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# EFFECTIVELY MANAGING SCIENCE TEACHERS' MOTIVATIONAL AND MATERIAL UTILIZATION COMPETENCES FOR SCIENCE STUDENTS' ACADEMIC PERFORMANCE IN SECONDARY SCHOOLS IN RIVERS STATE

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#### ABSTRACT

This study was a theoretical and empirical investigation into the influence of science teacher's motivational and material utilization competence on science students' academic performance. Descriptive and survey research design was used in carrying out this study. 25 secondary school teachers and 200 secondary school science students from the selected schools were the respondents. A questionnaire entitled 'Science Teachers' Motivational and Material Utilization Competences on Science Students' Academic Performance in Secondary Schools' (STMMUCSSAPSS). The researcher took time to comply with the formalities and procedures adopted in framing a research questionnaire and the instrument was validated by two experts in measurement and evaluation. The reliability of the questionnaire was established using the Pearson product-moment correlation coefficient (r) reliability estimate, which gave a cumulative reliability value of .810. The data collected from the respondents was analyzed through Statistical Package of the Social Sciences (SPSS) Version 25. Mean, standard deviation and variance was used in analyzing the research questions. The study concluded among others that science teachers' motivational competences influence students' academic performance, and science teachers' and material utilization (teaching aid) competences during instruction improves students' academic performance. The study recommended among others that programs for the education of the science teachers must be viewed by schools as a major responsibility of society and must be adequately supported and promoted and vigorously advanced by schools top leadership.

**Keywords**: Effective, Managing, Science Teachers, Motivational, Material Utilization, Competences, Science Students, Academic Performance, Secondary Schools, Rivers State.

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#### INTRODUCTION

A study of teachers' classroom practices as they relate to students' academic achievement is important for several reasons. Understanding the reasons teachers are important will give insight to professional development planners. Identifying such factors that contribute to increased student achievement is paramount in this age of accountability. The Federal Government of Nigeria mandates for student achievement through the various examination bodies are still in place, and schools are held accountable through statewide assessments of all students. Teachers need to be held to high standards to implement research-based best practices in their classrooms. Identifying such factors which contribute to students' achievement is very important. Regarding instructional processes and leadership, the school principal indirectly impacts the performance of teachers under his or her leadership as well as the climate and culture of the buildings (Leone, 2009).

Ehindero and Ajibade (2000) asserted that students, who are curious stakeholders in educational enterprise, have long suspected and speculated that some of their teachers lack the necessary instructional competence. That is, skills, techniques, strategies required to communicate concepts, ideas, principles in a way that would facilitate effective learning. They believe that these deficiencies contribute significantly to the growing rate of failure and subsequent drop out of students in secondary institutions.

The idea of highly competent teachers is a good one, but compliance has not been widespread (Denslow, 2000). Some states in Nigeria have set low expectations for teacher quality, and sometimes it depends on the school in which a teacher teaches. The question which begs to be asked is what defines teacher instructional competence? If a student is asked about a teacher who is highly competent, they will most likely say that it is the teacher who spends extra time with them and who makes the class content clear and attainable (White, 2004). Conversely, according to Ololube (2009), an unqualified and incompetent teacher is the one who has poor classroom organization, lacks knowledge of the subject matter, poor methodological competences, ineffective use of language, poor planning and preparation of lesion plan, lacks motivational competence, poor material utilization competence, poor construction and employment of various evaluation techniques and above all lacks interaction competence. Furthermore, the same source concludes that a competent science teacher is one who knows and applies the principles, rudiments, methods and techniques of teaching in the teaching and learning process.

Due to the increasing nature of poor academic performance of secondary school students especially in external examinations like West African Examinations Council (WAEC) and Joint Admission Matriculation Board (JAMB), many educationists (Uzorka, Orlu, Okemini, & Ololube, 2013; Mupa & Chinooneka, 2015) tend to shift the blame on lack of fund from the government to provide quality textbooks and instructional materials. However, these might not be the main reasons why students perform poorly in examinations. It is clear from all indications that some secondary school science teachers are not competent and this could lead to poor academic performance of the students.

These observations by stakeholders necessitate the need to investigate the effects of teachers teaching competence such as teaching skill and techniques necessary for teaching and learning in secondary schools on academic performance of science students. However, this study focused on two factors that may or may not influence science teacher's teaching competence in a classroom situation:

- Science teachers' motivational competences
- Science teachers' material utilization (teaching aids) competences

### **Statement of the Problem**

Competent science teachers are the most critical piece in improving science student achievement and closing the achievement gap. The most important difference between the most and least effective science classrooms is the science teacher. The single most important influence on science student learning is the quality of science teaching. If this problem is not clearly defined, science teachers may not be given the opportunities to improve practices in the classroom, and it is the science students' achievement that may be harmed as a result.

Many factors are involved in science student academic performance and science teacher competence, such as the science students' background, the condition of the school, the parents' education level, and the availability of textbooks to support the science learning. However, the most important variable, as shown by some researchers, is the quality of teacher training. For many years improving the quality of science education has been an important issue for the Ministry of Education in Nigeria (Ololube, 2006). Lack of trained teachers, the limited availability of materials, and a weak budgetary allocation and framework that does not comprehensively cover the needs of science education in the country continue to plague science teaching and learning outcomes.

Improving the quality of basic science education, therefore, seems to be at the forefront of the national education agenda, as evidenced by several actions that have already taken place, such as the transformation of the curriculum for basic science education, a new science teacher training strategy, improving access, and capacity building. Yet nothing tangible has been don on how to effectively improve on the mandates, no real commitment, the ability to adjust and improvise, the capacity to collaborate with other teachers, the ability to advance the profession of science teaching.

Internet searches reveal that there is are limited research on the effects of science teachers' competence on students' academic performance in Rivers State. However, these studies attempted scratching the surface close to the theme of this study. Therefore, there is the need to look at how science teachers' motivational and material utilization competences affect science students' academic performance in Rivers State because of its importance in determining student learning outcomes. Hence, this study intends to fill the gap by examining pertinent issues in science teachers' competence and its attendant effect on the academic performance of science students in Rivers State.

### Aim and Objective of the Study

The purpose of the study is to make a theoretical and empirical investigation of the effects of science teacher's motivational and material utilization competence on students' academic performance. This aim shall be pursued through in the following specific objectives:

• Investigate how science teachers' motivational competences during instruction improve students' academic performance.

• Examine how science teachers' material utilization (teaching aid) competences during instruction assist students' academic performance.

### **Research Questions**

The following research questions were answered during the course of this study:

- How does science teachers' motivational competence during instruction improve students' academic performance?
- How does science teachers' material utilization (teaching aid) competences during instruction assist students' academic performance?

### **REVIEW OF RELATED LITERATURE**

#### **Science Teachers Motivational competencies**

# Motivation as a Strategy for Teaching and Learning and Science Students Academic Performance

Motivation is regarded as one of the qualities of achieving good teaching and learning in schools. The phrase "science student's motivation to learn" has, to some degree, different connotation to varied people. Mupa and Chinooneka explained it as the significance, value, and benefits of academic tasks to the students regardless of whether or not they are intrinsically interesting (Mupa Chinooneka, 2015). Ololube remarked that motivation to learn is characterized by long-term, quality involvement in learning and commitment to the process of learning (Ololube, 2007). Science student's motivation naturally has to do with the desire to participate in the learning process, and it also concerns the reasons or goals that underlie their involvement or non-involvement in their academic activities. In other words, while students are motivated to perform a task, the sources of their motivation may differ (Filgona et al. 2020). Students who are intrinsically motivated accept an activity for its own sake, for the enjoyment it provides, the learning it permits, or the feelings of accomplishment it evokes. Extrinsically motivated students perform in order to obtain some reward or avoid some punishment external to the activity itself such as grades, stickers, or teacher approval (Ali, 2010).

At any rate, science students are more effective learners if they are intrinsically motivated towards learning than if they are extrinsically motivated. A growing body of evidence suggests that intrinsically motivated students employ strategies that demand more effort and that enable them to process information more deeply (Ali, 2010; Filgona et al. 2020; Ololube 2009).

The question remains: what factors influence the development of students' motivation? Ololube (2005a,b) and Ololube et al. (2013), motivation to learn is a competence acquired through general experience but stimulated most directly through modeling, communication of expectations and the teachers. Equally, when children do not view themselves as basically competent and able, their freedom to engage in academically challenging pursuits and capacity to tolerate and cope with failure are greatly diminished because the sources to which children attribute their successes and failures have important implications for how they approach and cope with learning situations.

Hardre and Reeve's in their study, "A Motivational Model of Rural Students' Intentions to Persist In, Versus Drop Out of High School" they found that there are large differences in teachers' beliefs about and orientations toward motivating students. A large majority of teachers see students' motivation as impressionable believing that they actually could make a difference and they actively tried to intervene when students obviously lacked motivation (Hardre & Reeve. 2003, pp. 347-356).

#### **Fostering of Motivation to Learn in Science Schools**

Perceptibly, motivation is critical in education; it is regarded as an essential component of teaching, but it is also crucial for students. Hardre and Reeve (2003), Austin, Dwyer and Freebody (2003) and Ololube (2009) identified three important elements in student's motivation to learn-the learning environment, classroom instruction, and interpersonal interaction. Some motivational elements at all of these levels are within the teacher's control and all of these can influence students' academic inspiration positively or negatively. First, teachers can motivate by features of the environmental design, which include their indirect effort to motivate students by arranging the classroom-learning environment in ways that promote students' motivation. Second, teachers can motivate students by using instructional strategies which include features of their instruction (e.g., scope, sequence, materials, media, interactions) that are intended to facilitate students' motivational characteristics such as attention, interest, engagement, effort, value, and their perception of their own competence. Third, teachers can motivate students by using motivating strategies which include direct efforts to motivate individuals or groups of students (e.g., activate or remediate their current motivation), are highly adaptive based on specialized student needs and circumstances. Motivating strategies are individualized and arise out of the teacher's specific beliefs and perceptions of individual students' motivational states and traits. Teachers use language to help students initiate and regulate (manage) their classrelated activities. When teachers use informational, flexible language, teachers nurture students' own initiative, helping them find reasons to act because they want to rather than because the teacher says they must (Harris & Muijs, 2005).

Conversely, students often fail to reach their full potential due to low motivation. Some factors that affect their motivation may relate to a country's education system in general while others are institutional or cultural views (Niederhauser, 1997, in Ololube, 2009). For example, the use of power in schools is important in motivating students which also helps in determining high student achievement: Teachers use this method to influence student's compliance in the classroom. This is evident in Cheng, Cheung and Tam's (2002) study. However, their investigation was limited to grade six students. Cheng (1994) in Ololube (2009) defined the power base as the use of reward power, coercive power, position power and personal power or professional power in the classroom to ensure students' compliance. Researchers, especially in Africa and Asia, see power as a valuable tool for effective teaching and high student academic achievement (Ololube, 2005b, 2009).

However, to motivate the unmotivated science students, science teachers should recognize that even when their students use strategies that are ultimately self-defeating such as withholding effort, cheating, procrastination, and so forth, their goal is actually to protect their sense of self-worth (Raffini, 1993, in Ololube, 2011).

#### Material Utilization (Teaching Aids) and Instructional Competence

Science teachers, like doctors and any other professional workers, need essential tools to do their work best. Of course, it is true that the central figures in any learning situation are always the students and not the teachers, but it is equally true that learning may be greatly enhanced by the utilization of the many resources available in the school and various school agencies (Ololube, 2009). Nevertheless, the science teacher's planning of effective learning activities will be easier, less time consuming and often vastly expanded in potential scope when they know precisely what type of materials are available to them and when to draw upon them (Stones, 2012).

Many of the materials needed for effective teaching are used often enough to warrant their being part of every classroom's basic equipment. However, at the other extreme are materials—often relatively expensive and needed in individual classes rarely and for short periods—which serves the specific needs of an educational system. Teachers are concerned about the ready availability of appropriate instructional materials because they know how much such tools influence teaching and the quality of learning in the classroom (Ololube, 2011).

The appropriate applications and the modern use of information communication technology (ICT) during the instruction of science subject is a prerequisite for effective teaching and learning. The idea behind ICT in science education is to develop professionally competent science teachers who can handle instructional processes and appropriately use the available instructional materials in a school environment to affect teaching and learning.

Meanwhile secondary schools especially in the developed world are under pressure to make science students more personally familiar with emerging technologies. This trend has in turn influenced science teacher education programmes to appropriately train pre-service teachers. There is a general belief that science students graduating from secondary schools must have levels of expertise beyond the simple ability to use current technology, and what is needed is technological competence (Ololube et al., 2012; Ololube et al., 2013). This is to say that the application of a sophisticated cognizance of technologies includes the ability to see novel applications and to expand the nature of the technologies' usage (Ifinedo & Ololube 2007).

# The Role of Science Teachers in the Use of Instructional Materials and Science Students Academic Performance

Over the past few years, there has been prediction that new teaching and learning technology would replace science teachers, textbooks and even science schools. It was also anticipated that the major method of science learning by 2000 would involve the use of modern technology like computers at all levels and in almost all subject areas especially in the sciences (Ololube, 2011). However, Darling–Hammond (2000) found that this prediction does not appear to be true. Cuban (1993) in Ololube (2009) on the other hand claim that the use of computers applications has to fit into the science teacher's pedagogical view of teaching and learning, and if introduction of computers for instance in schools is to be successful, one must start with the question of why they should be used and not how they should be used. It appears that technology is looked at as having a supplementary role in science teaching and that it should be organized according to the view of most educators and parents (Postholm et al., 2002).

Following this direction, Vygotsky in Ololube (2007) developed the concept of the zone of proximal development (ZPD) that has had a great effect on how we regard science teacher's instruction and assessment in assisting students' level of development. This is reinforced by

appropriate use of instructional materials. This concept is defined as: the distance between the actual developmental levels as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky in Ololube, 2007).

Thus, teaching is said to occur when assistance is offered at points in the ZPD where science student's performance requires assistance. According to Austin, Dwyer and Freebody (2003) and Freiberg and Freebody (1995), during the use of particular instructional materials, questioning is seen as a useful tool in assisting children in their science learning process, which leads them further into their ZPD. Students often have to answer questions which are posed to find out if students have understood what they expected to learn in the classroom. Such questions capture science students' actual developmental level (Postholm et al., 2002).

## METHODOLOGY

### **Research Design**

A descriptive and survey research design was used in carrying out this study. The design for this study followed a logical sequence that connects empirical data to the study's research questions and hypotheses, and ultimately to its conclusions using survey designs.

#### The Population and Sample

The proposed population for this study consisted of all secondary school teachers and students in Rivers State. The target population for the study consisted of all the secondary school teachers and students in Rivers State, from which a sample will be drawn from secondary school teachers and students in Rivers State.

### Sample and Sampling Technique

A sample of 100 secondary school teachers and 200 students constituted from the population, using six senior secondary schools in six local government areas out of the present 23 LGAs in Rivers State. Thus, an estimate of 25 secondary school teachers and 200 secondary school science students from the selected schools were used. This number was a convenient number within the time of the research. The stratified/purposive sampling technique was used for the study.

This study was restricted to the categories of Senior Secondary School (SSS) students who offer science subjects and teachers who teach science subjects (e.g., physics, chemistry, biology, mathematics, agricultural science and computer technology).

### **Instrument for Data Collection**

A questionnaire entitled 'Science Teachers' Motivational and Material Utilization Competences on Science Students' Academic Performance in Secondary School' (STMMUCSSAPSS). In order to decipher the relevant information, a questionnaire designed along 5-point Likert type scale, namely 5 for Totally Agree, TA; 4 for Agree, A; 3 for Not sure, NS; 2 for Disagree, D, and 1 for Totally Disagree, TD, was administered to the above-mentioned groups. The questionnaire will be divided into two sections: Section 'A' dealt with issues of respondents' personal data (gender, age, marital status, level of education, status of respondents, and state of origin). Section 'B' was designed to elicit information on variables that may or not be responsible for science teachers' instructional competence and its relationship to secondary school science students' performance in Rivers State of Nigeria. This section of the questionnaire comprised 25 items on issues of science teacher's instructional process competences *vis-à-vis* motivational competences, and material utilization (teaching aid).

### Validation of the Research Instrument

For the instrument to be made valid, the researcher took time to comply with the formalities and procedures adopted in framing a research questionnaire (Nworgu in Ololube 2006). Secondly, the face and the content validity of the research instrument (questionnaire) were determined by research experts from two universities and their inputs helped to restructure a number of items in the questionnaire.

### **Reliability of the Research Instrument**

The instrument was tested for reliability using the test-retest method by administering the questionnaire to a sample outside the real population of the study. The reliability of the questionnaire was established using the Pearson product-moment correlation cooefficient (r) reliability estimate, which gave a cumulative reliability value of .810.

### **Procedure for Data Collection**

The researcher personally administered the questionnaire in the selected secondary schools in Rivers State, together with two trained research assistants.

### **Data Analysis Methods**

The data collected from the respondents was analyzed through Statistical Package of the Social Sciences (SPSS) Version 25. Mean ranking was used in analyzing the research questions. Mean was used to determine the strength of some variables to the weakness of others, while Cross tabulation was used because it is one of the simplest and most common ways of demonstrating the presence or absence of a relationship.

### RESULT

**Research Question 1:** How does science teachers' motivational competences during instruction improve science students' academic performance?

The first research question is "How does science teachers' motivational competences during instruction improve students' academic performance?" The rationale underlying this research question is to unearth the extent to which science teachers motivate science students to achieve positive outcomes. To answer this question, the responses on items 1-6 of section "B" of the

questionnaire were tallied and analyzed, and the results are as presented in Table 1. The statistical analysis of respondents' answer to these items showed that science teachers demonstrate familiarity with students, and as such motivate students to learn effectively, which improves their academic performances. The application of the wise use of punishment is regarded as an essential part of professional science teaching and it is likewise shown from the study that professional science teachers guide students on how to apply rewards and punishment effectively.

Table 1: Means and standard deviations response on whether motivational competencies of teachers improves science students academic achievement

	Competencies	Science Teachers			Science Students		
	(Variables)	Mean	SD	Variance	Mean	SD	Variance
1	Science teachers demonstrate familiarity with their students effectively	3.72	.53	.28	3.71	.77	.59
2	Science teachers encourage students to work hard and more effectively	3.67	.52	.27	2.66	.72	.53
3	Science teachers use reward and punishment wisely as a means towards motivating students	3.55	.56	.31	2.83	.76	.57
4	Science teachers guide their on how to plan and carry out their academic work effectively.	3.71	.53	.28	2.77	.80	.65
5	Science teachers have the ability to make use of the learning opportunities available in the school environment.	3.66	.52	.26	2.68	.69	.53
6	Science teachers' motivational competence increases students' interest to teaching and learning.	3.55	.56	.30	2.81	.76	.67
	Total	3.64	.54	.28	2.91	.75	.59

**Research Question 2:** How does science teachers' material utilization (teaching aid) competences during instruction assist students' academic performance?

The second research question states, "How does science teachers' material utilization (teaching aid) competences during instruction assist science students' academic performance?" This research question is designed to assess science teachers' appropriate use of instructional materials during instructional processes and its input students' academic performance. Thus, science teachers were evaluated on the competency statements 7-11 (see table 2). The result revealed that the respondents agree and no differences in the respondents opinion.

s/n	Competencies	Science Teachers		Science Students	
	(Variables)	Mean	SD	Mean	SD
7	Science teachers select appropriate teaching materials during instructional process	3.74	.44	2.90	.82
8	Science teachers prepare and use teaching materials effectively during instructional process	3.67	.51	3.19	.74
9	Science teachers operate projected tools effectively during instructional process	3.64	.49	2.83	.80
10	Science teaching is greatly enhanced by the utilization of the many resources available in the school	3.62	.52	3.14	.75
11	Science teachers are concerned about how much teaching tools influence teaching and the quality of	3.66	.50	2.66	.81

3.67

.49

2.94

.78

Table 2: Means and standard deviations of differences of science teachers' material utilization (teaching aid) competences during instruction and students' academic performance

#### DISCUSSION

learning in the classroom

Total

#### Motivational competencies of teachers improves science students academic achievement

In line with the result, motivation is an intentional process of gathering information and evidence about the effectiveness of the teaching-learning process in the science educational environment and how positively they encourage teaching jobs effectively. The purposes include providing assurance that students are able to achieve what the course requires them to achieve and to improve academic performances. They concluded that this type of feedback process has yielded positive results.

Respondents' answers regarding the use of punishment during instructional process show a positive response because the use of power as a process of motivation in schools is regarded as important in determining high student achievement. Teachers use this method to influence student's compliance in the classroom. This was evident in the Cheng, Cheung and Tam (cf. 2002) study; however, their investigation was limited to grade 6 students. Cheng (1994a, pp. 221-239) viewed power base as the use of reward power, coercive power, position power and personal power or professional power in the classroom to ensure students' compliance. It is also accepted by many researchers especially in Africa and Asia as a valuable tool for effective teaching and high student achievement (Cheng, Cheung & Tam, 2002).

# Science teachers' material utilization (teaching aid) competences during instruction and students' academic performance

The results of the means and standard deviations in table 2 between science teachers and science students indicates that a variety of techniques are needed for teachers to effectively utilize instructional materials in the teaching and learning process.

In support of the result, Ololube (2005a,b) Harris & Muijs (2005) and Ololube (2006) indicated that science teachers who are professionally trained demonstrate a sound understanding of classroom technology operations and concepts and use productivity tools to enhance professional tasks such as correspondence, students' assessment, classroom materials and lesson

presentations. Thus, science teachers need to demonstrate introductory knowledge, skills, and understanding of concepts related to the use of materials needed for instructional process and the continual growth in technology knowledge and skills to stay abreast of current and emerging technologies that support student learning and informed decisions regarding the use of technology in support of student learning. To give credence to these findings, according to an Internet source, a course like 'educational technology' is designed to equip student teacher candidates with the knowledge and skills necessary to use technology in the field of education. It is established to maintain rigorous standards for teacher candidates' knowledge and performance and to ensure that all students' teachers achieve the predetermined aims and objectives of education. Working from a solid content background, professional teachers demonstrate proficient and flexible use of different ways of teaching that actively engage all students in learning.

Teacher candidates are well versed in the characteristics of students of different ages, abilities, and cultural backgrounds. They are skilled in integrating technology into instruction and creating an environment in which all students can be successful and want to learn. Teacher candidates know when and how to assess learning through various forms of traditional and authentic assessments. They are well prepared for successful careers in teaching and are expected to act in a professional manner in all circumstances with students, colleagues, parents/guardians, and community members. As professional educators, teacher candidates value collaboration and seek opportunities to work with other professionals and community members to improve the educational experiences for students.

Nevertheless, the same Internet source proposed four basic steps in the preparation of a teacher education program, which this study presumes will go a long way in increasing professional teachers' job effectiveness.

- The teacher candidate should be able to design and organize instruction and assessment procedures for all students based upon a thorough knowledge of subject matter, pedagogy, and students.
- The teacher candidate should be able to use appropriate, effective classroom practices, procedures, and pedagogies to create and manage a productive learning environment.
- The teacher candidate should be able to demonstrate strong communication skills, employ effective teaching strategies and methodologies, integrate technology into instruction, and use a variety of assessment measures to affect student learning.
- The teacher candidate should be able to engage in professional development, demonstrate ethical conduct in working with all constituencies (students, colleagues, parents/guardians, and community members), and reflect upon instruction and student learning to assess teaching effectiveness.

However, it is saddening to say that Nigeria in particular and other Sub-Saharan African countries are far behind in terms of educational technology. The educational technology bases of these countries are still at the embryonic stage.

# CONCLUSION

The study evaluated science teacher's competences, knowledge and skills and how the closer understanding of it has promoted the stability of the science student's academic environment and performance. The respondents support the idea that science teachers' competences and training are important factors in science teachers' job effectiveness and development. It was further argued that teachers who are bent on improving their competence are likely to contribute, directly or indirectly, to the growth of science students' academic performance.

Nigeria like other developing counties needs effective science teacher education programs. Urgent action is required in the field of science teacher training. Science teacher training is broadly divided into what is provided before and during employment. They are preservice or initial education, training, continuing professional development or in-service education, and training. Thus, the incompetence's that may occur because of low intellectual capacity and the continuous updating of science teachers' knowledge, skill and interest in the teaching field may be achieved through these means.

The study concluded among others that science teachers' motivational competences influence science students' academic performance and science teachers' material utilization (teaching aid) competences during instruction advances students' academic performance.

#### Recommendations

This study recommends that:

- Programs for the education of the nation's science teachers must be viewed by schools as a major responsibility of society and must be adequately supported and promoted and vigorously advanced by schools because of its benefits to science students' academic performance.
- Programs for the education of science teachers must enjoy parity with other professional education programs, full legitimacy and institutional commitment, and renewal for activities geared to the nature of the science field.
- Programs for the education of science teachers must be autonomous and secure in their borders, with clear organizational identity, constancy of budget and personnel, and decision-making authority similar to that enjoyed by the major professional schools.

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