Development of the Teacher Assessment Resources for Monitoring and Improving Instruction (TARMII) System

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Executive Summary

The development of the Teacher Assessment Resources for Monitoring and Improving Instruction (TARMII) system is developmentally linked to the Assessment Resource Banks (ARBs). The TARMII system while computer-based, ARBs were developed as manual assessment resources. Both the ARBs and TARMII are aligned to the National Curriculum Statement for English FAL and Mathematics are aimed at supporting teachers to enhance the teaching and learning process.

The TARMII system comprises a database of assessment items and computer software that runs the database. It is a tool designed to support teacher carry out classroom assessment to determine what learners know and can do, and to utilise the learner performance information to design corrective measures of interventions.

The process of developing the TARMII system consisted of three main stages:

a) Consultations with various stakeholder to obtain a buy-in;

b) Development of the database assessment items development; and

c) Development of the computer software to run the assessment items database.

Consultations with stakeholders took place before the development of the assessment items database and the computer software. It comprised conducting workshops or meetings with DBE national and provincial officials, the districts and schools. The main aim of these consultations was to pave the road for the other processes of TARMII development.

The development of English FAL and Mathematics assessment items for Grades 4, 5 and 6 was done with the assistance of local teachers of the respective learning areas or subjects. The items

were piloted in selected schools across the country to obtain the necessary item information. They were then uploaded into a prototype of the system.

The development of the system prototype marked an important stage in the development of the ICT component of TARMII. From the prototype various modules were added till a full system was developed. To ensure its proper functionality and relevance to the teachers' expectations, the TARMII system was constantly taken out to schools to obtain feedback from teachers. This iterative process of development meant that the system developers were regularly consulted. Through these consultations developers were informed about the challenges that were experienced with the system and were requested to make modifications to the system. This iterative process of development was exemplified with the conduct of the field trials with a fully functional TARMII system. The following information was obtained from the field trials:

- o   Information for further improvements to be made to the system;

- o   Minimum conditions for the TARMII system to function effectively;

- o   Key challenges for effective implementation of the TARMII system; and

- o   How the TARMII system should be implemented in practice.

Of particular importance is that even with the current repackaging of the National Curriculum Statement into the Curriculum Assessment Policy Statement, the TARMII system will remain relevant. This system should also assist teachers in meeting some of the goals stipulated in the Ministry of Basic Education's Action Plan to 2014.

Abbreviations

AS	Assessment Standard
APO	Area Project Office
ARB	Assessment Resource Banks
CAPS	Curriculum and Assessment Policy Statements
DBE	Department of Basic Education
FRQ	Free Response Question
FAL	First Additional Language
FLP	Foundations of Learning Programme
GOC	Gauteng Online Centre
HOD	Head of Department
HSRC	Human Sciences Research Council.
ICT	Information Communication Technology
LA	Learning Area
LO	Learning Outcome
MCQ	Multiple Choice Questions
NCS	National Curriculum Statement
RAM	Random Access Memory
TARMII	Teacher Assessment Resources for Monitoring and Improving Instruction

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Chapter 1

Background to the Project

The Human Sciences Research Council (HSRC) was commissioned by the Department of Basic Education (DBE) to develop a computerised classroom assessment system for teachers to use to enhance learning in the classroom. This system is called TARMII which stands for **Teacher Assessment Resources for Monitoring and Improving Instruction**. The project for developing TARMII or the TARMII system commenced in 2007. The system, TARMII, was developed for teachers of English First Additional Language (FAL) and Mathematics in the Intermediate Phase (in Grades 4, 5 and 6). It comprises a database of English FAL and Mathematics assessment items and a software that runs the system. All assessment items in the system's database are aligned to the National Curriculum Statement (NCS) (DoE, 2002a; 2002b) for the two Learning Areas or subjects (English and Mathematics) as they are matched to their Learning Outcomes (LOs) and Assessment Standards (ASs). Thus with the TARMII system a teacher would, after completing a unit of work, be able to compile a test for the ASs covered, print the test, administer it to the learners, mark and enter the scores obtained by each learner on each item in the test and then generate various reports on the performance of the whole class, a group of learners or individual learners. The heart of TARMII is the generation of learner performance reports which informs teachers on what the learners know and are able to do, and which areas of the curriculum they need to be assistance with. In this way the link between classroom assessment and instruction will be strengthened and assessment will better inform the teaching and learning process.

The development of the TARMII system follows the successful development and application of Assessment Resource Banks (ARBs) (Dye, Horn, Naidoo, Weber & Wolf, 2003). More follows on the development and implementation of ARBs, and their link to the TARMII system.

Assessment Resource Banks and the TARMII System

The Assessment Resource Banks (ARBs) are a collection of a large number of assessment tasks for use by teachers as additional resources in improving the teaching and learning process (Assessment Resource Banks, 2002; 2003). These were developed as part of the Assessment Modelling project under the auspices of the District Development Support Programme (DDSP). The DDSP was a school development programme which was implemented in the provinces of Limpopo, Eastern Cape, Northern Cape and KwaZulu-Natal by the Research Triangle Institute (RTI) between 2000 and 2003. It was driven by interventions aimed at providing support to provinces, districts and schools. The HSRC's role in the DDSP was to design an assessment model for the provinces, districts and schools. It is in this context that ARBs were developed, and integrated into other interventions. Thus the modelling developed linked assessment training, monitoring and support between the three levels on the education system (provinces, districts and schools), with the focus being the school (or classroom) where teaching and learning takes place. ARBs were developed for teachers of Foundation Phase (i.e. Grades R to 3) and Intermediate Phase (Grades 4 to 6) in 2002 and 2003 respectively. The Foundation Phase ARBs are available for Literacy and Numeracy and in eight of the eleven official languages (i.e. Afrikaans, English, Sesotho, Sepedi/Northern Sotho, Setswana, Tshivenda, IsiXhosa and IsiZulu).

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The Intermediate Phase ARBs, like the TARMII system, have been developed for English FAL and Mathematics for Grades 4, 5 and 6 in accordance with the National Curriculum Statement. The assessment tasks in the ARBs and assessment items in TARMII are based on and linked to the Learning Outcomes (LOs) and the Assessment Standards (ASs) as stipulated in curriculum English FAL and Mathematics curriculum documents (Department of Education, 2002a, b). Both ARB tasks and tests generated from TARMII are designed for application in classroom by the teacher. Thus they are aimed at improving learner performance by through instruction. According to Dye *et al* (2003) and Kanjee (2009) the successful application of ARBs in schools/classes by teachers hinged on the training and continued monitoring and support teachers' received in utilisation these resources. These assessment tasks were used mainly for (a) assessing learners in class, (b) planning of lessons, (c) presenting lessons in class, and (d) for giving learners classwork and homework (Kanjee, 2009). This is a lesson that should be borne in mind regarding the future use of TARMII by teachers in schools.

The integration of assessment to the teaching and learning process is central to the teachers' application of ARBs in the classroom, and also forms the basis for the development of the TARMII system.

Why Developing TARMII?

The development of the TARMII system builds on the documented successes that teachers' had had with the application of ARBs to support teaching and learning in their classes (Dye *et al,* 2003; Kanjee, 2009). The TARMII system is also aimed at further integrating assessment to the teaching and learning process with the view fostering assessment to serve the service learning.

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Results from a study on teachers' classroom assessment practices show that there is not much difference in between the assessment practices teachers in "good" and "poor" schools (Kanjee, Molefe, Makgamatha & Claassen, no date). Furthermore, although teachers in the same study reported to provide feedback to their learners, the nature of feedback they were referring to included motivational comments, marks, symbols ticks and crosses. Such feedback does not move learning forward. It is thus hoped that teachers will benefit from using TARMII in the following manner:

- o The system will provide teachers with high quality curriculum relevant tests on demand.

- o Teacher will apply tests generated from TARMII in their classes to obtain diagnostic information on the performance of their learners and ideas for interventions.

- o The system will also reduce teachers' workload as time will be saved from developing assessment tests.

- o The system will support teachers to improve their classroom assessment practices.

- o The TARMII system will provide teachers with curriculum relevant low-stakes tests which they can apply in their classrooms under non-threatening conditions.

- o Apart from administering the tests to learners teachers can also test themselves privately to gauge their content knowledge.

The success of TARMII would ultimately rest on its application and to what extend the system addresses the specific needs of teachers.

TARMII – The Envisaged Computer System

The development of TARMII began with conceptualising the final product or computer system. This included specifying the structural components of the system and their functions as shown in Figure 1 below. The envisaged computer system was to consist of the following six modules: *Database development module, Test development module, Data entry module, Data analysis module, Report generation module, and Learner tracking module.*

Figure 1
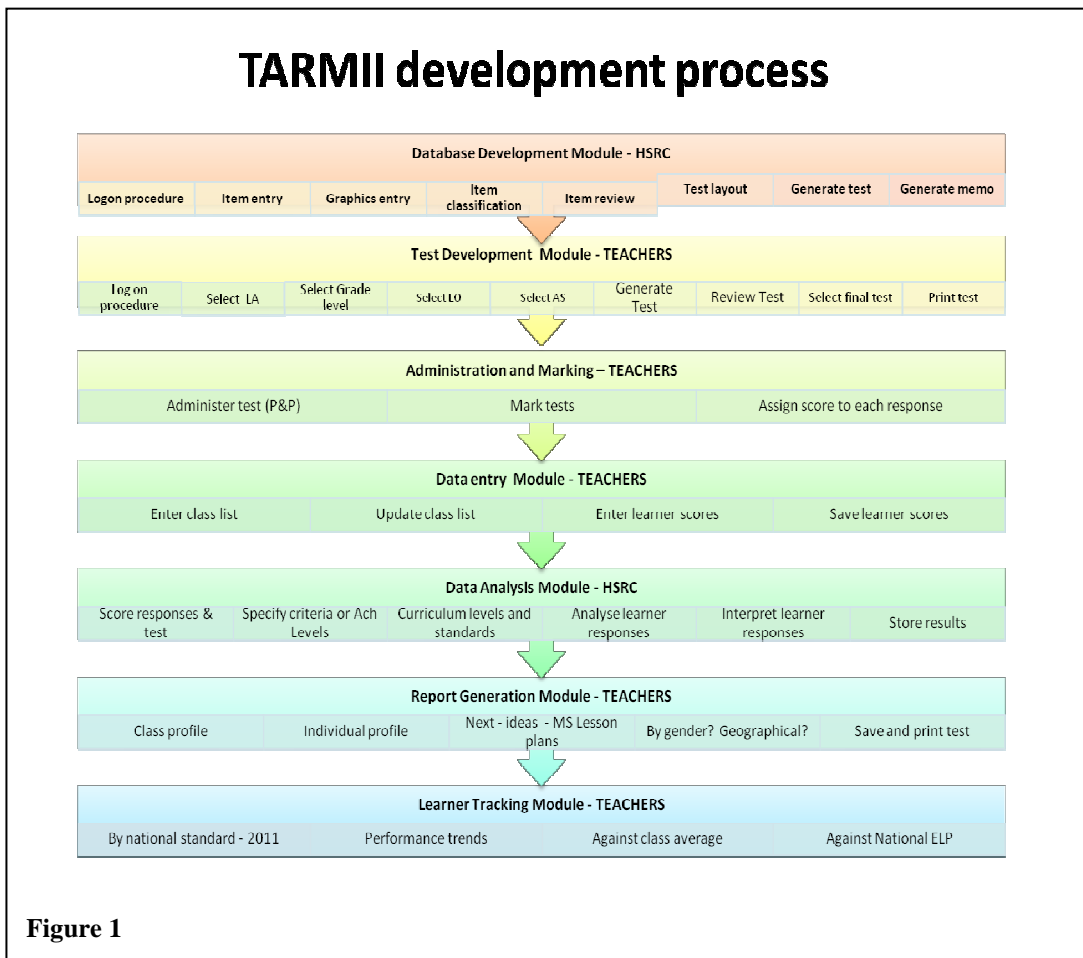
What follows are the system specifications and the descriptions of it various modules of the system.

Database Development Module

This module was used by the HSRC administrators (that is, researchers) to enter assessment items into the "shell". Through this module administrators were able to edit items entered into the database. The module comprised the following functions:

a) Logon procedure: This function enabled each administrator/researcher working on the system to have an account. Administrators did not share the accounts since this could make it difficult to track problems reported by specific users.

b) Item entry: The function was used by administrators to populate the database with English FAL and Mathematics assessment items. In was also used for the entry of various Mathematics formulae.

c) Graphics entry: The function was used to enter images in the items into the system.

d) Item classification: This function was used to enter the response options for each assessment item, for example A, B, C, D or Yes/No for multiple-choice items or 0, 1,2 or 3 for open-ended ones.

e) Item review: The function enables the user to review the test in order to make judgment about its suitability for the envisaged testing.

f) <u>Test layout</u>: The function specifies the standard information printed out with every teacher-generated test e.g. the upload cover page, teacher instructions and the practice items.

g) <u>Generate test:</u> The function allows the user to specify or sort criteria for the test they would like to generate (e.g. Learning Area, Learning Outcome(s), Assessment Standard(s) etc) and the selection of the number of question for their test.

Lastly, the database development module enables the administrator to delete or deactivate assessment items from the system.

Test Development Module

The module was designed for teachers to use to develop their tests. It is constituted by the following functions:

a) <u>Logon procedure</u>: This function enables the user to gain access into the system through a username and a password.

b) <u>Generate test</u>: The function has been formulated for the generation of tests by the user. For optimal system operation the following instructions were build into this function:

- o A stem and distracter have to be on the same page or on facing pages.

- o Sort selected questions on difficulty level (i.e., p-value in descending order).

- o Use criteria for achievement levels when selecting items.

- o Limit selection of Assessment Standards used to three.

- o Generate cover page, practice items and items for learners.

- Save unique assessment items IDs of the item or items in the test in database. This is to enable capturing of learner scores later on.

- Review of draft test on screen and prompt user to indicate when printing final version. Draft versions must have some watermark or text indicating it is a draft.

- Teacher must indicate for which class(es) the test was generated. When saving a test, a question score sheets must be created for all class(es) to be tested.

- Generate a memo and teacher instructions as separate action.

Data Entry Module

The module is designed for the teacher to use to enter learner responses from multiple-choice items and score/mark from open-ended items. It consists of the following functions:

a) Enter/Update class list: This function enables the user to add a new class by entering the name, subject of the class e.g. Grade 2B, Grade 4K. Additional information that can be captured into the class list includes learner name, surname, gender and home language.

b) Enter learner responses: With this function the teacher is able to enter the response or score of each learner for each question in the test. This information is captured on a score sheet generated when the test was accepted.

c) Save learners scores: The results of the scoring or mark entry process for each question in the test are stored with the assessment item unique ID.

Data Analysis Module

This module was designed to analyse the stored test score information entered by teachers into the system. It consists of the following functions:

a) <u>Score responses</u>: The instruction build into the system are that:

- o For multiple-choice items a score of 1 should be allocated for a correct response and a 0 for other options chosen.
- o For open-ended questions, the score entered by the teacher on the question score sheet should be used.

b) <u>Score test:</u> The system should add up the scores on the responses for a given student and store the total for that student for the test taken.

c) <u>Ranges for achievement levels</u>: The function specifies the numeric ranges for a given achievement level (e.g. Not Achieved: 0-25, Partially Achieved: 25-50, etc.) per assessment standard.

Report Generation Module

The module is designed for teacher usage to generate reports on the performance of learners in his or her class: The system should be able to generate the following learner achievement reports:

a) Pie chart will be used to represent the total score of all the students in the class. This will be accomplished by using the national achievement levels. Also the average for all assessment standards used in a test, maybe weighted.

b) Class performance by assessment standard was to represented by stacked bars.

c) Classroom diagnostic to be reported by achievement levels that specifies the items those learners in each achievement level did not get correct, broken down by MOST, MANY, SOME and FEW.

d) Details of learners report – show learners in each achievement level per assessment standard.

Learner Tracking Module

The module is to assist the teacher to monitor the performance of learners over time. The following reports were required:

a) Show learner performance against national standard.

b) Show learner performance for the past month, 6 months or year.

c) Show class performance for the past month, 6 months or year.

d) Show learner performance against class average.

e) Show learner performance against national average.

CD Version

The TARMII system was to be made available on a CD. It should be possible to install the system from a CD on a desktop, notebook or workstation to enable the private use of the tool by a teacher. The installer should be easy to use and should give the teacher step by step instructions. Other addition issues for the system developers were that:

a) The system should be compatible with the different types of computer models and software available in South Africa, especially ones used in schools. This was to enable

teachers in different schools using different types of computers to easily access and utilise the system.

b) Although the present emphasis is to have a system operating using English, the system should be set up to be able to operate in the other 10 official languages. This was to ensure the possible extension of the system to other languages in keeping with the multilingual composition of the South African population.

c) It should be user friendly to all teachers in South African schools. Teachers should find it easy operate the system with less difficulty. They should find the system to be easy to learn and operate regardless of their level of computer literacy. While being computer literate will be an advantage to learn to operate the system, teachers with complete or low levels of computer illiterate should be able to learn to use the system and acquire the necessary competence with ease.

d) A complete computer system was to be delivered to the HSRC with the necessary supporting documents (e.g. operating manuals, references etc.).

e) The HSRC would conduct field trials to ensure the applicability of the computer system in different types of schools in South Africa.

How the TARMII System is Supposed to Work

The computer system is designed as a tool in the hands of teachers. Thus Intermediate Phase teachers of English FAL and Mathematics should be able to use the system to do the following:

a) To generate tests from the assessment item database of the two learning areas (English FAL & Mathematics) for classroom applications.

b) Teacher will go into the system, select the learning area followed by the Learning Outcome(s), the Assessment Standard(s) and then the appropriate assessment items will be assembled into a test.

c) The test will then be printed and administered to the learners in the classroom. The learners' responses to the test items will then be entered in the computer for scoring and analyses.

d) The computer system should be able to analyse the scores and generate reports providing detailed information on learner strengths and weakness according to the four levels of performance given in the South African National Curriculum Statement (**N**ot Attained, Partly Attained, Attained and Outstanding[1]).

e) The computer system should be used to provide class profiles.

f) Scores obtained by learners should be stored to provide trends in learner performance.

g) Assist teacher in obtaining ideas for follow-up lesson plans or what teachers should do next.

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[1] The final version of the TARMII system (or TARMII 1.0) uses only two levels namely, *Achieved* and *Not Achieved*.

Chapter 2

General Methodology

The project consisted broadly of three main stages which are interlinked:

Stage 1: Consultative workshops and meetings with stakeholders;

Stage 2: Development of the database of English FAL and Mathematics assessment items;

Stage 3: Development of the computer software to run the assessment items database.

Each stage comprised sub-stages and process that required unique approaches for their implementation. These will be outlined in the following section on the development plan

The TARMII System Development Plan

The development of the TARMII system can be categorised into the following main stages:

a) Consultative workshops and meetings with stakeholders;

b) The process of obtaining an ICT service provider to develop a computer software

c) Development of (English and Mathematics) assessment items;

d) Conducting mini research studies to inform and support the process of TARMII development;

e) Development of computer software to run the database of assessment items.

Consultative Workshops and Meetings

Consultative meetings/workshops were held with various stakeholders from 2008 and continued throughout the various stages of the project. The purposes of these meetings and workshops were for the research team to obtain inputs from various stakeholders to inform the TARMII development process as well as to facilitate continued participation by different stakeholders. The stakeholders consulted included officials from the national and provincial offices of the Departments of Basic Education (DBE), districts and selected schools.

From the national DBE researchers obtained inputs regarding the selection of provinces of the preferred provinces to participate in the project and the development of computer system at various stages.

The four provinces of Gauteng, Mpumalanga, North West and Western Cape were originally earmarked for involvement in the project. However, the Western Cape was left out due to bureaucratic hurdles researchers were experiencing. The remaining three provinces were consulted and elected to participate in the study. Through consultations with officials in the three provinces, one district per province was identified for participation and to serve as a district level contact for the project. Thus the provincial DBE offices for Gauteng, Mpumalanga and North West were represented by District–D4–Tshwane South, Nkangala Region and Bojanala District respectively. Furthermore, one school was selected from each participating district to serve as a field trials school. The schools were selected in accordance with the following criteria:

- The schools had the three Intermediate Phase grades of interest to the study (i.e. Grades 4, 5 and 6);

- The schools offered the two learning areas/subject of interest to the project (i.e. English FAL and Mathematics); and

- The schools had a computer or computers accessible to teachers for their work.

The schools were Hillside Primary in Gauteng's District–D4–Tshwane South, Laer Skool Pansdrif in North West's Bojanala District (Brits APO) and Mhluzi Primary in Mpumalanga's Nkangala Region (Middleburg). Trials schools served the purpose of providing researchers the opportunity to obtain feedback from teachers regarding the development of various components of the computer system. All schools were contacted and informed about the project ahead of time. Only Intermediate Phase teachers of English FAL and Mathematics participated in the project.

Developing of Assessment Items

The process of developing assessment items started with the development of the assessment items frameworks. The frameworks were based on the National Curriculum Statement (NCS) for English (FAL) and Mathematics. They were developed in collaboration with education experts, district officials as well as practising teachers. The frameworks were mapped on the Learning Outcomes (LOs) and Assessment Standards (ASs) in each learning area. Only LOs and ASs amenable to pencil-and-paper testing were included in the frameworks. The frameworks:

- Describes the domains (content and skills) to be assessed by each item, in terms of the LOs and ASs in the NCS;
- Indicates the number and types (e.g. multiple choice questions, free responses, short answer questions, etc.) of items to assess each assessment standard; and

   o Indicate levels of difficulty for each item.

The process of mapping and developing assessment items in both English (FAL) and Mathematics was carried out with the assistance of experienced teachers of both learning areas. The teachers were contracted and trained in mapping the existing items in accordance with the respective frameworks or writing new ones to fill gaps in the items frameworks for Grades 4, 5 and 6. The aimed was to have enough test items to measure the ASs as comprehensively as possible. Where gaps were found as a result of inadequate number of test items, additional items were developed. In both learning areas the mapped and new items were subjected to review and moderation processes by English FAL and Mathematics experts outside the HSRC. This was to ensure that all items were in line with the LOs, ASs and the curriculum. As a result, a combination of ±3 000 assessment items for English FAL and Mathematics were developed across all three Intermediate Phase grades.

Each item was assigned an ID or item ID. An item ID is a label given to an assessment item in the database and carries with it information associated with that particular item. Item IDs were generated to embody the following information:

- Learning area or subject: The learning area or subject for which the item was developed represented by the first letter of the learning area or subject e.g. E for English or M for Mathematics.
- Grade: the grade for which the item was developed represented by a two digit number e.g. 04 for Grade 4 or 06 for Grade 6.
- Administration year: The year during which the item was administered to collect pilot data on it e.g. capital letter A for 2008 and B for 2009.

- Item number: any three digit number assigned to the item (e.g. 001) and may be accompanied by a letter of the alphabet (e.g. 001a).

For instance, item ID E04B054 implies that is an English item (E), for Grade 4 (04), which was administered during 2009 (B), and has an item number 054. The same notation was used for labelling Mathematics items.

Conduct of Supporting Research Studies

A number of mini research studies were conducted to inform and support the TARMII system development process. The studies were:

a) A study on teacher classroom assessment practices in South African schools;

b) The uses of computers in South African schools;

c) The pilot testing of English FAL and Mathematics assessment items;

d) A standard setting study involving English FAL and Mathematics assessment items

Teacher classroom assessment practices in South African schools

This study investigated classroom assessment practices by teachers of English FAL and Mathematics in both the Foundation Phase and the Intermediate Phase. The aims of the study were:

- To obtain information on teacher assessment beliefs, needs and practices

- To develop a strategy, informed by evidence, for implementing a computer based classroom assessment system in our schools

The key findings regarding teacher classroom assessment practices are:

- No evidence of useful comments in learner notebooks or teachers records

- Essentially for this group of South African teachers, classroom assessment is seen as a relatively formal process of recording marks for class work, or some other summative indicator of performance in the classroom.

- The broader meaning of classroom assessment seems not to have been adopted.

- There is small to no differences between "good" and "poor" schools with respect to their assessment practices.

Teachers' access and use of computers in South African schools

This study was conducted concurrently with the teacher classroom assessment study. The study investigated the teachers' use computers to support their assessment practices.

On the uses of computers it was found that 25% of the teachers indicated to have a high rate of computer usage, 33% to have "some computer use" whereas 40% had not used computers. Teachers who use computer do so mainly to writing reports, keeping records, developing class tests, lesson planning and classroom presentations. These are mostly teachers in quintiles three schools and above.

Assessment items pilot data collection

The study was conducted during 2008 and 2009 following the successful development and review of all English FAL and Mathematics assessment items for the three Intermediate Phase grades. In 2008 pilot data was collected from Grade 6 learners in ±240 selected schools in eight provinces. Again, in 2009 pilot testing was conducted with Grades 4, 5 and 6 learners in ±44 schools across all nine provinces. While the 2008 sample included a variety of schools, in 2009 these schools were reduce in number by excluding dysfunctional schools from the sample. This was to ensure that better and useful data is obtained.

The data collection process was preceded by the preparation of materials. It began with the preparation and compilation assessment items into booklets. A matrix sampling process was followed in organising assessment items for compilation into booklets. The items for each grade and learning area were arranged or put together into blocks (block design). Each block (of items) comprised between 10 and 15 items. The booklets were then put together by following a combination of blocks or a block design. A booklet was made up of two blocks of items and each block was repeated across two booklets. For example, if Booklet 1 for Mathematics consisted of block M01 and M02, then Booklet 2 was compiled by combining blocks M02 and M03 etc. The same process was followed for compiling the English FAL and Mathematics items booklets for Grades 4, 5 and 6. Once compiled, the booklets were ready for printing.

Printing specifications were obtained for the estimated number of schools and learners who were to participate in the pilot of assessment items. Printing and distribution of booklets to the provinces were combined. According to this strategy, printed booklets were taken to the provinces where they were received by a data collection company. From there the materials were distributed to fieldworkers who in turn used these to collect data from schools.

Data collection exercise was managed by the JET Education Services as per agreement[2]. JET conducted quality assurance of the data collection process in schools and ensured that completed booklets were send to the HSRC for coding and scoring[3], data entry, cleaning and analysis. The data obtained for each assessment item was added into the items database as part the item information.

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[2] At the time of development of the TARMII system, the HSRC and JET Education Services were working jointly as a consortium and had signed a memorandum of understanding to facilitate the collaboration.
[3] The HSRC had contracted local Intermediate Phase teachers of English FAL and Mathematics to code and score learner responses to the items.

Standard setting

All English FAL and Mathematics assessment items developed and piloted for inclusion in the

database were subject to a standard setting exercise. The purpose of the standard setting was to

obtain the standard setting ratings of values for each item in the database. These values or ratings

are to be used by the TARMII system in some of the reports to enable teachers to make

judgements regarding learners' proficiency on the content tested.

Local teachers of English FAL and Mathematics at Intermediate Phase were contracted and

trained on the Angoff method of standard setting. Two levels of achievement, *Achieved* and *Not*

Achieved, were used for this purpose and as a result only one cut-score was generated for each

item. The standard setting values for each assessment item generated through this process inputted

into the TARMII system database as additional item information to be used for generating reports

on learner and class performance over time.

Development of the Computer Software to Run the Items Database

The process of developing the computer software to run the database of assessment items

comprised the following sub-stages and processes:

a) Developing specifications for the ICT service(s) required for building the computer

   software

b) Process of obtaining a software developer

c) Development of TARMII prototype

d) Development of TARMII functions

Specifications for the computer software

The computer software specifications were developed in preparation for a call for tenders to obtain an ICT service provider to develop the system. They were based on the envisaged system as explained in above.

Process of obtaining a software developer

A tendering process was followed to obtain a competent ICT service provider to build the computer software. When this did not yield any success, permission was granted for the headhunting of the service provider.

Development of the Prototype

The ICT service provider was contracted to first develop a prototype of the system. It consisted of mainly Grade 6 English FAL and Mathematics assessment items. It did not have functioning features to demonstrate to teachers. During its development teachers were consulted to give input on their preferred features or components for the system in line with the challenges they were facing in the classroom. The question was what features would they prefer to have in the system to make their work in the classroom easier, manageable and effective?
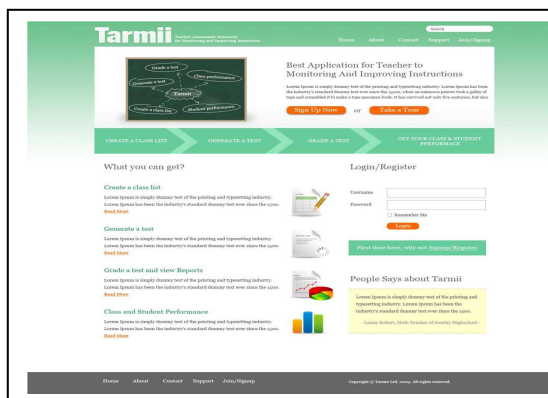
Figure 2
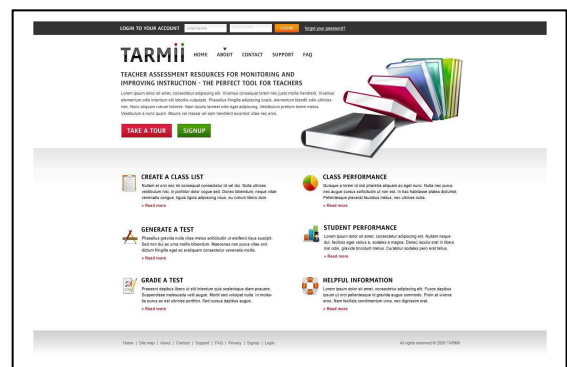
Figure 3

Teachers also participated in the selection of the background graphics for the system between Figures 2 and 3. Most teachers chose Figure 2 which became the interface of TARMII.

Development of TARMII functions

The development of the main four functions of TARMII and their sub-components took off from the prototype. Information on the various modules that were developed is provided in Figure 1. Every function and its sub-components the ICT service provider and experts had developed were subjected to prior testing or what is called *Acceptance Test* in the computer language before they could be put into the system. The purpose of running Acceptance Tests was to ensure or confirm that the system delivered the functionality that the HSRC requested for teachers as outlined in the TARMII (computer software) development plan or system specifications. The development of the system also followed an iterative process wherein the functions developed would continually be tested in HSRC offices and in schools with the involvement of teachers such during the field trails. Any identified or discovered structural or functionality faults would be communicated to the system developers for correction and further testing until the functions operated as requested or specified.

Information the HSRC provided to System Developers

The HSRC was required to provide system developers information crucial to the development and the ultimate functioning of the system. This information was incorporated into the TARMII system to support and augment its functions. Information provided included:

Current assessment practices in South Africa schools

A mini-study on current teacher classroom assessment practices was conducted with the view of obtaining information on teacher assessment beliefs, needs and practices. The findings from this study were used to inform the content and form of learner performance reports to be generated by teacher-users of the TARMII system.

Assessment item database

The English-FAL and Mathematics assessment items for Grade 4, 5 and 6 were uploaded into the system on the advice of system developers. Each assessment item was uploaded with its *item ID*. Linked to the each item ID is information about each item that is stored in the database e.g. item-type (open-ended or multiple-choice), item difficulty level (easy, moderate, difficult), standard setting value for the item, the correct answer etc.

Standard setting value for each item

Standard setting values were obtained through a standard setting process involving local teachers of English FAL and Mathematics in the Intermediate Phase. These values were included in the item database to enhance the classroom and learner progress reporting functions of the system.

Feedback from teachers

The iterative approach followed in developing the TARMII system required researchers to interact with teachers to obtain feedback on the various functions and the functionality of the system. Feedback was obtained from the start with the development of the system prototype, at different stages of developing a complete functional version of the system and during the field trials. It was communicated to the system developers for their consideration in improving the system for the better.

The TARMII System

The prototype was developed into a fully TARMII system with the following four functional components: **C**reating **C**lass **L**ists, **G**enerate **T**ests, **E**nter **M**arks and **G**enerate **R**eports. Although each component has a specific function, there is a connection between them as information generated and used in one component is utilised in the next. What follows is an explanation of TARMII components and their functions:

Create Class Lists

This component of TARMII enables a teacher to create class lists of learners for the grades (e.g. Grade 4, 5 or 6) and learning areas (e.g. English FAL or Mathematics) that s/he is teaching. These are lists of learners in the classes that teacher is teaching. The facility for creating class lists enables the teacher to include limited biographical information of each learner such as the learners' gender and home language. To allow for effective management of class lists, this feature of the TARMII system permits the teacher to add new names or to remove unwanted names from existing class lists. Existing class lists can also be copied (duplicated), removed and renamed. Created class lists are linked to the tests teacher generates for his or her class/learners. Class lists can also be imported from other spread sheets into TARMII or exported.

Generate Tests

This component enables a teacher to generate tests using TARMII for his or her class or classes. The test generation process the teacher follows includes:

1. Inputting the *Name of Test;*

2. Selecting the grade for which the test is to be generated (e.g. Grade 4, 5 or 6);

3.	Selecting the learning area (e.g. English FAL or Mathematics);

4.	Selecting the Learning Outcome or Learning Outcomes from the learning area chosen; and

5.	Choosing the ASs from which assessment items will be drawn from the system and compiled into a test.

After the selection of ASs the system randomly selects assessment items from the shell or database and compiles them into a test. Each test generated by the system comes with a memorandum which indicates correct answers and/or scoring criteria for the various items in the test. Both the test and its memorandum are presented on a computer screen as draft PDF documents. This affords the teacher an opportunity to review the test and its memorandum before deciding either to finalise them or to generate new ones. In a case where the teacher is unhappy with the contents of the test, s/he can create a new test. However, if the teacher is happy with the test, s/he can proceed to finalise it. This will result in a final PDF version of the tests and its memorandum appearing on the computer screen ready to be downloaded, printed or saved.

TARMII does allow a teacher to select multiple Learning Outcomes (i.e. more that one Learning outcome). However, only a maximum of three assessment standards can be selected for the test generation purposes. For whatever test criteria inputted, the system is programmed to randomly select a maximum of 20 assessment items into a test. This is in-build feature of the system to allow for the generation of a test that a teacher can print and administer successfully to a class within a 30 or 35 minutes period. Each generated test comprises a mixture of constructed-response (open-ended) and selected-response (multiple-choice) items.

When a test is finalised or approved test, the teacher can print it, produce enough copies for the number of learners in class and administer the test. Each final test comes with few practice examples which the teacher has to do with the learners before they taking take the test. When the administration of the test is complete, the teacher will first manually score constructed-response (open-ended) items and prepare for the entry of all learners' responses onto the scoring grid generated by the system. Learners' responses to multiple choice questions can be entered directly onto the grid without marking.

Enter Marks

This component of TARMII enables a display of a marking grid on the computer for each learner who took a test. The marking grid consists of answer options for multiple-choice questions and a range of marks, from the minimum to the maximum, which a learner can obtain when answering an open-ended question in the test. The process of marking a test entails the teacher first marking the learners' responses to open-ended questions on the test sheets only. Then the teacher enters onto the marking grid the learners' scores on open-ended items and their selected options to the multiple-choice items. This process is carried out for each learner by moving the curser from one question to another on a marking grid displayed on the computer screen, clicking or keying in the score the learner obtained for an open-ended question or the choice the learner made on a multiple-choice question. The marking grid allows for the teacher to indicate absentee learners who did not take the test. After enter the learners' marks and responses a teacher can go on to generate reports on the performance of the whole class, a group of learners, and individual learners.

Generate Reports

This component of the TARMII system allows the teacher to select reports that s/he would like to generate to determine what learners know and can do based on the work tested. The reports also provide the teacher with information from which ideas for possible intervention strategies can be hatched. The following seven reports can be generated from the system:

a) *Class Performance per Assessment Standard:* The report shows, on a pie chart, the performance of learners in the entire class on each assessment standard tested.

b) *Learner Understanding:* The report shows tabulated names of learners in the class who have achieved proficiency and those who have not achieved proficiency of the assessment standards tested.

c) *Strengths and Weaknesses:* The report lists in a table two questions that most learners got right and two questions that they got wrong. Only the question numbers in the test are given.

d) *Class Performance by Individual Question:* The report indicates, for each learner, questions in the test that they answered correctly and those that they got wrong.

e) *Class Progress:* Shows class performance over time.

f) *Learner Progress:* The report shows the performance of each individual learner over time against the performance of the whole class and the minimum achievement level.

g) *Marks Sheet:* Shows marks obtained by each learner on each administered test.

Of the seven reports mentioned above, only reports a) to d) uses two levels of performance to indicating the learners' competence on the skills and knowledge tested. The two levels are *Achieved* and *Not Achieved* and given as keys in these reports. The report on *Class Progress* shows the performance of the entire class over time against the minimum achievement level for the test taken. The *Learner Progress* report shows the performance of individual learners over time against the performance level of the whole class and the minimum achievement level for the test taken. The *Marks Sheet* gets generated by the system for each administered test that is scored entered.

The process of developing TARMII requires consultation with teachers who are the targeted users of the system. Periodical input from teachers during the various stages or phases of development is vital in ensuring that the system is tailored towards their classroom assessment needs. As a result TARMII field trials were conducted in schools with the view obtaining feedback from teachers on the functionality of the various features of this system.

Chapter 3

The TARMII System Field Trials

To ensure that the TARMII system will be effectively applied and address the specific needs of teachers, the system field trials were conducted with aim of obtaining more information on areas of the functionality of the system that needed further improvement. The field trials were conducted to achieve the following objectives:

a) To test the functionality of the system in a schooling context;

b) To determine the minimum level of teachers' computer literacy to work with TARMII;

c) To determine teachers' personal views about the system;

d) To identify areas in need of improvement;

e) To determine the field trials methods of training and support that will be required in the roll out of TARMII to schools;

Study Design

Field trials were designed as part of the TARMII system development plan. The three schools that took part in the field trials were selected by their provinces earlier on at the start of the project. They were also used as a spring board to bounce of ideas and to test functionality of the system as part of development.

Participants in the TARMII System Field Trials

The schools that participated in the field trails were Hillside Primary School, Laer Skool Pansdrif and Mhluzi Primary School. The field trials were conducted in these three schools to ensure that the system being developed was addressing the specific classroom (assessment) needs of teachers. As a result, the learning area or subject teachers and the Heads of Department (HODs) for Mathematics and English FAL in the Intermediate Phase (i.e. Grades 4, 5 and 6) in each school, were identified for participation in the study. The school principals as part of school management were earmarked to facilitated/coordinate teachers participation. Table 2 below shows the number of teachers per school who participated in the field trials.

Table 2: Number of Teacher Participants in the Field trial

| School | Number of Teachers per Grade | | | | | | | | Totals |
| | Grade 4 | | Grade 5 | | Grade 6 | | Grade 7[4] | | |
	English	Maths	English	Maths	English	Maths	English	Maths	
Hillside PS	0	1	0	1	0	1	0	1*	3
LS Pansdrif	1	1	1	1	1	1	0	0	6
Mhluzi PS	1	1	1	1	2	1	0	1	8
Totals	2	3	2	3	3	3	0	1	17

*Same teacher teaches Mathematics in Grade 5.

A total of 17 teachers (7 English FAL and 10 Mathematics teachers) across the three Intermediate Phase grades participated in the field trials. The distribution of teachers by school indicates that 3

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[4]Although the focus of TARMII development is Grades 4, 5 and 6, most primary schools end with Grade 7 which is the beginning of Senior Phase. This combination of the two phases is sometimes referred to as InterSen.

were from Hillside Primary School, 6 from Laer Skool Pansdrif and 8 from Mhluzi Primary School.

While all teachers in Hillside Primary School and Laer Skool Pansdrif participated in the field trials from the start to the finish, only 6 teachers in Mhluzi Primary School attended all field trials activities till the end. The two teachers discontinued their attendance of the TARMII field trials for different reasons which will be explained later.

Preparations for Site Visits

All the participating schools were notified just before the April 2010 school holidays about planned visits for the purpose of testing the fully functional TARMII with their teachers. The news of pending visits was well received by schools as a result of previous communications and contacts between the schools and HSRC researchers. Furthermore, researchers enquired about the existence of computers in schools which teachers would use to test out TARMII. All three schools indicated that they had computers which teachers could access and use during the TARMII field test. Further preparatory communication with schools revealed the following:

o Field trials of the system in the other two schools (Mhluzi PS and LS Pansdrif) were to be conducted for both English FAL and Mathematics.

o Each school was asked to assign one teacher to work or liaise directly with the research team on site. This was done to facilitate easy access to teachers and computers by members of the research team when in schools.

- Teachers were asked to have ready their class lists and the (English FAL or Mathematics) Assessment Standards they were working on in class at the time for doing practical exercises. This was done as one way of trying to facilitate the integration of TARMII into what teachers were busy with in their classrooms at the time.

- Site visits were planned to be conducted during the month of May 2010 before the June school break.

Data Collection

Following the schedule given in Table 1, researchers collected data through a series of workshops. Three site visits per school were originally planned for the month of May 2010. However, there were deviations in the site visits schedule due to challenges encountered by researchers in some of the schools[5].

Table 1: Schedule for Field trial Visits

Field trials Schools	Field trials Site Visits				
	Preliminary Visit Assessing the state of computers	Visit 1 Introductory Training & Practice	Visit 2 Monitoring & Support	Visit 3 Monitoring & Support	Visit 4 Monitoring & Support
Hillside PS	12 May 2010	12 May 2010	18 May 2010	27 May 2010	-
LS Pansdrif	11 May 2010	12 May 2010	19 May 2010	26 May 2010	-
Mhluzi PS		11 May 2010	18 May 2010	25 May 2010	08 June 2010

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[5] One great challenge was that the second school term had been shortened by the school authorities to accommodate the 2010 FIFA Soccer World Cup competition scheduled to take place from 11 June to 11 July 2010. This coupled with the writing of half year examinations by the schools meant that there was no much time on the part of the research team to manoeuvre.

Two teams consisting of at least two researchers each visited the schools during May-June 2010 to conduct the field trial. The field trial was conducted through a three to four series of workshops as indicated in Table 1. The workshops were divided into two; *Introductory Training Workshops* and *Monitoring and Support Workshops*.

Introductory Training Workshops

Introductory workshops were conducted on the first visit while monitoring and support were done during subsequent visits. Information on TARMII usage in school by teachers was collected during these activities through observation and detailed note taking. Teachers were also asked to keep records of their day-to-day interactions with TARMII in the form of dairies. They recorded all their experiences regarding what they had been able to do with TARMII. This would include positive and negative feedback as researchers were keen to know what works and what problems still persisted in the system.

The first training workshop on Day 1 in each school took the form of a presentation of the entire TARMII system that was installed in the computers[6]. This was followed by a hands-on exercise which involved teachers having to use different functions of the system such as creating (and managing) their class lists, generating their own tests, marking tests / entering scores and generating their own reports. Activities carried out by members of the HSRC research team on Day 1 are as follows.

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[6] The team had received an offline version of TARMII installer from the software developers for running the field tests in schools. This was a version used with teacher in the three field trials schools.

a) *Installing TARMII onto Computers*: This included checking out the computers allocated by the schools for their functionality, then loading/installing the TARMII, Adobe Reader and Mozilla FireFox onto them. Both Adobe Reader and Mozilla FireFox are necessary for effective running of TARMII.

b) *Demonstration of TARMII*: This entails giving a demonstration of the entire system to teachers starting with the creation of class lists, generation of tests, marking of tests and generation of reports. During the demonstrations researcher explained how each of the components functioned and what teachers could do with it.

c) *Practical Exercises*: Teachers were asked to sit behind a computer and start working on all components of the system. The aim of this activity was to give them the experience and feel of what they could do with TARMII. Teacher typed their own "real" class lists and generated tests based on the work they had covered or were still busy with in class.

d) *Recording of Daily Activities on TARMII:* Teachers were asked to record any thing they did using TARMII. This included both successes and challenges or problems encountered. This information was necessary to get to know where further improvements of the system were needed regarding the software and the assessment items in the system.

Although attempts were made to keep the format of the training consistent across schools, our encounter with different school–based conditions and challenges necessitated a need to customise training sessions to the prevailing school conditions. This was also necessitated by the fact that all three school differed in one way or another. For instance, some of the differences across schools included teachers' access to computers in schools; the functional state of the computer hardware; and computer literacy levels of teachers.

Monitoring and Support Workshops

Monitoring and support workshops were tailored to conditions prevailing at each site. They were conducted based on the success of the introductory workshops. Consequently, Day 2 was mainly used to consolidate teachers' skills of using TARMII by dealing with challenges ranging from teacher's level of competence in using a computer to the usage of TARMII.

Data Collection Techniques

The data was collected using the following techniques: unstructured observations, informal interviews and teacher diaries.

Unstructured Observations

Observations were unstructured; the researchers recorded everything as it happened. The field notes were then analysed on the basis of the following themes:

- o Background [more general issues]
- o Format of the workshop
- o Persons who attended the workshop
- o How training was conducted [theory and practice]
- o State and status equipment used during the workshops
- o Comments on the success or lack of success of the workshop and reasons for these
- o Implications for week 2 visits

Informal Conversational Interviews

Informal conversational interviews were the integral part of the observations during the workshops. The interviews were built on and emerged from observations to match to individual teachers and their school conditions.

Teacher Diaries

Teacher diaries were used to get the necessary background of the situation and insights into dynamics of everyday functioning of TARMII. Teachers in each school were asked to document all their engagements with TARMII. This included all the activities, challenges and problems they encountered. The use of teacher diaries was also meant to eliminate the researchers' biases, as we could not alter what is being written and our presence could not affect the data.

Chapter 4

Findings from the Field Trials

The results section presents a synthesis of interpretation on the data collected from the site visits. Owing to the unique nature of each school, each is reported as a case study. The major themes for reporting the results are; description of school ICT infrastructure, teachers' level of computer literacy, teachers' access to ICT facilities and feedback from teachers.

Case 1: Mhluzi Primary School

School Background Information

Mhluzi Primary School is found in Mhluzi township of Middleburg in Mpumalanga province. It is a quintile five school that falls under the Nkangala district. All teachers and learners in the school are African. At the time of conducting the field trials there were ±700 learners enrolled at the school with class sizes ranged from 40 to 60 learners. The Intersen[7] teachers consisted four English FAL and four Mathematics teachers.

ICT Infrastructure at School

Mhluzi PS was the first school to be visited by the HSRC research team. On arrival on the first day we found six PCs set up in the staffroom by the school's contact teacher who was the vice-principal. The school did not have a secure venue to house their computers for teachers to use. It had just lost a number of computers in a burglary such that the few remaining ones were

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[7] The word Intersen is used to denote a combination of Intermediate Phase and Senior Phase at primary school level (i.e. grades 4 to 7).

distributed among teachers to keep in their homes as their security on school premises was not guaranteed. Two computers out of six were found suitable for use with TARMII. The others showed numerous defects on operation such as:

- The installation of TARMII was very slow and had to be aborted. The RAM on these computers was 98mb. To operate TARMII effectively a minimum of 1 Gigabyte of RAM is required.

- None of the four computers had Mozilla Firefox installed.

- Only two computers had Adobe Reader 7 installed.

- The USB port on one computer was low powered; as a result it could not identify the mass storage device.

In an attempt to resolve these challenges the school principal and the school's ICT assistant[8] were advised to remove RAM from other computers and then to insert them into the identified working ones. Also, the school principal promised to purchase four 1 gig rams for the PCs that will be used by the teachers. These promises were never fulfilled because of lack of funds. Consequently only two relatively new computers were used for training. These computers already had Adobe Reader and only TARMII and Mozilla FireFox were installed onto them. In addition, HSRC researchers made their three laptops available to teachers for training purposes. The two computers at the schools were housed in the school secretary's office in the administration block and teachers could access them from there.

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[8] The ICT assistant was an unemployed youth with knowledge of computers. He was rendered his service to the school, solving their computer problems on a voluntary basis.

Some of the challenges the team experienced regarding the working of the two computers were:

o The two computers in the school secretary's office started to give trouble; this could have been as a result of being wheeled or pushed from the office of the secretary to the staffroom. Their memory cards could have moved out of place resulting in the PCs being slower. This problem was finally rectified after these computers were rebooted on numerous occasions. Teachers then continue use them during the training.

o After the installation of TARMII, it was noticed that the system continually displayed an "offline status report". This error message created a false impression to teachers that the installed system was dependent on an internet link. This problem was immediately communicated to the system developers who attended to it.

o All PDF tests generated had to be saved and printed in the school secretary' office as there was neither a printer in the staffroom nor printer link from the staffroom to the office. Also, shortage of printing paper caused a problem.

o The school principal and one teacher made their laptops available for use. However, the challenge with the principal's laptop was that it was not always available for teachers to use as he regularly took it to his outside-school meetings.

Computer Literacy Skills of Teachers

The introductory TARMII training session in Mhluzi Primary was attended by eight teachers with varying levels of computer literacy. Two teachers displayed very high levels of computer literacy and had indicated to have attended a computer course before. Of the remaining six, two could be said to be moderately competent in using computers whereas the remaining four had hardly ever

used a computer before. These computer illiterate teachers struggled to learn to operate a computer. As a result their progress in learning to use the TARMII system was delayed.

During the training teachers who were totally computer illiterate and those with moderate computer literacy opted to huddle around a computer. This was regardless of the availability of one or two laptops for individual teachers to work from. Instead two or three of these teachers would sit around a computer taking turns to practice, observing and correcting each other (i.e. practising peer-tutoring and peer-support). These teachers openly stated that it was their first time to work on a computer. They constantly said that researchers should have run a computer training course first before bringing in TARMII. They also indicated that they would be very interested in attending a computer training course if arranged by the department.

While teachers with medium to high levels of computer literacy generally found it easy to use the TARMII system, their counterparts with a lack or low levels of computer literacy took more time to acquaint themselves with the TARMII system. As the trials continued, two computer illiterate elderly teachers dropped out. One teacher took ill and was away from school for an extended number of days. The other teacher simply lacked the motivation to continue participating in the TARMII field trials. This was explicated by her utterances in response to her younger colleague's enquiry about her reasons for no longer showing interest in the monitoring and support workshops. To this the elderly lady teacher simply replied: "You go attend the computer course and I will give you my work so that you can type for me". All what these indicate is that computer literate teachers are more likely to learn to use the TARMII system more quickly than their computer illiterate counterparts. However, computer illiterate teachers can learn and acquire

equivalent TARMII usage competence with more motivation and practice. The challenge for

computer illiterate teachers would be to learn the computer basics while learning to use TARMII.

Access to ICT Facilities at School

The teachers were unhappy with the condition of the computers made available to them for the

trials because they were very slow and on many occasions the mouse and keyboard did not work.

One grade 4 Mathematics teacher mentioned that the frequent burglaries at the school created a

huge problem, as many of them had no computers of their own and relied on the school's

computer centre. For this teacher having slow computers would have been better than having no

computers at all as they could have used them to acquire and improve on their computer literacy.

Teachers expressed a unanimous desire for the school to be supplied with more up to date

computers although the fear for computer theft remained a reality. However the two well

functioning computers located in the office of the school's secretary or administrator were

accessible to the teacher to continue to sharpen their ability on TARMII usage. The onus was on

the teachers to use them.

Feedback from Teachers

Teachers felt that in order to effectively use TARMII, it would be necessary to spend more time

on the system practicing on how to enter marks and analyse the reports. A grade 4 teacher

indicated that to solve this problem, it would be important that the principal be made aware of the

need for teachers to have administration time to give teachers more time to sit and work on

TARMII. Teachers also spoke about getting school administration workers trained in TARMII so

that they could help in entering marks and give teachers time to read and interpret reports.

After the training and discussion sessions, teachers at this school were very upbeat about TARMII, they felt that the system definitely had a place in the teacher's tool box. However, the issue of time, resources and level of computer literacy would still pose challenges to the success of the system in the hands of teachers. According to the teachers, TARMII can help them in improving on their assessment practices. The generated reports would help teachers to identify gaps in learners understanding, in analysing large classes much more easily, since the reports provide analysis of individual learner performance. The overall impression from the school was that TARMII will be useful to teachers, if the issue of lack of resources is addressed.

Another crucial factor that was identified during the informal discussions is teachers understanding of tests. This group of teachers' thinking of tests are still embedded in the old traditional testing. When been asked how often they give tests, most teachers said they give tests for formal assessment, once in a term.

Case 2: Laer Skool Pansdrif

School Background Information
Laer Skool Pansdrif is a former model C farm school located in the farming areas just outside the Brits. It is a quintile 3 school falling under the Bojanala District of the North West province. During the conduct of the study the teaching staff in this school, though multiracial, it consisted of whites in the majority. The learner population of ± 390 was entirely African. The class sizes in the school ranged from 25 to 35 learners. At the time of the TARMII system field trials there were three teachers of English FAL and three of Mathematic in the Intermediate Phase. The medium of instruction was English FAL.

ICT Infrastructure at School

During its first visit to Laer Skool Pansdrif the team was shown the schools computer centre for learners. This centre was under the control and management of a computer teacher who had links with Future Kids. The computer centre had 22 computer monitors which were divided into three rows. Each row was linked to a main server system which had a 1gig ram. In addition, the centre had an Inkjet printer that was linked to the computer teacher's PC only[9]. The challenges experienced in this school were:

- The installation of TARMII on the three servers went smoothly until we tried to access the system from the learners' computer terminals. The installation of Firefox worked and the team was able to access Firefox from all computer terminals. TARMII on the other hand proved to be a problem as it could not be accessed on the monitors linked to the servers. The research team reported the problem to the TARMII system developers. Developers indicated that installing the system on such a network was not a simple process as a network specialist would be needed to change certain settings on the server system.

- The server connected to third set of computers did not have Adobe Reader on it and a request was made to the HOD to get the computer centre teacher to install Adobe on the PCs.

- The computer centre teacher's computer which was linked to the Inkjet printer was also used. However, the HSRC team was informed by the teacher that she would not be willing to print many tests for teachers on the Inkjet as it was expensive and not meant for use by

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[9] The InkJet printer was later replaced with a laser printer.

teachers. However, the school principal informed the team that teachers could use the learners' computer lab if need be[10].

- As observed in Mhluzi PS, after the installation of the system, we tended to get an "offline" error message on numerous occasions. Teachers who had not worked on the system could misinterpret this as a web based program that required an internet link.

- It was also noticed that the administration staff at this school controlled all computer facilities in the administration block. Teachers would hand over to the administration staff their notes or tests for typing and photocopying, and only to collect them when they were ready. Thus teachers in this school did not have the opportunity to actually sit in front of the computer and work.

For training purposes, TARMII was installed onto the three servers together with Mozilla Firefox and Adobe Reader. HSRC team members' laptops were also made available to teachers during training.

Computer Literacy Skills of Teachers

Unlike in the Mhluzi Primary School teachers who displayed different levels of computer literacy skills, the Laer Skool Pansdrif teachers in all three grades (Grades 4, 5 & 6) were highly computer literate with the exception of one male teacher whose competency was low. Nevertheless, the training session at the school went on fairly well because teachers were acquainted with using computers.

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[10] The school principal informed the team that in the past the school used to have a computer centre for teachers. But it was sacrificed and converted to a classroom due shortage of space to accommodate the learners.

Access to ICT Facilities at School

The teachers felt that the school' ICT setup was fairly adequate. The administration office had 3 PC's with a networked big printer, the learners' computer centre comprised of 25 networked PCs with a networked laser printer. However, the challenge for teachers to access these facilities remained real. On the one hand, the learners' computer centre was designed for use by learners and the computer teacher managed it as such. Although she was able to tolerate teachers using the learners' computers to do TARMII related work, she kept a distance from anything involving TARMII. She was however always wary of possible harm that may occur to the computers through actions such as the transfer of computer viruses from the team's memory sticks to her computers and the possible printing overload on her printer. She communicated all these issues to a member within the HSRC team. On the other hand, computers in the administration block were mainly earmarked for use by the administration staff to support teachers. This is regardless of the school principal assurance to our team that teachers had open access to administrators' computers. She further gave permission for TARMII to be installed on administrators' computers. However, teachers indicated that their work at the school did not give them the opportunity to sit and work on computers.

The school's big photocopying machine was used for any printing work the teachers requested and was serving the school very well. One teacher indicated that as long as the request for making copies gets to the office on time, the work (e.g. tests and worksheets) is normally given back to the teachers timeously. The Mathematics HOD at the school indicated that at times paper and ink became a big issue. This issue became a serious problem if many tests were generated over and above the normal worksheets that were needed on a daily basis.

Feedback from Teachers

Teachers felt that in order to effectively use TARMII, it would be necessary to spend time on the system, practicing on how to enter marks into the system and analyse the reports. The Mathematics HOD indicated that since their school was a farm school with few teachers, "a free period is like gold", and that it was virtually impossible to allocate additional free periods to a teacher. Sports and extra-curricular activities play an important part of the school's culture and that on any given day, a number of teachers were busy with sporting activities. A Grade 5 teacher indicated that the generation of tests would be no problem, however to capture names of learners and enter marks would demand extra time which could dissuade teachers from using TARMII.

Case 3: Hillside Primary School

School Background Information

Hillside Primary School is a former House of Delegates school found in the suburb of Laudium to the west of the city of Pretoria. It is a quintile three school that falls under District-D4-Tshwane South in the Gauteng Province. At the time of the study the teaching staff at the school was predominantly Indian and the learner population racially mixed with Africans in the majority. The school had approximately 930 learners with class sizes ranging from 35 to 40 learners. There were three teachers of English Home Language (HL) and three of Mathematics during field trials. Since the medium of instruction was English HL and not English FAL, the TARMII field trials were conducted for Mathematics teachers only concentrating on the Mathematics component of the system. Although the school principal at Hillside Primary School indicated that his school offered English HL in accordance with the school's language policy. However, due to the fact that most

learners who were admitted at the school found learning in English HL difficult, the school has decided to teach this learning area or subject at First Additional Language (FAL) level. He however invited the HSRC research team to look into the possibility of including English in future engagements with the school on the development of TARMII.[11]

ICT Infrastructure at School

The HSRC teams' experiences in Mhluzi Primary School and Laer Skool Pansdrif necessitated that the state of computers in Hillside Primary School be checked before the first training (or introductory) workshop was conducted. This decision gave researchers the opportunity to install TARMII and other programmes onto school computers ahead of the training workshop and to observe how they functioned. Furthermore, it ensured that more time was devoted to training teachers.

The school principal allowed the team to use the four computers (PCs) in the staffroom to conduct training. These were the computers teachers used to complete their administration work such as tests, marks and reports. The following challenges were experienced in Hillside Primary School:

- On the day of the installation it was realised that the four computers allocated for training were all running on 248mb of RAM. This was quite low considering that a minimum of 1gig of RAM is needed to run TARMII properly.

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[11] Both the Mathematics and English teachers at the school, including their HODs, had always attended the TARMII system demonstrations leading to the field trials and they constantly gave feedback on the development and functionality of the system. For instance, during one of the TARMII demonstrations, a Grade 4 English teacher at the school remarked that the short time it took to generate a test was a real plus for her as she could spend the spare time now interacting with learners.

- Although the Gauteng Online Centre (GOC) computers in the school were slightly better, our team was never allowed to use them. Instead the school principal advised us to first seek permission from Gauteng Department of Education (GDE) before we could use the GOC computers.
- Alternatively, the team was allowed to use the deputy principal's PC that contained a 1gig RAM. The deputy principal was a Mathematics teacher and was more than willing to make her computer available for installation of TARMII, Firefox and Adobe Reader. However, the deputy's computer was in her office and this meant that teachers could not have access to the computer when they needed to use it.
- Furthermore, the team requested permission to install TARMII on the secretary's computer. This was turned down by the school principal who indicated that since teachers had four computers in the staffroom, they were not permitted to use the secretary's moreover it contains confidential information.

Given the above-mentioned challenges, the HSRC team conducted training in the school library using three of our laptops. We could not train teachers using the deputy principal's office computer.

Computer Literacy Skills of Teachers

Of the three teachers who attended training, only one seemed to have difficulties in using a computer. This one teacher was experiencing challenges in using the mouse pad on the laptop and did not understand basic window's applications. However, with much individualised training this particular teacher managed to use TARMII. After interacting with the TARMII system the English HOD at the school commented: "…that [the system] was designed in such a way that

even a teacher with limited computer knowledge would be able to function effectively" simply because of the way the system was designed".

Given the situation at Hillside PS, the team decided to install TARMII onto the teachers' personal laptops so as to ensure the use of the system by teachers and to obtain feedback from them during the second semester.

Access to ICT Facilities at School

The school principal made it very clear that the secretary's computer was totally out of bounds for teachers. He however agreed to teachers using the deputy principal's computer. Teachers felt that the school needed to look into upgrading their computers as they were expected to do their own typing of tests, examinations and letters. According to them, this forced them to become computer literate. In the same way, for them to work on TARMII, they definitely would need better computers.

In addition, a Grade 4 Mathematics teacher indicated that although she had permission to work in the deputy principal's office, it was not convenient for her as she would have to go in during her free periods which could clash with the deputy's work schedule.

There was a single printer networked to the four teachers' computers in the staffroom. However, as indicated by the Mathematics HOD, at times there was a queue of documents waiting to be printed for teachers. The printer served teachers in Grades 1 to 7. As a result teachers were concerned that if the computers with TARMII were also connected to the printer, it would not handle the increase in demand for printing.

The school has a duplicating machine, and as long as there was sufficient paper, they could get the secretary to make the necessary copies. The deputy principal pointed out that at times paper and ink were saved for examinations purposes and the generation of TARMII tests could result in a shortage of paper and ink during the examination period. Also, there was a feeling among teachers that if a lot copies were made for English and Mathematics it would disadvantage other learning areas not yet included in the TARMII system.

Feedback from Teachers

A Grade 6 Mathematics teacher indicated that she was teaching across different grades and that entering marks into the TARMII system for so many classes would negatively affect on her work. This process would seriously affect her planning. Some teachers also stated that if they were to use the system then the principal would have to find ways to give teachers more free time to complete such work.

The deputy principal indicated that she was very impressed with how easy it was to actually use TARMII. She was referring to the user friendliness of the system. She indicated that the learner performance reports generated by the system would be an invaluable source of information to her. By using information from the reports she would be able to understand what is happening in her class or with individual learner. The Mathematics HOD felt that TARMII should be opened up to other learning areas in the future.

Minimum Requirements and Conditions for TARMII to Function Effectively

For teachers in schools to access and utilise the computerised version of the TARMII system, they should have to a computer. Such a computer should have TARMII installed. Evidence from the

field trials indicates that teachers who are computer literate tend to learn to use the system faster than their colleagues with limited or no computer literacy. However any teacher with limited computer knowledge can still be able to learn to use the TARMII system competently albeit with more practice.

In order for the TARMII system to be used successfully in schools, it is important that the computer(s) identified to house the system and to be used by teachers should meet the following minimum requirements needed for installing and using this system successfully:

- o Mozilla Firefox web browser [TARMII]
- o Adobe Reader Ver. 9
- o CD/DVD drive
- o A minimum of 1gig RAM
- o Either Windows XP, Windows Vista or Windows 7
- o A hard drive with a minimum 80 gig capacity
- o A printer

The TARMII system is available on CD which can be installed into a computer. Where computers are connected to a server, the school should enlist help from an IT technician to assist with customising the system to the school's network.

Key Challenges for Effective Implementation of the TARMII System

The three primary schools used to run the TARMII system field trials differed in their backgrounds. Also, the manner in which the field trails were implemented was customised to the

each school. However, from the lessons learnt during the field trials, key challenges and issues for future effective implementation of the TARMII system across different schools, were identified. These are explained below.

Teachers Computer Literacy Skills

The varying levels of computer literacy skills possessed by teachers stood as a challenge to their effective engagement with the system. Evidence from the field trails points to the fact that teachers who were computer literate found it easier and faster to learn to use TARMII than their less computer literate colleagues. However, it has also been demonstrated that teachers with no or low computer literacy can learner to use the system with more practice and support.

School ICT Infrastructure and Support Materials

The availability of functional computers, printers, paper and ink for printing, in schools will promote effective utilisation of the TARMII system. Also, the state of the computer hardware in schools can either enable or hamper teachers' effective utilisation of TARMII. Experience from field trials schools indicates that to run TARMII effectively on schools computers, such computers should have at least 1 gig of ram in memory and have Mozilla FireFox and Adobe Reader installed in the system[12].

ICT Support at School

Although TARMII was designed to function within different computer systems found in South African schools, varying IT problems may be experienced by teacher-users during the installation and use of the system as it occurred during field trails. This may be is as a result of lack of IT

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[12] Both these support programs have been included with the TARMII CD version.

knowledge and experience by users and there is a need to have on-site IT support to resolve such challenges.

Teachers' Access to Computers

It is absolutely crucial that teachers have access to a computer or computers in school for them to engage with the TARMII system effectively. However, experience during the field trials has shown that schools differ in terms of allowing teachers access to computers and providing teachers free time to do their work on computers. As a result, each school should be advised to customise teacher access and usage of the TARMII system to the conditions existing in that school.

## Integration of the TARMII System with the Teaching and Learning Process

Although the field trails were conducted over a limited period and could not yield information on affordances for the integration of the TARMII system into pedagogical practices at school level, it is however very crucial for this system to be incorporated into teaching, learning and assessment in the classroom, and not be used as an added-on responsibility. Evidence from current teacher classroom assessment practices in South African schools (Kanjee *et al*, no date) points to teachers still steeped on utilising assessment for summative purposes rather that supporting teaching and learning. However, TARMII is designed to support teachers to enhance teaching and learning thereby:

- o Reducing teacher workload i.e. – reducing the time teaches would take to develop tests;

- o Providing teachers with high quality tests;

- o Providing diagnostic information (learner strength and weaknesses) to teachers to inform their interventions; and

- o Utilise assessment to serve the teaching and learning process.

How is TARMII Envisaged to be Implemented in Practice

The following are generic guidelines for the implementation and use of the TARMII system in schools (see Figure 4 below). Training for the implementation and use of the TARMII system should first occur at the district level involving the English FAL and Mathematics learning area (subject) advisors or curriculum implementers.
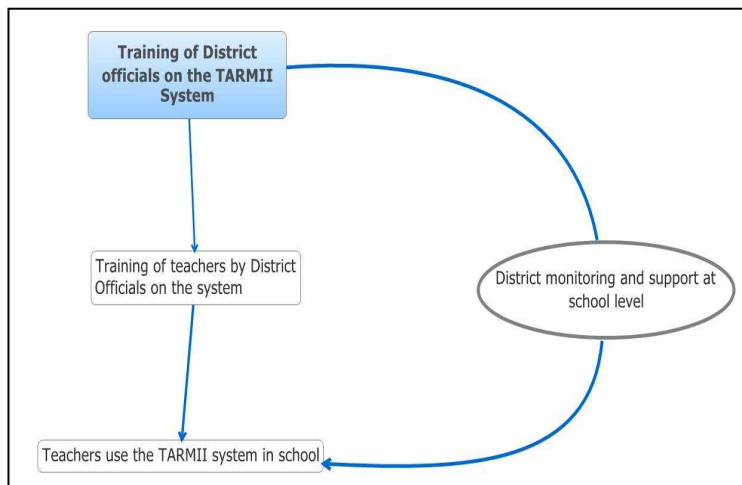
Figure 4

District officials then become charged with the responsibility of training all Intermediate Phase teachers of English FAL and Mathematics in the schools they are servicing. They also conduct monitoring and support visits to help teachers in their schools on how to use the system. School clusters can also be used for enhancing teachers' usage of the system. It is also important that TARMII implementation and use by teacher occur in an integrated manner with other forms of teaching and learning support given to teachers. In this way the pedagogical value of the system is likely to be realised.

Implications of TARMII to Action Plan to 2014

The assessment items that populate the TARMII system are based on the Assessment Standards specified in the NCS. However, Curriculum and Assessment Policy Statements (CAPS) have replaced the NCS on implementation at classroom level only. This implies that changes associated with the CAP will not influence the validity of the items offered by the TARMII system.

In view of Action Plan to 2014, the implications of the development of the TARMII system have relevance in improving teaching and learning. The rationale is that this system is designed to make relevant items, readily available to the teachers for the purpose of formative assessment at the appropriate time and to provide feedback to teachers on individual learners. The use of technology facilities will help teachers to individualize assistance to learners and develop teachers' computer skills.

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