conception of the project in 1977 and each provided a wide range of formal and non-formal self-instructional learning materials. Where possible, the materials were backed by a system of group learning. While there were differences in size, structure and variety of content, each supplement was aimed at the very wide and predominantly black adult readership of the carrier newspapers, and each included a mathematics component.

Under-education in South Africa is critical in the field of mathematics and particularly so at a secondary level. Shortages of professionally trained and mathematically qualified teachers are acute in secondary schools.[6] This has meant that those teaching mathematics are often only one step ahead of their students, and that as a result, rote-learning and authoritarian methods predominate. It is no wonder that there is a common perception that mathematics is difficult and unmanageable, especially at a secondary level. The result is large-scale fear and apprehension in undertaking mathematics courses, very high failure and drop-out rates, and vast numbers of adults with limited mathematics experience.

In this context, SACHED attached great importance to a mathematical programme within a mass medium. It could demonstrate that mathematics can be enjoyable and understandable by using progressive teaching methods. It could also reach people where they live and work. It could, by virtue of the fact that it appeared in a mass medium, convey the message that contrary to common opinion, mathematics was for everyone, not just an elite. Thus in line with the overall project aims, it could begin to contribute to the democratisation of knowledge in South Africa.

Each of the mathematics courses in the three supplements was framed by

the aims of the newspaper programme as a whole, and built on the experience of its predecessor. The response over the years 1977–1980, and particularly in 1980, was numerically encouraging, but inconsistent. It became more and more obvious that detailed research into the potential of the newspaper as a democratising medium for mathematics education for adults was necessary.

THE PURPOSE OF THE STUDY

Research into SACHED's newspaper mathematics courses was initially intended to be a formative evaluation of the 1981 course. Forced closure (by the state) of Sunday Post (the carrier newspaper) at the end of 1980 resulted in the study becoming a retrospective one, focussing instead on the basic algebra course (ALG80) that appeared in the 1980 supplement, Learning Post (LP80). To examine the potential of the newspaper as a democratising medium for mathematics education for adults, three broad questions were asked: who used the course, how and to what effect?

RESEARCH METHODOLOGY

The major constraint in the study was the time lapse between participation in the programme by students/learners and their interviews. As over a year had passed at the time of the interviews it was difficult to extract from interviewees details as to actual mathematical difficulties they experienced with the course. As will be seen later in the paper, the expressed appreciation or criticism of the course was only given in broad structural terms. The other side of this coin, however, was that the time lapse provided insight into the long-term effects of programme participation.

As a retrospective case study, all aspects of the programme were examined. Through analysis of relevant documents and consultation and discussion with relevant SACHED staff, insights were obtained into the historical context of the project as a whole and into the design and implementation of the maths component.

Feedback mechanisms that operated during publication provided biographic and course progress information of participants, i.e. on those people who corresponded with the programme. Independent surveys of national newspaper readership provided further information about people who claimed to read the published algebra lessons, but did not necessarily correspond with the programme (see p. 67).

For in-depth illumination as to who used the course, how and to what

effect, 30 in-depth structured interviews were carried out on a *selected cross-section of willing adult participants in the urban areas surrounding Johannesburg*. Interviewees, both men and women, included course completers and drop-outs, who spanned different ages and education levels.

With this background to the newspaper project and the purpose and methods of the research, the remainder of the paper will focus on the implementation and outcomes of SACHED's newspaper mathematics courses. It will attempt to illuminate and explore possibilities for the future use of the newspaper for mathematics education for adults in South Africa and elsewhere.

PROGRAMME IMPLEMENTATION – ALG80 IN OPERATION

1. *Aims and Constraints*

There are many adults in South Africa who dropped out of formal schooling at the end of primary school and who wish to re-enter the education process. State adult education provision for such adults is inadequate. A Std 5 (senior primary) course is offered followed by a Std 8 or junior certificate (JC) course, with little to bridge the gap between the two. In mathematics there is a particular and crucial need for a JC preparation course. SACHED's 1980 newspaper mathematics course was an algebra course which aimed directly at this gap: designed for adults re-entering the formal education process at a JC level, it hoped to provide foundation skills and to serve as an introduction to secondary level algebra.

The choice of formal algebra (as opposed to more functional/life skills orientated mathematics) was the result of a complex interplay of factors. Formal abstract algebra might seem incongruous as a mass-based *adult* education project. It raises the question: for whom is algebra really necessary? It is largely abstract and therefore alienating to many. However, it needs to be understood in the context of previous denial to formal education, the immediate recognition of algebra as formal mathematics, and in the light of the position that if properly taught – even at a distance – such content can be accessible and can thus contribute to the democratisation of knowledge.

The reasons for focussing on basic algebra to the exclusion of other aspects of junior secondary mathematics were both practical and educational. Firstly, the 1980 course had to be contained in 38 tabloid pages. Not all of JC mathematics could be dealt with in that limited amount of space. Secondly, the project planners, together with the course team, felt that a basic grounding in algebra would be of the greatest bridging benefit to adults

wishing to resume formal mathematics studies. Many elements of geometry and trigonometry assume an understanding of the concept of a variable as well as the ability to solve simple linear equations. To develop even these basic algebraic concepts from first principles required the 38 pages available.

It was noted earlier that one overall aim of the newspaper project was to provide as far as possible, a system of group learning. The political environment in 1980 made it extremely difficult for SACHED to organise and maintain large-scale group learning. As a small service organisation, SACHED has neither the grass roots structures, nor the resources to facilitate and support the organisation of learning groups. Accordingly, the only LP80 course around which group activity was organised was the accountancy course. ALG80 had to run as a correspondence-based course, and it was largely the positive and inspiring feedback on the mathematics materials in PC77 (see p. 1) that influenced the acceptance of this obvious limitation.

To meet its aims, and within the constraints described, ALG80 planned to:

(a) provide educationally effective, fully self-instructional distance learning materials which included in their content algebraic knowledge and skills essential to entry into the study of algebra at a JC level.

(b) support learners with written, two-way communication by means of regular tests submitted to the 'algebra tutor' for marking and comment. This would serve the additional function of providing ALG80 with feedback on, and from, its otherwise unknown audience.

Between March and October 1980, 32 of the 38 planned ALG80 lessons were published. Their content included:
- the introduction to and manipulation of negative numbers;
- the language of algebra and the four basic operations as applied to algebra;
- an introduction to equations and inequalities of the first degree.

The lessons appeared once a week, each occupying a full page of LP80.

A policy of 'open' participation operated. No enrolment was required nor were any selection criteria employed. No potential learner was excluded at any time during the publication of LP80. In other words, learners were allowed to 'drop-in' to the course.

Three tests (each shown to have content validity) were published and all responses were marked and returned to the learners with comment. In addition, and largely to facilitate the marking of large numbers of tests all arriving at the same time, a full answer and explanation sheet was sent with each marked script.

Because the aims of the project encompassed learning in its fullest sense, and because the course was correspondence-based, the preparation of the learning materials was pivotal.

2. *The Learning Materials*

The methodology behind SACHED's newspaper mathematics materials has its rather rigid roots in Busan's study methods and Mager's behavioural objectives. The methodology evolved into a much more flexible approach than that demanded by behaviourism, and it draws explicitly from Bååth's (1974) adaptation of Gagné's learning theory to distance learning.

What is advocated is a structured, systematic, four-stage approach which incorporates (1) setting the context, (2) planning (the macro issues), (3) writing (the micro issues) and (4) assessing overall coherence. While SACHED's course writer checklist (attached as Appendix A) expands the above four stages into a detailed list of guidelines, it does not and cannot explain how the stages and guidelines were articulated into practice for this project. Any educationist knows that while good intentions and sound educational guidelines are important for any project, they are neither a guarantee nor a determinant of quality educational material. Furthermore, it is impossible to express 'how to's' in a form that indicates the *process* of writing as well as the written product. How to's, when committed to paper, become static and deceptive of the dynamic process involved in developing distance materials.[8]

The development of the ALG80 lessons within the framework above (and obviously with some adaptations to suit the newspaper page) was certainly not a static one. The important processes involved are illuminated in an analysis of the lessons in a separate paper by the author.[9] Briefly, the methodology behind SACHED's distance learning materials corresponds closely with what can be called a generally accepted methodology for developing distance materials.[10] To attempt to summarise the analysis of the ALG80 materials within the scope of this paper will be to destroy their essence, particularly for those readers for whom this would be their first meeting with the development of formal mathematics materials for distance learners. For readers' immediate interest, an example of the ALG80 lesson (reduced from tabloid to A4 size) is attached as Appendix B.

There is, however, a fundamental aspect to developing distance learning materials that needs mention here because it illuminates the study as a whole. The materials must reflect awareness of the context of the course as a whole and most importantly who the course is for. The audience is crucial, for it is

the learner, and his or her educational background as well as social and political environment, that shapes both the teaching approach and lesson design of any course.

3. *The Audience*

ALG80 was aimed at adults who were studying, or wanting to study, mathematics at a junior secondary level. These adults would obviously be drawn from the readers of the carrier newspaper, Sunday Post. According to readership profiles, potential learners were likely to be mostly male, between 16 and 35 years old, with some formal secondary education and based in the urban areas of the Transvaal – the most populous and industrialised of South Africa's provinces.

This biographic profile, while important, was not the full picture. ALG80 further understood three broad areas which affected its learners and needed, therefore, to influence its materials.

(a) 'Deprived' home environments and long hours spent both at and commuting to and from work do not facilitate private study.

(b) ALG80 was in English, and this is a second language for most black South Africans. Learners would, in addition, have to learn the language of algebra itself.

(c) Learners, because of the under-education in South Africa described earlier, were likely (i) to be familiar only with authoritarian and rote learning methods, (ii) to be apprehensive about mathematics and (iii) to lack content knowledge.

ALG80 could do very little with regard to (a). However, that the lessons were in a newspaper which cost only 10c each week meant that little financial strain was made on learners. With regard to (b) and (c) it was possible, in the materials, to attend to the use of language, the introduction of new terms and to a teaching approach that taught content, reduced fear, and moved away from rote learning to encourage learning by understanding. An analysis of how this was achieved is found in Adler (1985b).

We now turn to results. Did the course and its materials work? In what ways? Did it reach people, and if so, how effectively? Results included insights into the nature of the newspaper as an educationally democratising medium and revealed both strengths and weaknesses in the programme.

RESULTS - THE STRENGTHS AND WEAKNESSES OF ALG80

479 people responded to one or more of ALG80's three published tests. Analysis of who these respondents were is given later. In contrast to the number who participated by sending in tests for marking, the number of people who claimed to have read the algebra lessons, as revealed by 1980 national newspaper readership surveys, was over 90 000, an impressively large number. This numerical contrast between readers and participants was not a surprise in terms of the expected audience of the newspaper project. It was anticipated that the audience would include serious learners (those who participate/respond to tests) and casual learners (those who read the lessons/articles but do not respond in any formal way). Further, what emerges from other newspaper-based programmes discussed by Clarke (1968), Colburn (1980) and Stewart (1986), is that large readership and small participant figures appear to be a common feature of such programmes. Thus the conclusion was reached that a newspaper-based mathematics programme will reach, but in all probability not teach, large numbers of adults.

In evaluating the newspaper as the delivery system for a junior secondary mathematics programme, structural constraints became evident. If issues of the paper are missed, back copies can be acquired but only with some delay. Effectively, a lesson is missed and while this can be made up later, the disrupted order of the lessons obstructs the cumulative nature of the subject. Space restrictions of a newspaper are another problem related to delivery, and they raise questions for a long term programme. Should courses be reprinted each year? Should new courses be published in addition to the repeated courses? These questions are not easily answered but must nevertheless be addressed in any future long term programme.

There was a third and most important finding relating to the newspaper medium, namely, motivation. For example, in response to why he studied algebra in LP80, a 32 year old man who completed primary school in 1965 and had not studied since said:

> I was very interested in mathematics . . . . Then I got this Learning Post and the algebra lesson inside. I tried, I read the whole lesson. I covered the answers and then did the exercise. I found I scored eight correct. This was so pleasing to me. I decided to look for Learning Post next week . . . well before I never knew where to get maths . . . I was scared of maths.[11]

The barriers of access and confidence were broken. Similar feedback from over one third of the interviewees led to the conclusion that the newspaper can itself become the motivation for learning. This is provided that the learner's experience of the learning materials is that they are understandable,

and therefore educative and beneficial. Expressed in another way, the newspaper can be instrumental in effectively opening up access.

While ALG80 was aimed at adults (people 16+ years old and not in school full time), ALG80's actual participant audience was only 46% adult. The remaining 54% were full time scholars. Adult participants spanned the education ladder from Std 2 to Std 10 with 90% having completed at least Std 6 (i.e. some secondary education). Adult youth (16–24 years) were dominant (43%) and men were over-represented (77%). In short, a wide range of people responded to ALG80.

Investigation clearly revealed that different people have different support needs. Dodds (1973) and McIntosh and Woodley (1981) have discussed youth. They argue that with their relative immaturity, youth need more counselling, and that they tend to drop out of courses more readily. The drop-out rate in ALG80 was highest in the youth age group. At the other end of the age spectrum, Rogers (1977, p. 29) argues convincingly that older adults who tend to be better completers (and were so in the ALG80 course), experience emotional rather than physical barriers to learning. In the words of two of the interviewees:

> Some of my comrades think that studying at my age is futile. They think we are too old because we have been out of school for some fifteen years back.[12]

> Some adults are scared because of their age . . . . If you say something in a night school class and it is stupid, how will people feel? It really puts you down . . . . Some adults have financial problems . . . they feel they are old. They must put the money to educate their children.[13]

One of the myths that surround maths is that it is not really for women. Commenting on why they thought so few women responded to the ALG80 programme, interviewees expressed factors common to women's issues taken up all over the world. The most dominant of these in the black South African context is time. Most women work a full day and, in addition, have to carry all the domestic chores of the household. Women need active encouragement to participate in further education.

ALG80 did not address the different barriers to participation of youth, older adults and women. Any future similar programme should try to do so.

ALG80's audience was further characterised by few completers (11% sent in all three tests) and relatively large drop-outs, mostly youth, and drop-ins (20% sent in 2/3 tests while 69% sent in only one of the three tests). In examining participant experiences with the course, improved and additional learning support elements were identified. In all likelihood, counselling and early assessment could have enhanced participation and minimised drop-outs. It also appeared that some face-to-face content tuition was necessary for those learners who, despite great effort, did not show any progress.

Mathematics is a cumulative subject. If problems are not addressed as they arise, learners will not be able to progress. These findings support the common view clearly espoused in Sewart (1981) and Young *et al.* (1980, Ch. 4), that learning materials, no matter how good, cannot in themselves constitute a sufficient resource for learning.

However, the provision of face-to-face support in a mass-based mathematics programme, and particularly for an organisation like SACHED, is problematic. Because SACHED has no organisational base (e.g. a union) nor an institutional base (e.g. the Church), the organisation faced tremendous difficulties when, during 1977, it attempted to provide a mass-based group support structure for PC77. More generally, and as Jenkins (1981, p. 170) points out, the problems of sustaining group learning have become well known. So while additional supports seem necessary for successful participation, their provision in a mass-based programme is undoubtedly problematic.

Despite weaknesses in support structures, ALG80 interviewees, whether completers, drop-outs or drop-ins, experienced learning gains. From the investigation into learning gains it became apparent that the educational effectiveness of ALG80 was in general considerable and in some cases no less than spectacular. Subject learning gains, gleaned from the tests mentioned earlier, were obvious in the outstanding achievements of seven interviewees, all of whom scored over 70% for each of the tests they sent in. These particular interviewees all left school many years prior to 1980, never studied algebra at school, never embarked on any post school studies prior to ALG80, and were not attached to any other educational institution during 1980. Their experience, of moving from no knowledge of algebra to a situation where they not only understood and learnt from the course, but in some cases went on to further study, says much for both their individual ability and determination, and for the potential of well-written distance learning materials.

Learning gains were further found to extend beyond the learning of content to increased self-confidence and self-esteem. This is evident in comments on what interviewees felt they had gained from the course:

> I was able to argue with others doing maths. For example, if someone says $2x + 2$ equals a number, then I can do it myself and if his is wrong then I can argue. Before I never said anything even if I was told the wrong answer.[14]

> It was something new in my life . . . It opened the gates for me . . . I now have a foundation of algebra.[15]

Because the published lessons were the only course materials, and because of the limited support structure for learners, it becomes tempting to attribute learning gains to the methodology behind the written materials. The ALG80

interviewees were asked what they liked and disliked about the ALG80 lessons. The one-and-a-half year time lapse between the use of the lessons and the interviews prevented detailed comments on or within specific lessons. However, the overall impression made by the lessons is clear:

> They were easy to understand alone . . . simplified . . . it can be managed without a help.[16]

> . . . it was explained so clearly. So even with nobody to help me it was fine . . . it was a somebody to me . . . .[17]

> . . . I understood better from these lessons than I did at school, that is why I was so interested . . . .[18]

> . . . The lessons they were quite alright . . . clearly explained . . . like a teacher teaching them in class . . . .[19]

How then do we put all these findings together: on the one hand a numerically extensive readership and a medium which was a powerful motivator, and on the other, a wide-ranging, relatively small participant audience with large drop-outs and weaknesses in support structures. Overriding all is the evidence of very definite learning gains.

Overall it must be concluded that the programme experienced a definite measure of success and thus it is worth repeating. But in what form? With what changes?

The research concluded with possible guidelines for the future use of the newspaper as a medium for maths education in the present South African context. While there is no attempt here to be prescriptive, this article concludes by drawing together some of the more important points from the guidelines which attempt both to capitalise on the power of the newspaper as a motivational medium for adult mathematics education, and also tackle the problems facing mass-based courses in relation to learning support structures.

SOME RECOMMENDATIONS

The points that follow refer specifically to mathematics for adults. However, some could no doubt be generalised to a broader conception of newspaper-based education.

(1) The major aim of a programme similar to ALG80 should be to *motivate* adult learners and to *open up access* to the learning of mathematics by using a widely circulated newspaper as the medium of instruction. A secondary aim could be to encourage, and develop over time, confidence in distance education methods.

These aims are unlikely to be met through the publication of a full JC maths course, but rather through the publication of extracts from such a course. Serious learners, attracted initially by the newspaper lessons, can be offered the full course through an aligned correspondence college which will be better equipped to provide the necessary learning support structures, e.g. face-to-face input.

(2) As was evident, accessibility depends on the newspaper lessons being written according to sound distance education principles. It is likely to be enhanced by a policy of open participation; i.e. any learner should be able to participate/join the programme at any time. There are different barriers to learning for youth, older adults and women and specific attempts to facilitate all their participation continue to be necessary.

(3) To enhance motivation fully, such a programme should provide written two-way communication around assignments so that learners can be encouraged by feedback, and such feedback could rely on pre-produced tutor comments, with encouragement to students to take on the full course.

These guidelines lead to a programme that uses the medium (the newspaper) where it is uniquely effective, that is in motivating the learning of mathematics. They place the serious business of teaching JC mathematics at a distance in all its complexities, not least of which is the length of the course, in a separate institution that is more likely to be able to provide necessary support structures. In so doing the structural limitation of the newspaper as a delivery system for a cumulative subject like mathematics is also overcome.

AND IN CONCLUSION

The mathematics by newspaper suggested here is essentially an exercise in motivation. Because mathematics materials will be published in a mass medium and therefore be widely available and cheap, and provided the lessons are understandable, the programme can work to motivate adult learners. It can begin to dispel the myths that mathematics is difficult and reserved for a few. The common view that mathematics is only for men can also be dispelled. Adult learners can begin to develop confidence in their own abilities and confidence in distance education methods. Newspaper-based mathematics can contribute positively to the democratisation of knowledge so sorely needed in South Africa today.

In conclusion it is also important to look to future research. There are many questions that this study did not and could not examine. Briefly,

details on the limitations and effectiveness of the newspaper as a medium for mathematics instruction did not emerge. Generalised, structural points have already been made. However, because of a time-lapse and its retrospective nature, the study could not elicit *specific details* on aspects of the course that were either effective or problematic, and this is particularly so with regard to the written materials. Thus we are left with questions such as: is the structure of algebra peculiarly suited to newspaper and distance learning format? Can other mathematical content also be adequately presented for the autonomous distance learner? What are the limitations on teaching mathematics at a distance?

In the light of the positive learning outcomes in this study, and the ever-increasing need to democratise education and make a subject like mathematics accessible to the majority, and particularly the vast numbers of under-educated adults across the globe, we need much more research-backed development of the learning of mathematics at a distance.

APPENDIX A. SACHED'S CHECKLIST FOR COURSE WRITERS

Four Stages in Writing Lessons for Formal Distance Learning Courses

STAGE 1: Set the context

1(a) Establish who your learner is: his/her biographic profile, educational background and learning/studying circumstances.

1(b) Situate the lesson within the course: what content and skills you can assume at the point of the lesson at hand.

1(c) Identify constraints the distance learning mode places on the lesson.

STAGE 2: Plan the lesson (macro points)

Decide on:

2(a) Clear and appropriate *lesson objectives.*

2(b) *Content and skills* needed to meet objectives.

2(c) *Activities/assignments* that will ensure they are met.

2(d) Appropriate (both in terms of audience, i.e. adults and of specific subject matter) approach to content.

2(e) A lesson *structure* as revealed in the lesson *headings* that is both logical and coherent and that divides the content into manageable self-contained portions.

Lesson planning is the stage most often overlooked. Remember it is crucial to the wholeness of a lesson. The diagram below of the five steps of planning illustrates (a) their cyclical nature and (b) that each forms an important part of the whole.

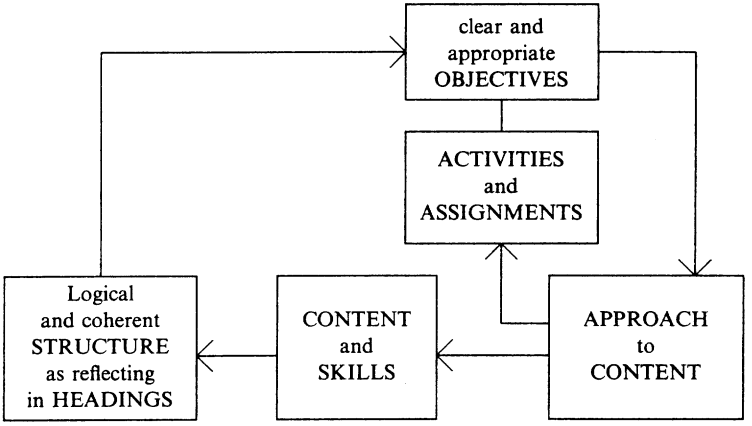


Fig. A1. Five steps in planning a distance lesson.

STAGE 3: Write the lesson – remember these micro points

NB: You must remember at all times when writing your lesson that it replaces the teacher. Talk to your learners through your lesson. Explain and develop new concepts and content in as detailed and step-by-step a manner as you would in a classroom. Make sure there are no gaps or jumps in the material.

There are three parts or components to a lesson:

3(a) Your lesson must have an *introduction* that:
- prepares students physically;
- provides a mental set through revision, referral, relevant examples of introduction, etc.;
- stimulates interest (is motivating).

3(b) In the *body or main text* you must ensure that
(i) you are aware of any *assumptions* you are making about your learners both in terms of their content, knowledge, skills and in terms of their attitude to learning;
(ii) the *main points* of the lesson are clearly identifiable;
(iii) your use of *language* is clear and suited to second language readers, your *tone* is suited to adults and your *style* of writing is conversational;

(iv) the *activities* involve learners in the development of concepts; enable practice and consolidation of subject matter; are varied challenging and sufficient; and are preceded by clear instructions;

(v) the *answers* which provide learners with immediate feedback help them to assess their own progress, diagnose their own problems and remedy these;

(vi) *diagrams* are clearly explained;

(vii) *visual presentation* is attractive/inviting and uncluttered;

(viii) *lesson headings*, in addition to reflecting structure, summarise lesson content and are informative.

3(c) Your lesson *conclusion* must assist learners to review what they have learned.

STAGE 4: Assess the overall coherence of your lesson – the overview

Your completed lesson should be both coherent and whole. This means you must:

4(a) reasses its length;

4(b) cut out any unnecessary sections – sections that disturb the coherence and are not reflected in the objectives;

4(c) provide signposts and links between sections so that at all times the student knows what is being done, why, and where s/he is going.

ALGEBRA II

POLYNOMIALS

Today you will learn more of the language used in Algebra. You will learn:

- What POLYNOMIALS, MONOMIALS, BINOMIALS and TRINOMIALS are.
- What the CONSTANT TERM of an expression is.
- That ALGEBRAIC SYMBOLS usually REPRESENT NUMBERS.
- How to find the NUMERICAL VALUE of an expression by SUBSTITUTION.

POLYNOMIALS

● **POLYNOMIAL is another name for an Algebraic expression.**

$2a + b - 3c$ is an algebraic expression with three terms.
We can say that
$2a + b - 3c$ is a POLYNOMIAL WITH THREE TERMS.
$4p - 3q$ is a polynomial with two terms.
Complete the following.
1) $3x - 5y + 2z - 16$ is a polynomial with ..... terms.
2) 15d is a ..... with ..... term.
Check your answers.

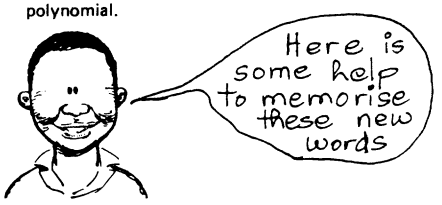
A polynomial can have one or more terms.
There are special names for polynomials with one, two or three terms.

● **A polynomial with ONE TERM is called a MONOMIAL.** 15d is a MONOMIAL. It has ONE term.

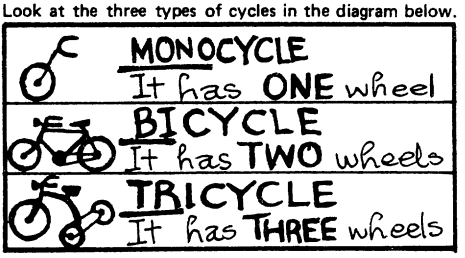
● **A polynomial with TWO TERMS is called a BINOMIAL.** $4p - 3q$ is a BINOMIAL.

● **A polynomial with THREE terms is called a TRINOMIAL.** $2a - b + 3c$ is a TRINOMIAL.

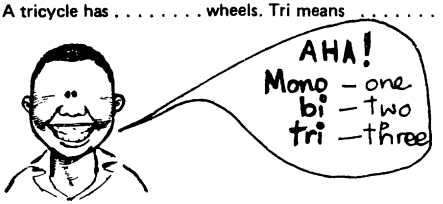
● **When there are more than three terms we use the general word POLYNOMIAL.** $p + 3q + 4r - 2s$ is a polynomial.



Look at the three types of cycles in the diagram below.



A monocycle has one wheel. Mono means one.
3) A bicycle has two wheels. Bi means .....
4) A tricycle has ..... wheels. Tri means .....



Now write the correct name for each expression below.
Example: a + b + c is a trinomial.
5) $3a - b$ is a .....
6) $2x + 3p - q + r + 2s$ is a .....
7) $-10z$ is .....
8) $a + b - 2$ is a .....
9) $d - 6e + 5f - 11$ is a .....
Check your answers.

▲THE CONSTANT TERM

In some of the algebraic expressions above, one term has no letters. For example in the expression $a + b - 2$, the term -2 has no letters.

▲**A term with no letters is called the CONSTANT TERM (or just the CONSTANT).**
In $a + b - 2$, the constant term is -2.
In $3x + 7$, the constant term is 7 (or + 7)

Now pick out the constant term in each expression below. Write each constant on the dotted line. I have completed (10) as an example for you.
10) $6q + 13 - 3t$ ... +13 .....
11) $a - 3b - 4 + d$ .....
12) $1 - 10x$ .....
13) $2r + 3s - 14t$ .....
14) $-7 + 2y + x$ .....
Check your answers.

SYMBOLS FOR NUMBERS

In the previous lesson you learned that letters of the alphabet can be used as algebraic symbols. We used h to represent house, c to represent car and so on. However

In Algebra letters of the alphabet usually represent numbers.

Suppose you want to write about a number and you do not know what the number is. Then you can, for example, suppose that the number is x.

When you use the symbol x to represent some number you still add, subtract, multiply and divide in the usual way.

Look closely at the examples below:

If you
- **ADD 4 to x you get $x + 4$.**
- **SUBTRACT 3 from x you get $x - 3$.**
- **DIVIDE x by 2 you get $\frac{x}{2}$ or $x \div 2$.**
- **MULTIPLY x by 7 you get $x \times 7$ which is written as $7x$.**

Note: In algebraic terms you can leave out the x sign. You will learn about this in a later lesson.

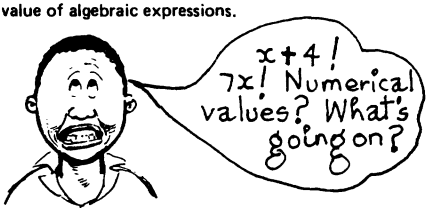
Now let's see if you can write short algebraic statements where symbols are used to represent numbers.

15) Subtract p from 10 . . . . . .
16) Add 5 to y . . . . . .
17) Divide b by 3 . . . . . .
18) Multiply z by 4 . . . . . .
19) The sum of a, b and c. . . . . .
20) −4 times t . . . . . .

Check your answers.

SUBSTITUTION

You have seen how to use the four operations +, −, ÷, × with symbols. This will help you work out the numerical value of algebraic expressions.



Let me explain.

I have said that in algebra symbols usually represent numbers. Often you are told what numbers the symbols represent and then you are asked to work out the value of the algebraic expression. Here is an example:

> If p represents the number 6, what is the value of $p + 4$; $p - 5$; $3p$; $p \div 2$?

p represents 6.

To find the value of p + 4 you write 6 instead of p.

$p + 4 = 6 + 4 = 10$.

10 is the value of p + 4 in numbers.

We say 10 is the numerical value of p + 4.

We found the numerical value of p + 4 by substituting 6 for p.

Now let's find numerical values for the other expression in the box above. Complete (21) − (23).

21) $p - 5 = 6 - 5 =$ . . . . . .

We substitute 6 for p.

22) $3p = 3 \times p = 3 \times$ . . . . . $=$ . . . . . .
23) $p + 2 =$ . . . . . $=$ . . . . . .

Check your answers.

Another problem!

If a represents the number 2 (we usually write a = 2) and b = 4 what is the numerical value of each of the following

Fill in the missing numbers.

24) a + b = ... + ... = ...
25) b − a = ...
26) 2a = ...
27) b ÷ 4 = ...

Check your answers.

I'll help you with the next 2 problems. Fill in missing numbers.

28) If $x = 2$, $y = 3$ and $z = 4$ find the numerical value of $x + y + 2z$.

$x + y + 2z$
$= 2 + 3 + (2 \times 4)$
a) $= 2 + 3 +$ . . . . . .
b) = ...

29) If $p = 5$ and $q = 4$ what is the value of $3p - 2q$

Now (a) $3p = 3 \times$ . . . . . .
(b) $2q = 2 \times$ . . . . . .
So (c) $3p - 2q = (3 \times 5) - (2 \times 4)$
= . . . . . − . . . . .
= . . . .

Check your answers. If they are correct continue with (30) below. If you have mistakes go over (24) − (29) again. Discuss your mistakes with a friend.

30) If a = 3, b = 2 and c = 4 find the numerical value of each expression below. Work in your exercise book

a) 2b + 2c
b) 5a + b + 7c
c) 2a + b − c
d) 10a − 6b − 2c

Check your answers carefully.

SUMMARY EXERCISE

This exercise summarises all the important things you have learned in this lesson. Work through it carefully. Fill in all the missing words and numbers.

● **Polynomial is another name for an algebraic expression. Some polynomials have special names.**
A Polynomial with ONE term is called a MONOMIAL.

31) A Polynomial with TWO terms is called a .....

32) A polynomial with THREE terms is called a .....

33) A polynomial with more than three terms remains a .....

▲ **A constant term is a term with no symbols. In the expression $2a - b + 3$, the constant term is 3. The terms 2a and –b both have symbols.**

34) Which is the constant term in $4x - 7 + 8z$? .....

■ **Algebraic symbols usually represent numbers. If we know what numbers the symbols represent we can work out the numerical value of a polynomial.**

35) If a = 1, b = 2 and c = 4 find the numerical value of 2a + 8b – 5c.

Check all your answers carefully. If you have more than one wrong, work carefully through the lesson again.

ANSWERS

1) 4 2) polynomial, one 3) two 4) three, three
5) binomial 6) polynomial 7) monomial
8) trinomial 9) polynomial 10) +13
11) –4 (Do you have the –sign in front of your 4? The whole term –4 is the constant) 12) 1
13) There is no constant here. Your answer should be blank. 14) –7 15) 10 – p 16) y + 5
17) $\frac{3}{4}$ or b ÷ 3 18) 4z 19) a + b + c 20) –4t
21) 1 22) 3 x 6 = 18 23) 6 ÷ 2 = 3
24) 2 + 4 = 6 25) 4 – 2 = 2 26) 2 x 2 = 4
27) 4 ÷ 4 = 1 28) a) 2 + 3 + 8 b) 13
29) a) 3 x 5 b) 2 x 4 c) 15 – 8 = 7
30) a) 2b + 2c
= (2 x 2) + (2 x 4)
= 4 + 8
= 12
b) 5a + b + 7c
= (5 x 3) + 2 + (7 x 4)
= 15 + 2 + 28
= 45
c) 2a + b – c
= 6 + 2 – 4
= 4
d) 10a – 6b – 2c
= 30 – 12 – 8
= 10
31) binomial 32) trinomial 33) polynomial
34) –7 35) 2a + 8b – 5c
= (2 x 1) + (8 x 2) – (5 x 4)
= 2 + 16 – 20
= –2

NOTES

[1] This paper is based on the author's M.Ed dissertation. See Adler (1985a).

[2] For details of the work of the SACHED TRUST, and an in-depth investigation of the programme, see Adler (1985a).

[3] For a detailed analysis of the 1978 revolt, see Kane-Berman (1978).

[4] The resolutions passed at the conference are available in *Perspectives in Education* **9**(1), July 1986, 60–70.

[5] See the Government Gazette 10563, Proclamation R235, 29 December 1986.

[6] Only 12% of black secondary school teachers have a degree. See Carstens *et al.* (1986), and SAIRR (1984, p. 440).

[7] See Adler (1983, p. 2).

[8] For insight into the process of course writing see Riley (1984).

[9] See Adler (1985b).

[10] This methodology is well documented. See CET (1980), IEC (1979) and Rowntree and Connors (1979).

[11] Interviewee 9.

[12] Interviewee 9.

[13] Interviewee 6.

[14] Interviewee 13.

[15] Interviewee 15.

[16] Interviewee 21.

[17] Interviewee 4.

[18] Interviewee 12.

[19] Interviewee 11.

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