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Review

Heads of departments leadership roles in improving mathematics and science teaching in Cape Town primary schools in the Western Cape Province of South Africa

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Instructional support for all categories of mathematics and science teachers' world wide is a necessity because it helps to support and improve teachers' effectiveness and efficiency in the delivery of subject content knowledge during teaching. This research paper highlights heads of departments (HoDs) leadership roles in providing instructional support to mathematics and science teachers in Cape Town primary schools of the Western Cape Province of South Africa and how such support could be improved for efficient and effective teaching of mathematics and science during lessons in classrooms. This paper draws on current literature and case studies of primary schools in the city of Cape Town. The author used qualitative research approach and descriptively analysed semi-structured interviews for the study report. Findings revealed that the HoDs provide basic instructional support to mathematics and science teachers and that their efforts in providing instructional support were met with a number of challenges. The most serious among the challenges were work load and time constraints. The study also identified a number of issues that could help to enhance educational policy makers and other stake holders' decisions in their discourse to improve teacher support for mathematics and science teaching.

Keywords: leadership, environment, resources and culture.

INTRODUCTION

School leadership has become a priority in educational policy agendas both international and locally (OECD, 2008). Effective school leadership roles such as HoDs instructional support are essential to improve the efficiency and effectiveness of teaching and learning of mathematics and science, particularly in primary schools. According to Colitz, Fuglestad, and Lillejord (2002:196), "…the failure rate in mathematics and science in South Africa is unacceptably high and it requires efficient leadership in the field." Colitz, *et al*. (2002) further argue that teachers' knowledge in both mathematics and science need to be improved at the basic level. In support, Taylor, Fleisch and Shindle (2007:17), state that "…the subjects which learners take at the basic school level provide a foundation for the knowledge and skills required at higher education." Therefore, the mastery of core subjects, particularly, mathematics and science in primary schools has a direct effect on learners' achievement in the senior secondary national matriculation examination.

Huber (2008) on school development and improvement emphasized the importance of school leadership in view of the continuous improvement process targeted at the individual teacher and learner performance. The instructional support HoDs provide to mathematics and science teachers is unique. Research by Ingersoll and May (2012) shows that institutional factors, such as the quality of principal leadership, the HoDs input into instructional support, professional development opportunities and the adequacy of school resources affect mathematics and science teachers performance.

Effective instructional support such as creating conducive environment is essential in helping teachers meet the challenges of teaching mathematics and science to ensure that HoDs should create instructional support teams that will examine the use of culturally responsive pedagogy in the classrooms. Culturally responsive pedagogy recognizes and uses the students' culture and language in instruction and respects the students' diversity and personal identities (Boaduo and Babitseng, 2012; Richards, Brown, Forde, 2004).

Creating conducive working environment

School leadership roles include creating an environment that is characterized by higher-level learning, values of creativity, innovation, expertise, self-development, knowledge sharing, mutual trust and appreciation of diversity (Zdunczyk, 2007). The author has observed that creating a working environment that is conducive for mathematics and science teachers would include communication procedures and policies, technology, training schemes and resources availability. The importance of such an environment is that it develops and enhances the professional growth and performance of the teachers through in-depth content knowledge of the subjects and skills of which teaching methods and lesson delivery approaches strategies to use during mathematics and science lessons are appropriate and applicable. The appropriate and availability of teaching and learning resources which are important to consider in any form of support services provision is paramount because without such resources teachers and learners will not be able to catch up. Furthermore, learners cannot acquire the necessary content knowledge and skills to use in the articulation of science and mathematics on the basis that; South African schools have a much higher percentage of out-of-field teachers in mathematics and science than the general population (Mulford, 2003).

Collinson (2007:447-451) stipulates that "…school leadership work at developing their schools' capacity by establishing an environment in which members, especially the teaching staff and thereby the school as an organization can continuously learn and improve" are requirements for effectiveness and efficiency. He identified four factors which impact on favourable environment for teaching and learning namely social, ethical, political and intellectual. In terms of the social factors the author is of the view that schools are established within community and societal cultures, and the norms and values of those larger social spheres mediate and shape what transpires among people within the school. Therefore, knowledge of the school community and the societal culture are paramount in setting a peaceful coexisting environment for mathematics and science teachers and this is supported by Ingersoll and May (2012). Social knowledge and skills are learned through interactions with others over time and as a result leaders have to structure various possibilities for interactions such as dialogue, decision making, and dissemination of information.

On ethical factors, school leadership mostly depends on ethical factors that deserve study and attention as professional principles. Such professional principles include caring, respect, and participation associated with inclusion, equity and knowledge associated with efficient reliability and conditions that foster organizational learning as supported by Leithwood (1999). Collinson, (2007:451) further asserts that "…people, by their nature, seek organizations with which they share values or understanding in which they find a sense of meaning and belonging. From this perspective the issue of ethics is very important when creating conducive environment for effective and efficient mathematics and science teaching in schools.

In relation to the democratic and political factors, school leaders should work to establish and sustain democratic values in the daily lives of the members in the school communities because they are responsible for creating just, fair, humane and caring environments, processes, and structures that provide equitable opportunity, access, and experiences for everyone to advance and progress (Da Ponte and Chapman, 2006). At the same time leaders should challenge inequality and the issue of disruption of the sources and systems that contribute to those injustices (Bredeson, 2004). Democratic processes are desirable and necessary approach to leading schools effectively and efficiently in the increasingly culturally diverse communities such as South Africa.

Turning to the intellectual factors in the school system Collinson (2007) and Ingersoll and May (2012) are of the view that individual teachers' content knowledge of their subject and the pedagogical skills are necessary and important for their application contributing immensely to the successes of their teaching thereby helping learners to improve in their performance. For these reasons, he suggests that all members, particularly the teachers, must learn together and share their learning and collectively make sense of their environment. His view is that leaders in this case are critical in tapping the talents and knowledge of all members, encouraging innovation, and providing opportunities for the dissemination and discussion of innovative ideas at the school level.

Furthermore, school leadership is required to create the internal conditions necessary for the continuous professional development and increasing the professionalism of the teachers (Huber, 2004).

In terms of what has been espoused above, it is clear that school leadership needs to have a form of culture which will consistently guide activities in the school environment. According to Dambe and Moorad (2008:583) "…successful organisations like schools must develop a shared culture which all members' are committed to." Such a culture should be characterised by stated missions, visions, goals, values and standards of performance (Ninan, 2006). This author includes that this kind of culture should allow teachers to participate in decisions that affect their work, have reasonable autonomy to carry out their work, share a sense of purpose and receive recognition, respect and dignity from their communities and superiors.

Provision of resources

Another form of support is providing the required resources to enable mathematics and science teachers to teach effectively and efficiently. These should include the required textbooks in sufficient quantities, laboratory and laboratory equipment, workbooks, paper and pencils. Other forms of resources should include overhead projectors, transparency pens, and transparencies, and computers with projection systems readily available for use during the delivery of lessons (Sheard, *et al*., 2009).

Science equipment is needed to conduct science experiments. In order for students and teachers to conduct experiments, teachers need to know what equipments are available and should be found in all science laboratories. The same is expected of mathematics teachers where equipment for teaching and learning should be made available during lesson delivery. The reason is that having easy access to resource materials needed for teaching and learning will enhance the effectiveness and efficiency and the likelihood of teachers guiding students to do practical work.

HoDs should secure needed resources that support teachers' work and creativity. They should act as intermediaries between their subordinates and their own superiors (Stoker et al., 2001; Tierney et al., 1999). They should ascertain what resources teachers need to support their work, and secure them from the higher organizational levels such as the school principal and the Department of Education (Hjorth, 2005; Tierney et al., 1999).

Coaching and mentoring support

In addition to the available equipment and resources, teachers need to be taught the effective use of the available equipment and resources. This should be the task of HoDs who should motivate, educate, provide demonstration lessons and lead by example (Allio, 2006). In view of this, HoDs need to take coaching and mentoring role to bring out the best of their teachers. They should act as mentors, engaging in appropriate roles for teachers in all required situations. Sheard *et al*. (2009:542) have noted that "…an essential form of support for mathematics and science teachers is providing them with coaching and mentoring in order for them to improve on their teaching and enhance students' learning. HoDs should perform both roles of mentoring and coaching because their job functions include supporting, coaching, protecting, exposing, being visible and challenging work assignments.

Psycho-social functions should include encouragement, friendship, advice and feedback, as well as helping individual teachers to develop a sense of competence, confidence and effectiveness in their teaching (Ehrich, 2008). According to this author mentoring and coaching help teachers to gain more confidence in their professional capability, translate educational theory into practice more effectively and efficiently by developing improved communication skills. Morrison (2007:8) postulates the following tasks as what HoDs should do as coaches and mentors:

- "Identifying appropriate instructional strategies and interventions to address diverse teaching needs and to improve the teacher performance.
- Conducts demonstration lessons using research-based instructional strategies. Collaborates with grade-level teachers to set goals for improving instruction. Thus assists teachers in designing and delivering effective instruction.
- Observes instruction during Mathematics and Science session and provides support for the teacher(s) in terms of suggestions or motivation. Provides professional development instruction on a variety of topics related to Mathematics and Science instruction
- Ensure that district standards/benchmarks are the instructional focus for planning and delivering of the instruction. Coordinate the implementation of the assessment system, including data management/reporting system and analysis/interpretation of data to inform decision-making at the school and department level."

METHODOLOGY

This study was qualitative in nature. Qualitative approach was used to make sense of the complex nature of instructional support HoDs provide to mathematics and science teachers, the meaning they put into it and how they interpret what they experience (Richard & Morse 2008). It was also used for the purpose of understanding in detail the phenomenon of instructional support that

HoDs provide to mathematics and science teachers (Traynor, 2007).

The interpretive paradigm is another approach used to understand phenomena through accessing the meanings that participants assign to them (Rowlands, 2005). The interpretive paradigm was used in order to get a better understanding of the nature of the instructional support that HoDs provide to the mathematics and science teachers and the meaning that they assign to it (Meyer, 2003). This was identified as the most appropriate approach for this study because interpretive research approach enables the development of intimate relationship between the researcher and what is being researched and the situational constraints that shape the processes.

Furthermore, this approach was used on the grounds that it is consistent and compatible with the epistemological and ontological assumptions that the world and reality are interpreted by people in the context of historical and social practices (Rowlands, 2005). By this, Rowlands implies the experience of the world is subjective and best understood in terms of individuals' subjective meanings rather than the researcher's objective definitions.

Population Sample

Semi-structured interview questions and purposive sampling were used to select information-rich participants, namely, identified school HoDs and mathematics and science teachers in Cape Town Primary Schools. The Semi-structured interview questions were considered more flexible than structured interviews questions as they helped to expand on the participants' responses and to probe deeper into the research problem than could otherwise be the case (de Vos, Strydom, Fauche and Delport, 2002).

Data collection, analysis and interpretation

In order to obtain relevant data for the study the researcher used face-to-face instrumentation as well as open ended and semi-structured interviews questions with HoDs and teachers with the application of document analysis. The interviews and document analysis were intended to ensure that relevant data have been collected for the study and to strengthen the basis for interpretation.

The data-analysis and interpretative approach adopted in this study were content based. According to Brantlinger *et al*. (2005:197), "…content analysis is a close inspection of text(s) to understand themes or perspectives." This approach was guided by the research question which tended to find out about the nature of the instructional support HoDs provide to mathematics and science teachers in Cape Town primary schools confident to be able to delivery lessons to learners.

The analysis procedure for this study took two forms: First, the researcher transcribed the interview recordings, read through them thoroughly and highlighted the themes for easy identification and interpretation and identified and colour-coded the recurring themes within the data from each of the participants. This enabled the researcher to determine the emerging themes from the data for easy analysis and interpretation (Hramiak, 2005).

The second stage involved identifying common themes and areas of variations among the participants and those themes that emerged were synthesized for appropriate analysis and interpretation (Wiersma & Jurs, 2005:217). The themes were later used to structure the presentation of the discussion provided in this text.

Reliability and validity

Reliability and validity remain pertinent in qualitative inquiry and should be maintained as emphasized by Morse et al, 2002). To ensure reliability and validity, the author used rigorous strategies inherent within qualitative design, such as pilot study, member checks, and triangulation of document and interview data.

FINDINGS

The following were the major findings that emerged in the conduct of this study. HoDs provide instructional support to mathematics and science teachers in Cape Town primary schools. The support includes professional development, motivation and monitoring, creating and conducive working environment.

The following emerged as challenges namely: work overload, time constraint, lack of science laboratories and equipment and frequent curriculum change.

It was further identified from the findings of the study that part of the daily practices of the HoDs was to communicate pertinent information pertaining to the teachers' daily practices and instructions that dealt with teaching and learning. This practice correlates with the views of Alexandra (2004:56) who claims that "…it is expected of HoDs to create an atmosphere of good communication systems through which teachers are informed of what is expected of them, what the programme is all about and how the programme should be implemented." The participants indicated that information and communication at the department level took place during staff meetings and staff development meetings. Quinn (2002) is of the view that teachers need shared agreement that supports directness, facts and authenticity and open communication procedures. HoDs need to be tactical in information communication by getting the right information through the right sources to

the teachers at the right time for the right effect.

DISCUSSION

In general, the findings revealed that HoDs provide professional support to their mathematics and science teachers in their schools. Crum and Sherman (2008:567) point out that "… HoDs leadership responsibility includes developing their teachers within departments to be effective and efficient at their respective jobs. However, the finding of this study revealed that most of the HoDs have been appointed on the basis of their long experience in the teaching profession. The problem identified and explained in the background indicates that HoDs lack leadership skills and content knowledge of the mathematics and science. The profile of the HoDs revealed that most of them do not have honours degrees and have been appointed on the basis of long experience in the teaching profession.

In the final analysis leadership development that lies totally on experiential teaching and learning, and peer mentorship without the inclusion of a range of experts, runs the risk of pooling ignorant and accepting outdated practices (Scott, 2002). This could be interpreted to mean that leaders should be equipped with current leadership training and skills so that they are able to carry on with their leadership duties effectively and efficiently. The overall continuing professional teacher development is meant to properly equip them to undertake their demanding tasks and to continually enhance their professional competence and performance (Robinson & Carrington, 2002).

Furthermore, it was found that some HoDs use the Integrated Quality Management System (IQMS) to monitor their teachers. Monitoring and evaluation are essential to all teachers, individual learner classrooms to consolidate achievement and identify areas of weakness for corrective measures (UNESCO-UIS report, 2008),

Another issue that came out was motivational support for teachers by HoDs. The motivational support provided by the HoDs was meant for providing support and involving teachers in the planning of their daily activities of school work. According to Wong (2006) if the individual teachers are not motivated to teach, no amount of investments in infrastructure and technological developments would make the teaching of mathematics and science effective. To emphasize the importance of motivational support, Wong (2006) further highlights important factors in the establishment of the right incentives and rewards as motivational aids to encourage people to share and apply knowledge. The motivational support HoDs provide to mathematics and science teachers in Cape Town primary schools help to stimulate and reinforce the positive behaviours and culture needed for effective teaching and learning.

Other support strategy that was indented in the findings was mentoring and coaching. Naidu *et al*. (2008:97) emphasise this strategy, and define mentoring "…as the process whereby an experienced person assists and guides a less experienced person." The HoDs assist and guide the teacher as their mentees. These authors reiterate further that mentoring and coaching are powerful tools for use to ensure continuous professional development depending on the availability of the experts and experienced professionals already in schools. They emphasise that mentoring and coaching are necessary in order to provide development support to teachers in school departments.

It is acknowledged by the teachers that two of the most important forms of support HoDs provide to them in mathematics and science are coaching and mentoring. The reason is that the work environment is often challenged by inherent difficulties such as lack of practical knowledge and experiences and skills application (Jain and Mukherji, 2008).

From the study the following emerged as challenges: work overload, time constraint, lack of science laboratories, equipment and frequent curriculum change.

Naidu *et al*. (2008:51) have observed the challenges encountered by HoDs, and argued that "…IQMS had increased HoDs and teachers' workload and involved a lot of paperwork that is seen as unnecessary by teachers in schools." They, however, suggested that workload should be fairly shared or where possible, the services of additional staff in the form of SGBs' paid teachers should be engaged.

Mercer (2009) supports this view by arguing that it is not easy for HoDs in primary schools to balance their teaching demands and their departmental management tasks due to time constraints. He further contends that HoDs experience considerable conflict in trying to act as both managers and teachers because the management is seen as taking time away from their teaching.

Bartell, (2005:85) concurs that "…it is difficult for HoDs to find enough time in the work day to plan with teachers, observe in their classrooms and to have the kind of in-depth conversation that make for rich mentoring."

Another revelation is that there is lack of science space in the schools: laboratory and science corners. Three out of the four schools interviewed lacked science space for children to interact and manipulate the tools during the science lessons. Frazier Sterling, Logerwell and Kitsantas (2008:3) point out that "…these science teachers need to be assigned laboratories that are purposely designed for science instruction." They need to be able to teach in one room so that they do not spending their time providing for the same science activity in different classrooms.

Depending on the type of school, the HoDs in conjunction with the school principal and the sub-committee of SGB called the "Asset Management Committee" can come together and procure laboratories for departments (Clarke, 2008). The benefit goes to the

school and the learners. It is possible for the SGB to procure a laboratory for the school because asset management is school-based depending on the school or institution capacity of schools (Weber, 2005)

Another concern was about frequent curriculum changes. This was reiterated by the current Minister of Basic Education, Motshekga, who said:

"Teachers are frustrated because they cannot find their way through the apparently never ending demands of new policy, new initiatives, new regulations and new forms to fill in. They find it difficult to find the most effective route towards their own professional growth and fulfilment" (Cameron, 2009:n.p).

Measures need to be put in place to curb this trend of frequent curriculum changes that impact negatively on teachers.

It was further revealed in workshops and in-service that training was the ideal way of improving the support that HoDs provide to mathematics and science teachers. The fact that HoDs in the primary schools are in charge of many subject areas, which they may not necessarily have the capability to supervise effectively, is enough for them to suggest regular workshops and in-service training. It is even very necessary when the HoDs are not appointed based on their subject expertise but rather their long experience in the teaching service.

Leithwood (2005:622) states that "…the factors stimulating successful leadership practices include on-the-job learning, professional development experiences, socialization processes and individual traits which are developed during workshops and in-service training sessions". However the HoDs expressed sentiments about the manner the workshops are organised and presented. In other words, they felt very little is achieved at those workshops. They complained: "*We always go to workshops, unfortunately those workshops … they take our knowledge, it's a workshop, our input, they use our input, do not tell us something or anything new".*

In conclusion, the significance of Head of departments' leadership roles in improving mathematics and science teaching in Cape Town primary schools in the Western Cape Province of South Africa is realistic. Though the said HoDs are trying their bit to support their teachers, the question of whether or not the support is adequate to enable mathematics and science teachers to teach as they should is a matter of concern, considering the HoDs backgrounds, how they are selected and the support they receive. The HoDs sentiments about the manner workshops are organised and presented needs attention. They felt very little is achieved at those workshops. They claim the workshops are more or less talk shows and mere recycling of the HoDs knowledge, almost nothing new and not much expect or researched based instruction support strategy is taught or given to them. This assertion needs to be verified and rectified the relevant authorities.

RECOMMENDATIONS

The following recommendations are made for HoDs to better support mathematics and science teachers in primary schools in the study area and elsewhere:

In order for the HoDs to be effective in their supportive roles, the researcher recommends that they be provided with interventions such as formal training and education, leadership programmes and nurturing. These interventions might increase their knowledge and skills and help to boost their self-esteem and self-confidence, all of which have the potential to result in the enhancement of their self-efficacy to be creative and supportive (Mayfield & Mayfield, 2007).

To ensure that all HoDs already in their posts have the formal basic leadership training, the Cape Town DoE in conjunction with the WCED should establish a partnership relationship with Institutions of Higher Education which offer teacher professional development in order for them to provide refresher courses and advanced training. Further training might assist and equip the HoDs with skills on supporting Mathematics and Science teachers at the primary school level effectively.

The other recommendation, which is closely linked to the one above, is that the bar should be raised so that the entry point to the HoD status becomes at least a bachelor's degree. In other words, promotion of teachers to HoD should be linked to the upgrading of academic programmes. The assumption is that the higher the education qualification the teacher obtains, the more knowledgeable they would be, especially if the degree of study includes educational management. For those teachers who already hold the HoD position without the proper academic qualification, further programmes should be in place for them to undergo staff development. Such programmes might enable them to hone their supportive skills and to have more insight into their leadership and management roles.

Managing the activities across the different phases and among different subject areas in the primary school not only stresses HoDs, but also takes up their time. This implies that HoDs should prioritise their time in order to function effectively and efficiently.

For the workload of Mathematics and Science teachers to be reduced, it should be fairly distributed and/or, where possible, the services of additional staff in the form of SGB-paid teachers should be solicited.

The study did not reveal a direct link between the role of the School Governing Body and the support HoDs provide for Mathematics and Science teachers. The researcher recommends that all stakeholders, including the school district office and the SGB intensify their efforts and direct their energies towards supporting the HoDs, as the tasks of the latter form the core of teaching and learning.

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