British Journal of Mass Communication and Media Research
ISSN: 2997-6030
Volume 6, Issue 1, 2026 (pp. 18-41)
www.abjournals.org

DOES "MANIPLO-SPATIAL ARTY" REALLY WORK? A STUDY OF THE EFFECTIVENESS OF "MANIPLO-SPATIAL ARTY" AS A TEACHING AND LEARNING IN SCIENCE PEDAGOGY

Audu Omar Ahmed Otobo[1], Baba Jonah[2], and Wama Zipporah Andrew[3].

[1]Industrial Design Department, Faculty of Environmental Studies, University of Maiduguri, Maiduguri, Nigeria.
Email: Otoboahmed19@gmail.com

[2]Industrial Design Department, Faculty of Environmental Studies, University of Maiduguri, Maiduguri, Nigeria.
Email: jobabah2005@unimaid.edu.ng

[3]Department of Primary Education College Education Zing, Taraba State, Nigeria.
Email: wamaandrewagya@gmail.com

Cite this article:

Audu Omar Ahmed Otobo, Baba Jonah, Wama Zipporah Andrew (2026), Does "Maniplo-Spatial Arty" Really Work? A Study of the Effectiveness of "Maniplo-Spatial Arty" as a Teaching and Learning in Science Pedagogy. British Journal of Mass Communication and Media Research 6(1), 18-41. DOI: 10.52589/BJMCMR-MUSHTMR9

Manuscript History

Received: 20 Aug 2025

Accepted: 24 Sep 2025

Published: 7 Apr 2026

ABSTRACT: *Within the science schooling community and beyond, see "maniplo-spatial arty" carried out by learners as a requisite configuration of science education. Enquiries have been made by some erudite about its effectiveness as a teaching and learning strategy. This erudition explored the effectiveness of maniplo-spatial work by analyzing a sample of 25 idiosyncratic science lessons involving maniplo-spatial work in Nigerian Junior Secondary Schools (JSS III) and Senior Secondary Schools (SSSIII). Statistics took the form of observational field notes and recorded interviews with teachers and learners. The analysis used a model of effectiveness based on work of Millar et al., Otobo and Arku, and Tiberghien. The teachers' enthusiasm in this lesson was predominantly on emerging learners' substantive scientific knowledge, rather than on evolving learners' understanding of scientific enquiry procedures. Maniplo-spatial work was generally effective in the receipt of learners to do what is intended with physical objects, but much less effective in getting them to use little evidence that mental (cognitive) challenges of linking observables to ideas is recognized by those who designed maniplo-spatial activities for the lesson. Tasks fused explicit strategies to help learners to make such links, or were presented in schoolrooms in ways that reflected the size of the learning demand of the maniplo-spatial tasks, and categorizing those that require specific support for learners' discerning and learning in order to be effective.*

KEYWORDS: "Manipulative works," Teaching and Learning, Science Pedagogy.

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

British Journal of Mass Communication and Media Research
ISSN: 2997-6030
Volume 6, Issue 1, 2026 (pp. 18-41)

INTRODUCTION

Globally, one of the topographies of science education that sets it apart from most other conservatory focuses is that it involves "maniplo-spatial arty" doings in which the learners deploy and witness tangible things. In countries with a tradition of "maniplo-spatial arty" (rendering with creative, test-sites, inventive, imaginative, workshop and corroborative operations) in science pedagogical cycles, maniplo-spatial arty activities are often seen by teachers and others (predominantly scientists) as central to the appeal and productivity of science education (Fadzil Saat, 2013; Schwichow, Zimmerman, Croker & Hartig, 2016), The House of Commons Science and Technology Committee (2002) for paradigm remarked that:

In our interpretation "maniplo-spatial arty," as well as fieldwork, is a dynamic part of science pedagogy. It supports learners to develop their understanding of science, and appreciate that science is built on evinced and acquired hands-on adroitness that is essential if learners are to progress in science. Learners should be given the opportunity to do exhilarating and varied operational experimentations and exploratory work.

The justification of Erudite Robert (2002), Okam and Zakari (2017), and Hinneh (2017), on the supply of persons with science, agility, engineering and reckoning skills, highlights the worth of science education test-sites (laboratories) as a crucial concern. These, they argue, 'are a vital part of learners' learning involvements…and should play a domineering role in heartening learners to study [science] at higher levels (Roberts, 2002).

There is also an insinuation that learners find "maniplo-spatial arty" reasonably beneficial and hilarious as compared with other science schooling and erudition activities. In survey responses of over 1,500 learners (of a range of ages) (Otobo & Arku, 2021; Cerinin, Murray & Reiss, 2003), 73 chose (maniplo-spatial arty) 'doing experimentation in class as one of the varied methods of teaching and learning science they found 'most enjoyable.' A fairly smaller proportion (38%) selected it as one the three methods of teaching and learning science they found 'most useful and resourceful.' In both cases, this placed it in the third rank order.

Notwithstanding the rife use of 'maniplo-spatial arty' activities as teaching and learning strategies in science pedagogy, and commonly articulated view that increasing its amount would improve science education, some science educationalists have raised queries about its effectiveness. Hodson (1991), for paradigm, claimed that: An experience in many schools it 'maniplo-spatial arty' (laboratories) is vague, disordered and uncreative. For many progenies, what goes on in the laboratory underwrites diminutive to their learning of science. From a similar viewpoint, Osborne (1993), Hofstein and Mamlok-Naaman (2007), and Otobo and Watila (2018) anticipated and debated a range of alternatives to maniplo-spatial arty operatives. It was proposed that it is 'time for a reappraisal' of maniplo-spatial arty in the teaching and learning of science (Wellington, 1998; McKnight, Yarbro, Grayeal & Grayeal, 2016, Otobo & Arku 2021).

This paper presents encounters from a study of effectiveness of 'maniplo-spatial arty' as it is physio gnomically used in science didactical cycles in 10-year-old to 15-year-old learners in schools in Nigeria. The erudition queries addresses were essentially: How effective is 'maniplo-spatial arty' operatives in science pedagogy as it is actually carried-out as a teaching and learning strategy? The erudition looked at both cognitive consequences—the effectiveness of 'maniplo-spatial arty' in enhancing learners' knowledge and comprehension, either of the natural world or the procedures and practices of methodical inquiry. Though we will use the

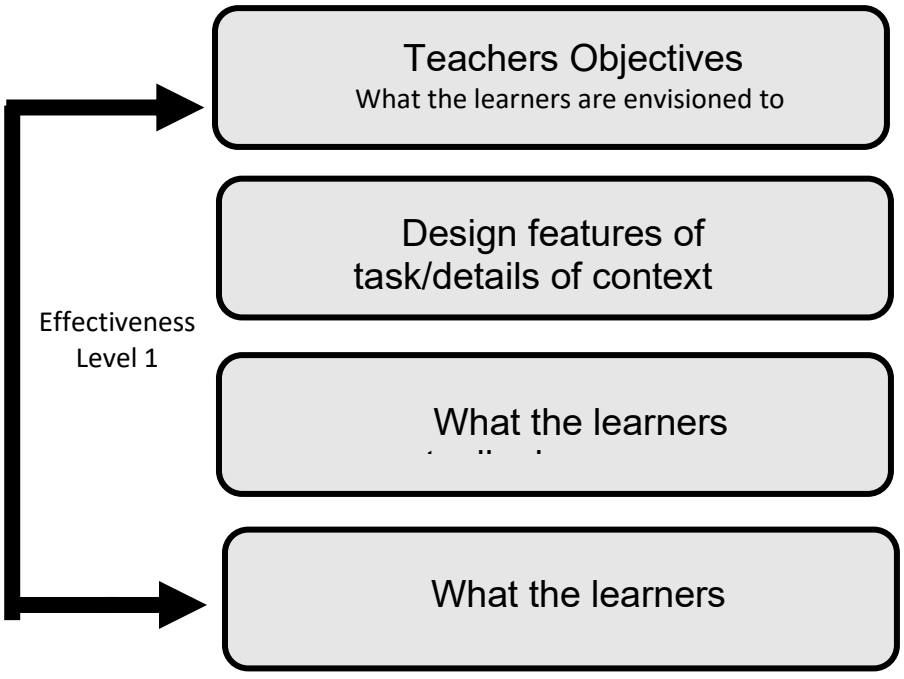
Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

term "maniplo-spatial arty" relatively than 'laboratory work' (test-sites) or 'experimental operations,' particularly in philosophy of science, it is generally taken to mean a premeditated intervention in the material world to test a guess derived from a theory or proposition. Many sciences pedagogy 'maniplo-spatial arty' tasks, hitherto, do not have this form. And while many manipulated spatial schoolings are undertaken in specifically designed and purpose-built laboratories (White, 1988; Otobo & Watila, 2018), the type of activity we are interested in is characterized by the kinds of things learners do, rather than where they do them.

A Structural Consideration for the Effectiveness of 'Maniplo-spatial Arty' Work

'Maniplo-spatial arty' operatives, as some columnists have pointed out, is a far-reaching category that incorporates actives of a wide range of types and with widely differing aims and objectives (Millar, Le Maréchal & Tiberghien, 1999; Otobo & Arku, 2021). It does not make sense, therefore, to ask whether 'maniplo-spatial arty' in general is an effective teaching and learning strategy. Rather, this erudition is to consider the effectiveness of *explicit* paradigms of 'maniplo-spatial arty' operation, or *explicit* arty tasks. To transform a diagnostic structure, the present erudition started from a model of the processes involved in designing and appraising a 'maniplo-spatial task' (Figure 1) proposed by Millar et al. (1999) and Graves (1951).

Figure 1: Mode of design process and appraisal of a 'maniple-spatial arty' task



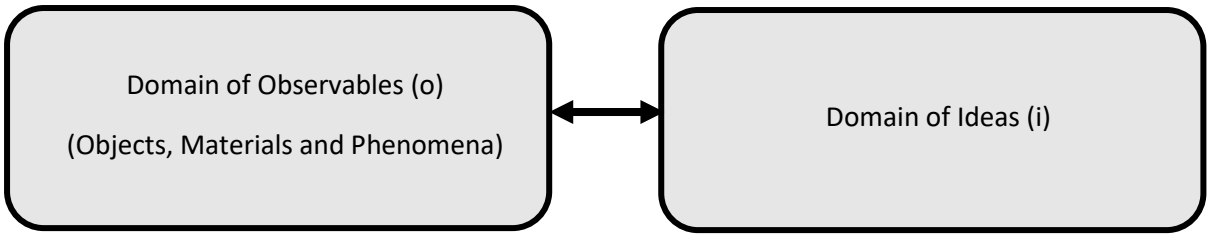
The starting point (Box A) is then the teacher's learning objectives—what he or she wants the learner to learn. This might be a specific engineering operative or creative rendering or piece of substantive scientific knowledge or a specific aspect of the process of scientific enquiry (for example, the collection, analysis, or interpretation of empirical evidence). Once this has been decided, the phase (Box B) is to design (or select) a maniplo-spatial operative that might enable the learners to achieve the desired learning objective. The next phase of the model (Box C) asks what the learners essentially do as they take on the task. For various reasons, this may

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

differ to a greater or lesser extent from what was envisioned by the teacher (or the facilitator of the 'maniplo-spatial task). For paradigm, the learner might not understand the instructions, or they may understand and follow them squarely but be prevented by faulty or inadequate operative apparatus functions from rendering or seeing what the teacher envisioned. Even if the task is carried out as envisioned, and the apparatus operative functions as it is designed to do, the learners still may not think about the task and the annotations they make using the ideas that the teacher or the instructor intended (and conceivably indeed expected) them to use. This erudition can contemplate this as a matter of whether or not learners do things that teachers or facilitators intended with ideas; this is, their intellectual activities as distinct from physical actions. The final phase of the model (Box D) is then concerned with what the learners learn as an implication of understanding the task. This model therefore extricates two learning "effectiveness." The erudition can consider the match between what the teacher or facilitator envisioned learners to do and what they actually do (the effectiveness of the task at Level 1), and the match between what the teacher intended the learners to learn and what they actually learn (the effectiveness of the task at Level 2). "Level 1 Effectiveness" is henceforth concerned with the relationship Boxes B and C in Figure 1, while "Level 2 Effectiveness" is concerned with the relationship between Boxes A and D.

In the dialogue above, the erudition has before now alluded to a further dimension—the kind of physical or mental (actions), and consequently learning, involved. The ultimate purpose of maniplo-spatial arty work in science pedagogy is to help learners make links between the real world of objects, materials and events, and the abstract world of thought and ideas (Graves, 1951; Brodin, 1978; Millar et al., 1999; Jokiranta, 2014, Shamos, 1960). Erudite Tiberghien (2000), Otobo and Arku (2021) characterized 'maniplo-spatial arty' work as trying to help learners make links between two domains of ideas (1) (Figure 2).

Figure 2: Maniplo-spatial work: Linking two domains (Otobo & Arku, 2021; Teberghien, 2000)



Some technical (science) pedagogical 'maniplo-spatial' tasks deal only, or largely with the domain of annotations; others involve both domains. Mating the two-level model of effectiveness with this two-domain model of knowledge leads to the analytical structure presented in Table 1 in view of the effectiveness of a given 'maniplo-spatial arty' task. This structure can apply equally to 'maniplo-spatial task' in which the impetus is on learners' learning about some aspects of scientific enquiry procedures.

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

British Journal of Mass Communication and Media Research
ISSN: 2997-6030
Volume 6, Issue 1, 2026 (pp. 18-41)
www.abjournals.org

Table 1: Analytical structure for considering the effectiveness of a maniple-spatial task.

Effectiveness	Domain of observation tasks (o)	Domain of ideas (i)
A 'Manipo-spartia'l task is effective at level 1 (The "doing" level) If…	…to learners doing the objects and materials provided what the teachers envisioned them to do, and generate the kind of data the teacher envisioned.	…when first carrying out the task, the learners think about their actions and observations using the idea that the teacher envisioned them to use.
A 'Manipo-spartial' task is effective at level 2 (The "learning" level) if…	…the learners can later call the things they did with objects or materials or observed when carrying out a task, and key features of the data they collected.	…the learners can later show understanding of the idea the task was designed to help them learn.

The four cells of Table 1 are not autonomous; it seems improbable, for paradigm, that a task could be effective at Level 2:i unless it was also effective at Level 1:i and perhaps in turn at Level 1:o. And the erudition is more likely to be interested in evidence of efficacious learning at Level 2:o if the task has been effective at Level 1:o. (In other words, the actions and annotations that the learners recall are the ones the erudition wanted them to make.) Despite these interdependencies, their structure provides a useful tool for analyzing paradigms of "maniplo-spatial arty" task in science pedagogy. Table 2 shows how it might apply to a maniplo-spatial task in which the learners are reconnoitering and interpreting electric current in parallel branches of an electrical motor-circuit, where the teacher's or the facilitator's aim is that learners should develop their understanding of the scientific model of current as moving charges. If the teacher's or the facilitator's focus was instead on developing learners' understanding of how to deal with 'messy' real data, then domain-o perceptive would focus on the actual annotations and data collected, whereas the domain-i perceptive would see these as an instance of a more general phenomenon, measurement error (or uncertainty).

Table 2: Indicators of the effectiveness of a maniple-spatial task involving a checkup of electric-motor circuit at each level and domain.

Effectiveness	**Domain of observables tasks (o)**	**Domain of ideas (i)**
Level 1 (the "Learning" level)	Learners set up the parallel circuit correctly from a given diagram and are able to insert the ammeter correctly and are interpreted with sufficient accuracy to obtain the pattern of interpreting envisioned by the teacher.	Learner's task and think about the circuit ammeter interpreting using the idea of electric current (charges flowing through wires and the flow dividing and recombining at junction points).
Level 2 (the "Learning" level)	Learners are able later to set up a parallel circuit and can recall	Learners show understanding of electric current as a flow of

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

	that the sum of the ammeter interpreting two parallel branches is equal to the interpretation on an ammeter placed before or after the branch.	charges and can apply these ideas to circuits. The sum of the branch currents is equal to the current before or after the branch.

A conceivable objection to this theoretic structure is that all observations is 'philosophy-laden,' so there is no clear-curt otherness between observables and ideas. Erudite Hanson (1958), Price, Jhangani and Chiang (2015), White and Sabarwal (2014), and Otobo and Arku (2021) posit that even basic remark statements that report maniple-spatial involvement are dependent upon the theoretic structure within which the observer operates (for paradigms of this in science education settings) (Gott & Welford, 1987; Feyerbend, 1988). Otobo and Arku (2021) and Hainsworth (1956) go further, declaring that 'observation' statement[s] are not just philosophy-laden … but *fully theoretical.'* They argue, however, that a pragmatic otherness can be regarded as observational and theoretical statements. The distinction that we draw in this erudition between the domain of objects and the observable, and the domain of ideas (thus between statements about this domains) is a pragmatic one, laterally these lines. We admit that all observations are at some level 'philosophy-laden,' but would argue that the extent of their "phlosophy-ladeness' fluctuates noticeably, and that the philosophy with which a given statement is 'laden' is often not an issue in the framework in which the statement is being accentuated. The otherness between observables and ideas is, we believe, a valuable and important one in analyzing the effectiveness of 'maniplo-spatial arty' tasks.

Erudition Tactic and Methods

A quantitative erudition of (large-scale) science colleges 'mainplo-spatial arty' task in Nigeria, the most recent of which is now over 25 years old (Otobo & Arku, 2021; Beatty & Woolnough, 1982; Thompson, 1975; Kerr, 1961), provides insight into the interpretations of teachers or facilitators and learners. This erudition did not, however, compare expressed interpretations on 'maniplo-spatial arty' task with observations of concrete maniple-spatiality. They might thus be seen as erudition of the rhetoric of 'maniplo-spatial arty' task, rather than the reality. It has been suggested that questionnaire-based survey is unlikely to provide accurate insights into the reality of teaching within its natural topography but is more likely to reproduce an existent rhetoric (Crossley & Vulliamy, 1964; Linn, Davis & Bell, 2004). An interview erudition is unlocked to the same opposition (Cohen, Marrison, Manion, 2000; Hammersley & Atkinson 1983). In contrast, this erudition sought to explore critically the reality of 'manipl-spatial work' in college laboratories—basic-tech labs. This requires a strategy that brings the scholars into closer contact with the teachers and learners as they undertake 'maniplo-spatial' tasks, bringing together information in the teaching laboratory (test-workshop), focusing on observation of actual practices augmented by the interviews conducted in the context of these observations. Such a tactic may realize a higher degree of *environmental validity* (Bracht & Glass,1968), that is, external validity and generalizability to others settings. When an interviewee is aware that the interviewer has observed the practice being mulled over, responses are more effectively anchored to realities, and less likely to be 'rhetorical' in nature.

For these ins and outs, a case-study strategy was chosen. There are a number of precedents for the use of such a strategy to explore, in a critical manner, the rapport between rhetoric and

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

reality within a didactic context (Ball, 1984; Green & Sharp, 1976). To evade what Herriot and Firestone (1984) term as the 'exhaustive particularism' of the conformist single in depth case-study, the erudition used a multi-site strategy, involving series 2 case-studies in different settings, parallel in scale to those undertaken by Herriot and Firestone (1984) and Stenhouse (1984). An erudite suggests that 'the possibility of perusing numerous heterogenous sites makes multi-site schoolings one potentially useful approach to increasing the generalizability of qualitative work' (Schofield, 1993).

Eight colleges were approached and the heads of the science departments (laboratory) were asked for consent to observe one or more science lessons at their colleges, Junior Secondary School (JSS 111) or Senior Secondary School (SSS 111) learners in Northeast Nigeria (learners aged 11–14 and 15–18, respectively) that involved some learner 'maniplo-spatial' task, to talk to the teacher about the lesson, and conceivably also to talk to some learners. In same science lessons in English colleges (UK), learners are assessed on their performance of a (maniple-spatial task) practical investigation, and this relates to their national test score at age 14 and their grade in the General Certificate of Secondary Education at age 16. The erudition queried that the lesson observed should not be of this kind. (Absolutely, we understood that schools were unlikely to give us permission to observe these, as a scholar's presence could have been a gratuitous distraction.) All the colleges approached were maintained state comprehensive colleges in a variety of urban and rural settings. Some of the physiognomics (characteristics) are present in Table 3; the college names listed are pseudonyms.

Table 3: College sample

College	Location	Size	Age Range (Years)	Education Authority
Government College	Urban	500	11-16	A
Sanda Kyarimi	Urban	1550	11-18	B
Elkanemi College	Urban	890	11-18	B
Gubio GSS	Rural	630	11-18	C
Konduga GSS	Rural	720	11-18	B
Waka Biu GSS	Rural	1280	11-18	B
Mafa GSS	Rural	670	11-18	C

The erudition had limited control of the content or subject matter of the lessons essentially observed in each college. Characteristically, a day of the week was agreed on for the observation visit, and a number of lessons with different teachers were offered as conceivable options when the scholar arrived. The choices were made on the basis of 'maniplo-spatial task' considerations of timing to allow pre-lesson and teacher interviews, and with the aim, as the erudition ensued, of achieving reasonable even coverage of three colleges' years in Junior Secondary School (JSS 111) and Senior Secondary School (SSS 111), and certifying that the sample included biology, basic-technology and physics topics. The dispersion of the lessons observed across key phases and science subjects is presented in Table 4. The lower number of biology lessons is a replication of the number of learners' 'maniplo-spatial tasks' that appear to be carried out by learners in biology lessons as compared with basic-technology and physics. The lesson observations later in the sequence seemed to raise the same queries as preceding

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

ones, portentous that the statistics saturation had been achieved by this point. The content of the 25 lessons observed is summarized in Table 5, along with details of the teacher and the age of the learners involved.

Table 4: Samples of lessons observed by science subjects and key phases

Key Phases (learner age)	**Biology**	**Chemistry**	**Physics**	**Total**
3 (11–14) Years	2	6	7	15
4 (15–16) Years	1	3	6	10

Table 5: Maniplo-spatial" tasks and teacher observed

Task Contents	**Instructors**
Food test – test results	Fatuiyi
Heart beats/pulse numerical equivalence	Rufai
Chemical reactions-how to identify	Musawah
Separation sand and pepper	Kabiru
Separation of iron /salt and sand	Numkovia
Chromatograph-separations of inks	Ochegbor
Cooling curve- characteristics plateau.	Abdulrasheed
Chromatograph-separations of inks	Idamah
Heat absorption – colour as a variable	-
Electric circuit – current conservation	-
Electric circuit – current conservation	Onojah
Electromagnetics – factors effecting strength	-
Electromagnetics – factors effecting strength	-
Pulleys and levers – factors affecting	-
Magnetic permeability of material	-
Acid + base = salt + water	Idamah
Starch production-factors that effects	
Electrolysis – cathode deposits	Rufai
Electrolysis – cathode deposits	Ndahmusa
Work done in raising mass	Ndahmusa
Lenes and eyes – similarities	Ugochukwu
Refraction – ray paths	Nuganjuhwa
Current in series and parallel circuits	Ugochukwu
Voltage – in parallel circuits.	Nuganjuhwa
Work done in raising mas	Ejegha
Current in series circuit	Ndirmbula

The teachers' names are all pseudonyms; the initial letter of their surname matches that of their colleges (Table 3). The field proceedings were taken in each lesson observed, and recorded interviews were carried out with the teacher before and after the lesson. The pre-lesson interview was used to obtain the teacher's account of maniplo-spatial tasks to be observed and of his or her view of the erudition objectives of the lesson. The post-lesson interview collected

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

the teacher's replications on the lesson and on its realization as a teaching and learning manifestation. Where conceivable, dialogues with groups of learners during and after the lesson were recorded (tape-recorded). These were used principally to gain intuitions into the learners' intellect about the tasks that were not ostensible from the observation.

RESULTS

The investigative package presented in Table 1 was used in analyzing the statistics and will also be used here to structure the dialogue. The erudition will begin by considering the effectiveness of task at Level 1 (in getting learners to do what the teacher envisioned). During this dialogue, each teacher is specified a pseudonym. In abstracts from interviews with learners, each is acknowledged by a cryptograph consisting of the first and last letters of the teacher's surname (to classify the lesson involved) and a number.

First, hitherto, one general point should be made. In all the lesson the erudition observed, the teacher's motivation appeared to be firmly (indeed exclusively) on the substantive skill (science) content of the 'maniplo-spatial task.' There was virtually no dialogue in any of the lessons observed of specific point about technical query in general, or any instances of the use by teacher of learners' (data) statistics to draw out general points about collection, analysis, and construal of experimental statistics. In some lessons were study opportunities to do this, they were not subjugated. So, in the dialogue below, our focus is largely on the use of 'maniplo-spatial task' to develop learners' comprehension of utilitarian science ideas—not because our configuration excludes other aspects of learning, but because this reflects what the erudition actually observed.

According to Donnelly et al. (1996) and Otobo and Arku (2021), in a detailed erudition, the 'Mnemonic Engineering Operatives Enquiry' component of Achievement Test found that extended, and more opened-ended, investigative 'maniplo-spatial tasks' were seldom used to teach learners about specific aspect technical query, but almost entirely to quantify their ability to conduct an experimental query 'scientifically.' It would seem, therefore, that an unintended consequence of the introduction of Achievement Test may be that teachers overlook opportunities that arise in the course of demonstrative 'practical task' (i.e., 'maniplo-spatial tasks' principally intended to let learners observe a phenomenon, or to help them understand a scientific idea or explanation) to highpoint and debate the rationale for the design of the task, or issues about statistical analysis and interpretation thrown up by the statistics actually collected, seeing this as a discrete strand of the science curriculum with which they deal on other occasions.

What Learners Do with Workings and Materials

The maniplo-spatial task observed was, in most cases, effective in aiding the majority of the learners to do what the teacher intended with apparatuses (objects) provided, that is, efficaciously to 'produce the individualism' (Hacking, 1983; Otobo & Arku, 2021). Various bearings subsidized this, in particular, the prevalent use of 'technique style' imposition (Kirschner, 1992, Clackson & Wright, 1992). In many of the lessons observed, teachers focused their efforts on ratifying that learners understand the technique they had to follow.

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

A specific part of 'maniplo-spatial work' (often the vital feature of the lesson) is probably considered efficacious by the teacher if the learners succeed in producing the desired phenomena and making the desired observations. More than a few teachers in the erudition, particularly those teaching outside their subject specialism, make clear their choice of maniplo-spatial task, as in the excerpt.

Scholar: Why did you choose a 'maniplo-spatial task'?

Mrs. Nugamjuhwa: It was part of the new arrangement of work we are now using.

Scholar: So, it really wasn't your choice?

Mrs. Nugamjuhwa: No, no, it wasn't.

Scholar: Is that same for the worksheets (questionnaires)?

Mrs. Nugamjuhwa: Yes, they are part of the same arrangement.

This moved responsibilities for the choice of question to be addressed and/or phenomenon to be produced (as well as other issues concomitant to the task) on to the author(s) of a published or college produced arrangement of work, and depicted their own accountability primarily in terms of 'delivering' an activity judged appropriate by others. Fourteen of the 25 teachers observed implicitly that they were following an arrangement of work that included the 'maniplo-spatial activity' observed. Ten teachers used (worksheets) questionnaires that were part of such arrangement. The use of both was greater among teachers for whom the lesson was outside their erudition specialism. Table 6 shows that four (of ten) teachers teaching in their subject specialism were following an arrangement of work, equated with 10 (of 16) teachers for those teaching outside their subject specialism, with only two (of ten) teachers teaching within their subject specialism. While the sample size (n = 25) is too small to make a sweeping statement with confidence from these statistics, the pattern is reliable with the findings of other erudition (e.g., Hacker & Rowe, 1985) that teachers working outside their specialization tend to rely more on humdrum and controllable actives, which reduce the chances of unexpected events or questions.

Table 6: Teachers' use of arrangements of work and questionnaires (worksheets)

	Yes	Using Worksheets	No
Teachers working within their subject specialism.	Yes	2	2
Following a scheme work	No	0	5
Teachers working outside their specialism	Yes	0	4
Following a scheme of work	No	1	5

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

Some teachers expounded their use of 'technique style' task on the basis that there was, in their view, simple insufficient time within a typical 1-hour 'maniplo-spatial lesson' to be confident that most of the learners would successfully design and set up the mockups (apparatus/working tools), produce a particular phenomenon, and record and analyze the results, if the task were presented in a more open and unstructured manner. In Mrs. Onojah's words, 'I contemplate that they need to come in, be told how to do it, and get a result.' Compatibly, Mr. Ndahmusa annotated that, 'Often the maniplo-spatially task is design to be learners friendly. You know, to make sure that within your double [period lesson], they will see—at least most of them will do—what you want.'

The splendid sagaciousness, from the set of lessons observed, was that a high precedence for teachers is pledging that the majority of learners can produce the intended phenomenon, and collect the intended statistics. This is not astounding, as the effectiveness of a maniplo-spatial task in all the other cells of Table 1 depends on its effectiveness at level 1:o. If, however, this ceases to be merely a precedent and becomes the sole objective, the learning value of 'maniplo-spatial work' is suggestively limited.

What Learners Do with Ideas (Level: i)

The meaning 'what learners do with objects and materials' is self-explanatory. 'What learners do with ideas, however, is less approximately clear. The erudition uses 'doing with ideas' to refer to mental actions—the process of thinking (and hence talking) about objects, materials, and phenomena in terms of theoretical entities or paradigms that are not directly observable. Evidently, not all thinking is tantamount to 'doing with ideas' in this sense. For paradigms, a learner may think about the readings on the voltmeter entirely in terms of observables—the position of a pointer on a scale—rather than as measures of latent difference. Or they may see variation in recurrent measurements of the same quantity as a sign of inadequate equipment, or as a real effect, rather than as a paradigm of a general issue facing all experimental statistics collection. Getting learners to think about objects, materials, and phenomena within a particular framework of ideas can be difficult, as these ideas do not present themselves directly to their sagaciousness.

Virtually all of the 25 tasks presented in Table 5 provided chances for learners to think about observables using specific technical ideas, although the extent to which this might have had a significant impact on their actions or on the possible learning outcomes varied from task to task. As debated in the previous section, a desirable majority of the tasks appeared to be effective in OK'ing the learners to do what was intended with objects and materials. This was, however, noticeably less evident that they were as effective as getting the learner to think about those same objects and materials using the ideas that were implicitly or explicitly intended by the teacher. One conceivable reason for this was that, in many of the tasks observed, the learners seemed unacquainted with the ideas that the teacher intended them to use. This dearth of acquaintance did not necessarily mean that the ideas had not been imparted. For paradigm, notwithstanding Mrs. Ugochukwu's confirmation that the learners in her college, Senior Secondary School (SSS 1) class, had been taught about electric circuit at several times in the preceding years, some were still manifestly unfamiliar with the basic idea that a voltmeter measures a difference of same kind between two points. A knowledge of this might have made them more likely to place the voltmeter in parallel rather than in series:

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

Scholar: [Observing as Ugochukwu 7 places the voltmeter in series.] So how have you got your voltmeter coupled [Ugochukwu 7 snubs the question.] How would you say your voltmeter is coupled to the circuit?

Ugochukwu 7: [Interjecting] It needs to be on an analogous line, doesn't it?

Scholar: [To Ugochukwu 7] So how have you got it?

Ugochukwu 7: I'm not sure. I don't know.

A dynamic motivation, however, for a small number of samples of learners 'doing things with ideas' appeared to be the extent to which the 'maniplo-spatial task, and the way the teacher introduced and staged it, facilitated the learners to make creative links between the domains of observables and ideas. To typify the practices characteristically pragmatic and the issues they raised, the erudition will debate briefly three lessons; further samples can be found in Otobo and Arku (2021). All provided chances for the learners to think about the observables using technical ideas (scientific) that might have made their observations more meaningful. The two-tasks used by Mr. Musa and Mrs. Rufai, however, were used exclusively to enable the learner to engender a dataset in which they should see a pattern between observables.

Mrs. Rufai's task required the learners to measure and then compare their pulsation rate (observable) with their heart rate (observable) in order to diagnose the comparison of these values, and plausibly realized that they were measuring the same thing. Mrs. Rufai chose to not debate the circulatory system before they began. Amplification when interviewed that she whispered the connection between heart rate and pulsation rate will emerge from the statistics. This rather inductive ('statistics first') view of 'maniplo-spatial task' seemed to underlie the practice of several teachers observed. Tactlessly, by the end of the lesson, when the learners' results had been put up on the board, many learners had obtained different values for these two interpretations; so, the desired results failed to emerge. As per the circulation of blood within the body having not been debated, most learners had no clear idea why the pulsation rate should be the same, as the heart beat and some, as the following extract shows, were clearly skeptical of Mrs. Rufai's efforts to imply that two different numerical values were indispensable the same:

Mrs. Rufai: The question is [pointing to data on the board], is the pulsation rate the same as the heart beat?

RA 15: No.

RA 16: No, no.

Mrs. Rufai: Right, near enough, who said that? [No response from the learners and nobody heard any saying it on the acoustic tape.]

RA 12: [Calling out] But 104 and 90 are miles apart.

By the end of the lesson, one learner (RA 19), who seemed muddled by the statistics on the board, asked, 'What is pulsation?'—to which Mrs. Rufai, without any further explanation replied, 'Your pulsation is your heart beat.' Had this task started with a dialogue of the idea that blood is pumped by the heart around the body, and that the pulsation is the consequence of the heart beat and should therefore be measured at the same time and have the same value,

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

this might have made the task more telling to the learners and therefore more efficacious. This is one manifestation of the point made earlier that teachers repeatedly overlooked opportunities to develop learners' understanding of specific aspects of technical (scientific) enquiry procedure. There was an opportunity, which was not taken, to ask whether the measurements provided a suggestion of real changes in the heart rate (perhaps owing to a construal having been taken after running around the class to borrow stethoscope) or were simply a result of measurement error (or uncertainty).

In Mr. Idamah's lesson, the aim of the 'maniplo-spatial task' was explained to the learners as being to answer the question, 'What effect does the colour of a can have on its capacity to take in heat or not take in heat?' Even though expressed in run-of-the-mill language, this clearly involves theoretical ideas. While temperature might be measured, observable heat and movement of heat are not. Having introduced the term 'heat,' Mr. Idamah made no further focus on any technical ideas about heat, or energy, moving from the lamp into or out of the cans. In fact, the task was undertaken absolutely at the level of observables and its purpose might have been more accurately described as: to see which of a number of differently colored cans shows the greatest change in thermometer interpretation when placed near a lamp. Mr. Idamah later explained that this was in fact what his aim had been, and that he saw the purpose of this particular 'maniplo-spatial' knowledge as being to enable the learners to carry out a procedure efficaciously and create and record statistics from which 'the ideas of absorption and reflection will be developed in subsequent lessons.' His desire to ensure that the learners understood what to do with objects and materials (apparatus/equipment's), and could get ahead in generating the statistics, led him to give all of the procedural instructions in graphic run-of-the-mill language. Having explained the procedure, he paused briefly before the learners began the task to remind them that they had previously used the term 'absorb' to mean 'taking in heat' and 'reflect' to mean 'not taking in heat.' In spite of this brief reminder of relevant technical ideas, none of the learners was heard to use these as they carried out the task. Undeniably almost all of the learners' dialogue observed by the scholar focused on the maniplo-spatiality of carrying out the task and, explicitly, on who would do what with which piece of equipment and when they could swap roles. On the junctures when learners were earwigged talking about their observations, beyond simple calling out of thermometer interpretations, their annotations debated only to observables. The following extracts are typical:

Idamah 4: [Feeling the black can.] The black can is very hot.

Idamah 5: Let me feel it.

Idamah 6: Let me feel it too.

Idamah 10: [Feeling the black can.] Think the black feels hotter than

The third lesson stands in noticeable disparity to the two above. In it, the teacher, Mr. Ndirmbula, consciously configured the 'maniplo-spatial' task so as to input the learners in fashioning links between the domains of observables and ideas. Mr. Ndirmbula's lesson on current and voltage in a parallel circuit was introduced through the use of a model, presented in a short PowerPoint, in which run-of-the-mill (everyday) objects provided an analogy to an electric circuit. Acolytes observed a caricature (cartoon) character pick up boxes from a store. Having got the acolytes to debate and understand what was happening in this model, Mr. Ndirmbula used it as scaffold for getting them to think and talk about an ammeter (In the model, this was a stratagem to count people.) and then, based on an analogy between people and

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

charges in the technical model, to think about the function of the ammeter as being to charges. As the acolytes' (pupils') familiarity and sureness with the use the technical ideas and terminology increased, many began to replace idiomatic terms that had been used in debating the model with apposite scientific terminology used within a scientific model, as the following extract illustrates:

Scholar: What have you found?

Ndribula 5: I was wrong. [Their initial prediction was based on a current diminution model.] They all stay the same except for one where it went up a tiny little bit.

Scholar: So, what's that told you?

Ndribula 5: That amps don't really change.

Scholar: And what are the amps measuring in the model you're using?

Ndribula 5: The amount of change going round. The number of people's not changing.

Although the majority of learners continued to use a combination of scientific and colloquial terminology, a small number of learners, by the end of the task, were able to discuss (and appeared to understand) the electric circuit situation and could use the appropriate scientific terminology:

> **Scholar:** So, what's the voltmeter actually measuring?
>
> **Ndribula's 21:** The energy.

Scholar: [Directing the question to Ndurbula 22] So this voltmeter that you've connected across a bulb, what's it measuring?

Ndribula 22: How much energy is going in and how much energy is coming out.

Ndribula 21: How much energy it has lost.

Despite the fact that Mr. Ndirmbula was not inimitable in the sample of teachers observed in *anticipating* the learners to think about the task using specific ideas, he was the only teacher observed who devoted so much of the lesson time to ensuring that learners were not only introduced to the appropriate scientific terminology but also understood what the technical terms meant and were able to use them pertinently to talk about the task.

Recurring to the set of lessons observed, the focus of the teacher's persuasion on their acolytes' 'maniplo-spatial' actions (rather than psychological ones) is clear from the enticingly greater amounts of time spent on this. Table 7 presents an estimate of the time spent by the teacher on the 'whole class's activities only, as it was not possible from the lesson field notes to estimate accurately the time spent by the teacher on different types of activity during periods of small group or individual task, and this would, in any case, have contrasted from learner to learner. In spite of this constraint, Table 7 provides a clear suggestion of the extent of the disparity in the relative amounts of time spent supporting 'maniplo-spatial' and psychological activities.

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

Table 7: Distribution of whole class time to different characteristics of the lesson

- Time (min.) spent by teachers on whole class, discussion and perhaps demonstration)
- Time (min) spent by students.

Task Teacher	What to do with	Ideas/or models to be used	Manipulating objects and materials
1. Fatuyi	13	0	1076
2. Rufai	13	0	1076
3. Musa	4	0	14
4. folorunsho	11	0	30
5. Kabiru	17	0	40
6. Nunkoria	3	3	18
7. Ochiegbo	15	0	28
8. Abdulrasheed	14	0	23
9. Idamah	9	0	28
10. James	8	0	26
11. Odeyi	10	0	34
12. Onojah	14	0	25
13. Kashimu	6	0	20
14. Ochebe	9	4	23
15. Joseph	10	0	40
16. Emmanuel	21	0	33
17. Idamah	11	5	40
18. Rotimi	9	0	33
19. Rufai	14	0	23
20. Ndahmusa	2	0	7
21. Ndamusa	33	0	10
22. Ugochukwu	10	0	24
23. Ejegha	5	5	34
24. Nugamjuhwa	11	0	15
25. Ndribula	7	29	14

All of the teachers observed enthusiastic 'whole class time,' in some cases a substantial proportion of the lesson, to ensure that the learner was able to produce the phenomenon efficiently and collect the statistics. Only Mr. Ndribula gave appreciable 'whole class time,' and most gave none at all, to debating the ideas that were required to carry out the task with understanding and so make it more than a simple robotical procedure.

The statistics in Table 7 do not mean that in only five of the 25 lessons observed did the teacher use any stage to help the learners to contemplate about the observables using specific hypothetical ideas. Some teachers who had not debated hypothetical ideas with the whole class in advance became aware, as the 'maniplo-spatial task' proceeded, of the need to introduce such ideas. For paradigm, Mr. Anyaoha, finding that learners were not thinking about the

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

temperature plateau as a liquid cooled and solidified using the ideas that he intended them to use, began to assist the learners on the 'group by group basis':

Mr. Anyaoha: Here's a liquid. [stands in front of a small group of learners, who had been inept to explain to him the obstinacy for the temperature plateau, and moves his arms about intermittently and with dynamism making a noise like an inundation train] And here's a solid [arms held, and moved, stringently in front of him whilst making a low droning noise] I want to change this liquid [weaves arms energetically again] into a solid [arms move rigidly and less energetically]. What's this [arms go from moving energetically and less intermittently to being held rigidly] got to lose [places strong emphasis on the word 'lose'] to change into a solid?

Anyaoha 3: Energy.

Anyaoha 1: As its movement.

His interpositions might be seen as providing a *platform*, something that 'enables a teen or novice to solve a problem, carry out a task, or achieve a goal which would be beyond his solo efforts' (Wood, Bruner, & Ross, 1976). This was, hitherto, an *ad hoc* rejoinder to events in one novice group, rather than a strategic interposition to address a conceptual challenge that had been recognized in advance and had influenced the design or presentation of 'maniplo-spatial tasks.'

To reiterate, then, the erudition observations of these 25 lessons suggested that the 'maniplo-spatial tasks' used were generally ineffective in helping learners to see the task from a scientific perspective, and to use hypothetical ideas as a framework within which their actions made sense or guide to interpreting their observations. Teachers overtly gave much lower priority to the underlying scientific ideas than to 'production phenomenon.' The design of the 'maniplo-spatial tasks,' and the way they were presented to the learners by the teachers and were staged in the schoolroom setting, were blindingly similar across the set of tasks, given their wide variety of content. There were no understandable differences in the design or staging of tasks that depended more critically on learners' emergent links between the domains of objects and observables. The diagnostic configuration presented in Table 1 extricates two levels of effectiveness of a 'maniplo-spatial task.' Level 1 concerns whether learners *fixed* the things the task designer intended, and Level 2, whether they *learned* the things they were intended to learn. The erudition will now consider the effectiveness of the lessons observed at Level 2. The modification between Level 1 and Level 2 is impartially clear for the domain of observables. Effectiveness at Level 2 would mean that the learner could later reminisce and report accurately on things they had done with the object and materials (apparatus and paraphernalia) involved, and the phenomena they had observed. The transformation between effectiveness at Levels 1 and 2 is less clear, hitherto, for the domain of ideas. Here the erudition is making a distinctiveness between being able to 'do things with ideas' during the lesson, and showing understanding of these ideas later. It might be argued that, if a learner can use an idea appropriately during a lesson, this indicates that the idea has been 'learned,' in which case the only distinctiveness between Level 1 and Level 2 is that between short-term and long-term retention of what is learned. The erudition might, on the other hand, argue that, if the dexterity to use an idea is not retained for even a short time (for paradigm, a week), then it is difficult to claim that it was ever 'learned.' In this erudition, we took effectiveness at Level 2 to mean approximate signal of medium-term to long-term retention of information and ideas initially obtained through the 'maniplo-spatial task.'

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

British Journal of Mass Communication and Media Research
ISSN: 2997-6030
Volume 6, Issue 1, 2026 (pp. 18-41)

www.abjournals.org

The design of this erudition, however, means that we can say much less about the effectiveness of 'maniplo-spatial task' at Level 2 than at Level 1, and that anything we do say is based on weaker evidence. The erudition pursued and gained permission to observe single lessons that included 'maniplo-spatial work.' Had the learning asked for wider access to observe consequent lessons, this would not have been forthcoming in many cases because of the perceived disruption to routines. Other actions, to assess learners' understanding of the key points of the maniplo-spatial tasks, either shortly after the lesson observed or later, were also impossible, not the least because this would have required that different diagnostic apparatuses be created for each lesson observed, which have introduced many new variables and made general conclusions almost incredible to draw. The erudition thus decided to limit statistics assortment to a single visit for each 'maniplo-spatial task.' Our findings about effectiveness at Level 2 are based on two main kinds of evidence: proposition of short-term knowledge within the lessons observed or in post-lesson learner interviews, and annotations by learners during interviews on previous 'maniplo-spatial works' they had done, in some cases on previous instances on which they had done the same 'maniplo-spatial task' as that observed.

What Learners Acquire about Observables (Level 2:a)

In an interview about the lessons observed and about previous maniplo-spatial tasks, many learners were able to ruminate details of what they had done, or observed their teachers doing, with apparatuses and paraphernalia (objects and materials) and what they had seen. Recurrently, however, this was all they could call to mind. Even when learners were able to recall specific 'maniplo-spatial tasks' they had carried out previously, their recalls typically amounted to little more than recollection that a particular task had 'been done,' or focused on an unambiguous detail or aspect of the task. The task about which the learners were able to recollect specific details inclined to be those that were, in some sense, unusual. These characteristically exhibited one more of the following three physiognomic factors:

1. A unique visuality, acoustic, or olfactory factor ('flashes, or bangs or smells').
2. A novel context or method of presentation.
3. A 'gore' issue.

Of the 68 tasks remembered in learners' interviews, 27 were ones in which the learners' primary, and in most cases only, remembrance was concomitant to a distinctive visuality, acoustic, or olfactory factor. In further 18 tasks, the remembrance involved tasks that were presented in a comparatively unusual context or method. For paradigms, they might take place in a topography other than the science laboratory, or involve some form of role-play or a private-eye mystery. A 'gore' factor was suggested in three of the most vividly recollected natural science (biology) tasks. (Labeling reflects the learner's understanding of the tasks.) Erudite Gagne and White (1978) and Otobo and Arku (2021) posited that it is the act of undertaking a task, rather than merely rendering about it or having it demonstrated, which makes its reminiscence more likely. This erudition suggests that task recollection depended to a much greater extent on the presence of at least one of the above three characteristics. Enchantingly, White's (1979) peculiar example of a 'maniplo-spatial task' that he vividly recollects is not one that he undertook but the visually remarkable ignition of carbon monoxide *demonstrated* to him by the teacher. Likewise, 14 of the'maniplo-spatial tasks' recollected by the learners in this erudition (21%) were visually prodigious teacher demonstrations. One of the most frequently mentioned was a demonstration of the Thermite reaction, which often had

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

both characteristics 1 and 2 above. Learners' recollections invariably focused on the visually and aurally prodigious nature of the reaction itself and the fact that it was undertaken outside the laboratory (Conoley & Hills, 1998). For some, the fact of having carried several bricks outside to provide a base on which to place the reagents was the most durable recollection:

Scholar: What other maniplo-spatial tasks do you remember?

Mr. Ducinwhyai 18: That one with the brick that we did outside was quite good.

Mr. Ducinwhyai 17: Yeah, he put loads of different stuff in it, set light to it, and it whoosh! That was pretty exciting.

Miss Rifkatu 9: Well can you [addressing another learner] remember that experiment that we had to do with a brick outside?

Scholar: Was that Mr. John?

Rifkatu 9: Yeah.

Scholar: What do you remember?

Rifkatu 9: A big explosion and all that.

A 'maniplo-spatial activity' might also be 'unusual' in a way it is staged in a didactic cycle. Several recalls, for paradigm, were of lessons that involved a component of 'role-playing.' Many of Miss Yousuf's SSS III (Senior Secondary School) learners recollected an 'unusual 'maniplo-spatial activity,' also on topic of current conservation and voltage, which they had undertaken in Mr. Ndribula's class about one year earlier. This was not the lesson designated hitherto, although it had some similarities to it. Although the learners referred to it as 'maniplo-spatial,' it was not an activity in which they had to activate or observe the real objects of the erudition. Instead, they had constructed a 'circuit' by rearranging the laboratory benches and then walking or standing these so as to 'act out' the role of electrons, with other objects or feature representative battery, lamps, ammeters, and voltmeter (Braund, 1999). A source of cardboard boxes was used to characterize energy being given by the battery to electrons, and by the electrons to the lamps. Erudition proposes that 'when learners act out actions, the experience can help them to remember' (National Curriculum Council, 1989). The fact that this activity, and another more modest kind of roll-play involving chromatography, in which learners were invited to see themselves as criminological scientists and asked to determine which of several given inks was the same as one used to sign a forge cheque, was recalled by many learners appears to bear this out.

The nature of learners' recollections in this erudition, however, submits that memorable aspects or features of a 'maniplo-spatial task' seldom provide an anchor for the associated scientific ideas, as Erudite White (1979) has anticipated, but rather an anchor for *graphic* accounts of the task. The learner's helplessness to recollect anything beyond a scrappy description does not, of course, mean that they may not have learnt more than this from the task. But it does indicate that what the learners are aware of having learnt, and are able to recollect without assistance, frequently differs decidedly from what the teacher had envisioned them to learn.

Similarly, learners' recollections about procedures tended are concomitant to what they had done rather than the ideas this was intended to convey:

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

Scholar: What maniplo-spatial tasks do you remember doing?

Abdulrasheed 7: Purifying paraphernalia.

Abdulrasheed 8: Yeah.

Scholar: What did you distill or purify? Crude oil?

Abdulrasheed 7: Yeah, a blue liquid.

Abdulrasheed 8: Yeah, it was a blue liquid.

Abdulrasheed 7: Just a blue liquid; we don't know what it was; just a blue liquid and we got water out of it.

Researcher: You got water out of it; how did that work?

Abdulrasheed 7: Well, we got a bottle.

Abdulrasheed 8: We put a liquid in it, put a thermometer in it, put it on a trivet, put a Bunsen burner under it and it went through all the tubes in place, and went into a test tube in the beaker.

Abdulrasheed 7: Hot water went into a beaker.

Abdulrasheed 8: Yeah.

Abdulrasheed 7: And if the temperature goes over too far, over a hundred, you have to take it out and then hold on a bit and then have another go.

The paradigm verified above what learners may recollect in some detail procedure they have followed. But there is no mention in the extract above, or in the dialog from which it is taken, of different boiling points of the apparatuses of mixture of liquids or how this procedure resulted in their separation. The emphasis on the observable details is unswerving with the enunciation of many of the teachers observed, distinguished earlier, on getting the learners efficaciously to do what they intended with apparatus and paraphernalia's (objects and materials), in order to produce an exact phenomenon, reflected in their use of whole class time in lessons (Table 7).

What Learners Acquire about Ideas (Level 2:i)

For paradigm, we have noted, statistics collected during and approximately after a 'maniplo-spatial' activity do not provide a strong proposition of learners learning of the ideas the activity aims to help them understand. A 'maniplo-spatial' activity is, of course, expected to be just one component of a strategic sequence of activities designed to develop learners' understanding of a specific point or topic. Focusing on some of the lessons observed, teachers may have used successive lessons to joke-out the links between observations and ideas. Also, it may be perverse to expect lasting learning to fog from any single exposure to an idea, however clear or notable. Mr. Ndribula, for paradigm, commented that, 'What I hope it is when they do it [the science operative topic] again…even though they will have overlooked it; they will go, "Oh absolutely. I recall that" and they will get it quicker the next time.

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

Post-lesson learner consultations provided diminutive suggestions of lasting effects of 'maniplo-spatial tasks' on learners' abstract understanding. Effectively all the learners' recollections were in the sphere of objects and observables. Even the Senior Secondary School (SSS II) learners are being taught by Miss. Ejegha, all of whom had undertaken the same lesson by Mr. Ndribula debated earlier, when learners were guided towards creating links between the domains of objects of observables and ideas, showed no suggestion of being able to recall either the observables or the ideas, or links between them. On the other hand, many did recollect an 'unusual' maniple-spatial lesson, also taught by Mr. Ndribula the past year, involving the electric circuit role-play described in the preceding section. Hitherto, many of them were able to recollect scientific ideas involved.

Ejegha 4: One to do with electric circuits. We put all table together so that they made, they were the wires.

Ejegha 5: Yeah, we had to walk on the table boxes and people imagining to be voltmeters

Scholar: What did it display to you?

Ejegha 5: [Hilarity] I can't diagnose.

Ejegha 4: [Heebie-jeebies head signifying that they too don't know]

Unfluctuating those learners who recollect the term 'electron' used it only to describe their role within the role-play, rather than as the name of a depressingly charged atom whose movement through wires constitutes an electric current.

CONCLUSION

The objective of this erudition was to attain a picture of the 'realism' of 'maniplo-spatial arty' work as it is used in college science pedagogy in Nigeria with learners aged 11-16. One imperative result is the seeming separation, in teachers' thinking and planning, of the teaching of applicable scientific knowledge and of the procedures of scientific request for information. In a sample of 25 lessons involving 'maniplo-spatial task, designated essentially on the single criterion that they did not involve assessment of learners, the awesome emphasis in teachers' presentation of task, and the dialogue of learners' actions and statistics, was on the applicable science content rather than on aspects of experimental design or statistics collection, analysis, and construal of evidence. The implicit hypothesis is that learners will pick up an anecdotal understanding of what it means to plan and conduct a query scientifically.' So, their dexterity in science schoolwork can be tested at intervals, but not have to be explicitly taught (the rehearsal noted by Donnelly et al., 1996; Otobo & Wilson, 2021). This proposes that we still have some way to go in Nigeria to develop models of rehearsal in the use of 'maniplo-spatial work' that more effectively integrates its roles in developing applicable and procedural understanding.

Comprehensively, we noted a significant difference between the efficacy of 'maniplo-spatial work' in the sphere of observables and in the sphere of ideas. Hitherto, many teachers do assume learners to learn hypothetical (theoretic) ideas through maniplo-spatial activities, as an import of actions carried out with apparatus and paraphernalia (objects and materials). The teacher in the erudition sample recurrently included the learning of technical ideas amongst

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

their objectives for maniplo-spatial lesson. This, however, contrasted with the absence of any overt evidence of planning how learners might learn such ideas from what they did and observed, either in the acoustic or textuality instructions on the task or in the way these were presented. Diminutive time is devoted to supporting the learners' development of ideas. Many teachers appeared (wordlessly or explicitly) to hold an inductive, 'discovery based' construal of learning—to expect that the ideas that they intended learners to learn would 'emerge' of their own accord from the observations or measurements, as long as they only produced them efficaciously (Solomon, 1994). The eventual epistemic tide in this viewpoint, and the 'maniplo-spatial arty' hitches to which leads, have long been recognized (Driver, 1975). Our erudition suggests that maniplo-spatial work in science could be significantly improved if teachers documented that explanatory ideas do not 'emerge' from observations, no matter how prudently these are guided and constrained.

There is an empathy between ideas and observation in science. An important role of maniplo-spatial work is to help learners develop links between observation and ideas. But these ideas have to be habituated. And it may be important that they are 'in play' *during* the maniplo-spatial activity, rather than habituated after it to account for what has been observed. Erudite Solomon (1999) debates the critical role of 'envisionment' in 'maniplo-spatial work' of helping learners to visualize what might be going on 'beneath the observable surface' as they activate the objects and materials and make their observations. This gives drive to the operation made, setting the learners' actions within a particular perspective on the event. Erudite Millar (1998) and Otobo and Arku (2021) mull over the erudition function of several common 'maniplo-spatial tasks' in similar terms. The evidence of this erudition suggests, thus far, that few 'maniplo-spatial' lessons are designed to stimulate an interaction between observations and ideas *during the maniplo-spatial activity*. Even if these links are developed in successive lessons, the fact that the ideas are not accessible to make sense of the activity (to see its drive) or of the observations made (to construe these in the light of the theoretic summary of ideas and models) reduces the effectiveness of the maniplo-spatial activity as a learning event.

IMPLICATIONS

As a reputable suggestion for practice, we accept as true that the two-sphere model used throughout this paper is a useful tool for teachers astute about maniplo-spatial work. In the beginning, it draws consideration to the two—spheres (domains of knowledge) involved, and their separateness—that one does not simply 'emerge' from the other. Secondly, it provides a means of assessing the 'learning demand' of the task. Erudite Leach and Scott (1995, 2002) and Otobo and Arku (2021) have developed the ideas of learning demand to debate teaching and learning in science more generally. They use it to capture the sense that some activities, and the learning steps they are designed to help learners take, make meaningfully greater cognitive demands than others. In the context of maniplo-spatial work, there is a substantial difference in learning demand between tasks in which the key aim is that learners should see an event or phenomenon or become able to manipulate a piece of equipment, and tasks where the aim is that learners develop an understanding of certain theoretical ideas or models that might account for what is observed. If teachers could be helped to discriminate more clearly between tasks of reasonably low learning demand and those where the learning demand is much higher, this would then allow them to catalogue those tasks where learners might require greater levels of support in order that the envisioned learning might transpire. The only lesson

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

of those observed in which we saw clear suggestion, from the way the task was presented to the learners and staged in the schoolroom, that high learning demand had been foreseeable as Mr. Ndribula's lesson on electric circuits.

The key insinuation here is for the design of 'maniplo-spatial tasks' as many of the topographies of their staging follow from this. We (erudition) believe that, in the light of the statistics collected in this knowledge, maniplo-spatial could be suggestively improved were teachers, and other authors of teaching materials, more clearly aware that maniplo-spatial tasks requiring learners to make links between the domains of objects and ideas are palpably more demanding than those that simply require them to observe and reminisce the observable features of an event or process. Task design might then more obviously resonate an understanding that 'doing' things with objects, materials, and phenomena will not lead to the learners 'learning' (or even 'using') scientific ideas and perceptions unless they are provided with what Wood et al. (1976) term a 'scaffold.' The process of scaffolding provides the initial means by which learners are helped to 'see' the phenomena in the same 'scientific way' that the teacher 'sees' it (Ogborn, Kress, Martins & McGillicuddy, 1996). As erudite Lunetta (1998) has dealt with:

Test center inquiry alone is not satisfactory to permit students to construct the multifaceted intangible understandings of the current scientific community. If students' understanding is to be changed towards those of accepted science, then intervention and negotiation with authority, usually a teacher, is essential.

The issue, then, is the *form* of this intervention and negotiation with the teacher, and the extent to which the need for it is accredited and built into the maniplo-spatial task by the teacher or the author of the teaching materials.

Given the importance in any maniplo-spatial task of helping the learners to do what the teacher envisioned with objects and materials in the circumscribed time accessible, 'recipes' are likely to continue to have a significant role in science maniplo-spatial work. If, hitherto, the scale of the mental challenge for learners in linking their actions and observations to a configuration of ideas were documented, teachers might then split maniplo-spatial lesson time more equitably between 'doing' and 'learning.' These do not, of course, have to be obdurately separated, but teachers need, on the basis of our statistics in this erudition, to devote a greater proportion of the lesson time to helping learners use ideas concomitated with the phenomena they have produced, rather than seeing the efficacious production of the phenomenon as an end in itself.

We have dealt with the above that the analytical framework we used in this erudition could assist teachers in assessing the learning demand of maniplo-spatial tasks, and hence in recognizing tasks that required more cautious design for effective learning to be a leeway. Also, we think that the use of this framework could help teachers to make more focused appraisals of the effectiveness their own postmodernist (technological advancement) practice, perhaps thought-provoking review and revision of some of the maniplo-spatial activities they use in ways that could significantly increase their 'payoff' in terms of learner learning.

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

REFERENCES

Ahmed, O.A, & Watila, M.M. (2018). Implication of Hemispheric Task for Effective Arty Teaching Skills. The Artist Journal, (ATU*). A Journal of Faculty of Environmental Studies University of Uyo.* 2(3),31-40

Ball, S. J. (1981). Beachside comprehensive: A case-study of secondary schooling. Cambridge, UK:Cambridge University Press.

Beaty, J.W., & Woolnough, B. E. (1982). Practical work in 11-13 science: The context, type and aims of current practice. *British Educational Research Journal*, 8(1), 23-30.

Bracht, G. H., & Glass, G. V. (1968). The external validity of experiments.*American Educational Research Journal*, 5(4), 437-474.

Braund, M. (1999). Electric drama to improve understanding in science School Science Review,81(294), 35-41.

Brodin, G. (1978). The role of laboratory in the education of industrial physics and engineers. In J.G. Jones & J.L., Lewis (Eds.), *The role of laboratory in physics education* (pp. 4-14).Oxford, UK: ICPE/GIREP.

Cerini, B., Murray, I., & Reiss, M. (2003). *Students review of the science curriculum*. Major findings.
London: Planate Science/Institute of Education University of London/Science Museum. Retrieved February 27, 2007, from http;//www.planet-science .com/SciTech/review.

Clackson, S.G., & Wright, D.K. (1992). An appraisal of practical work in science education. *School Science Review*, 74(266), 39-42.

Fadzil, H.M. & Saat, R.M. (2013). Phenomenographic study of students' manipulative skills during transition from primary to secondary school in. *Saint Humanika*, 63(2), 71-75.

Hinneh, J. T. (2017). Attitude towards Practical Work and Students Achievement in Biology: A Case of a Private Senior Secondary School in Gaborone Batswana. *JOSR Journal of Mathematics (JOSR-JM)*, 13(4), 06-11.

Holstein, A., & Mamlok-Naaman, R. (2007). The Laboratory in science education:
The state of the art. *Chemistry Education Research and Practice*, 8(2), 105-107. https://doi.ong/10.10339/B7RP00093A

Jokiranta, K. (2014). *The Effectiveness of Practical work in Science Education*. Bachelor's Thesis.
Available from: https://jyu.fi/dspace/bitsteam/handle/123456789/4297/UBN:fi:iyu-20140281251.pdf?seqence=1 (Accessed 27 March 2023)

Linn, M. C., Davis, E. A., & Bell, (eds.) (2004). *Internet environments for scidence education*. Malwal, N.J. Lawrence Erlbaum Associates.

McKnight, K., Yarboro, J., Graybeal, L. & Graybeal. J. (2016*). United Arab Emirates:What makes an effective teacher*? [Online]. Available from: https//www.pearson.com/content/dam/corporate/global/peason-dot-com/files/innovation/globalsurvey/reports/RINVN11137UAE report f crops 091116.pdf (Accessed 27th March 2023).

Millar, R. (2004). The role of Practical Work in the Teaching and Learning of Science [Online]. Available
from: https://sires.nationalacademicies.org/cs/groups/dbassesite/documents/webpage/dbasses 07330.pdf. (Accessed 27th March 2023).

Okam, C.C., & Zakari, L.L. (2017). Impact of Laboratory-Based Teaching Strategy on students' Attitudes and Mastery of Chemistry in Katsina Metropolis, Katsina State, Nigeria.

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9

International Journal of Innovative Research and Development, 6(1), 112.
Otobo, A.O. A. & Aruku, Y. A. (2021). *Optimizing Learning*: Mnemonic Visuals for Engineering Science and Technology Research Modibbo Adamawa University, Yola, Adamawa State, Nigeria. 7(2)" 17-27.
Otobo, A.O. A. & Wilson, j. (2021). JOSR Journal of Humanities And Social Science (JOSS-JHSS) Volume
26, Issues 1, Series 2, e-JSSN:2279-0837, e-JSSN: 2279-0843. www:josrjournals.org.
Price, P., Jhangiani, R., & Chiang, I. A (2015). *Research Methods in psychology* (2nd ed.). Washington D.C: Saylor.org
+Roberts, A. (2008). *Practical Work in Primary Schoo*l [Online]

Article DOI: 10.52589/BJMCMR-MUSHTMR9
DOI URL: https://doi.org/10.52589/BJMCMR-MUSHTMR9