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## **PRAXIS NISUS: INTRINSIC MOTIVATION AND DEMOCRATIC EDUCATION - CONVERGENCIES, DIVERGENCIES AND POSSIBILITIES FOR SCIENCE EDUCATION**

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### **ABSTRACT**

This work acknowledges the paradigm shift in curriculum emphases from the traditional content laden approaches to contemporary approaches that foreground the child in liberating contexts. Such contexts are trellised on intrinsically motivating students and the provisioning of democratic educational settings in which students' potential is unleashed and flourishes. This work attempts to make sense and project the architecture of this intersection between the need for intrinsic motivation and the demands of democratic education spotlighting on science classrooms. Theoretical gleanings indicate that intrinsic motivation and democratic education remain distinct constructs though amenable and can be deliberately reconciled in pedagogic settings to conduce productive learning engagements.

**KEYWORDS:** Intrinsic motivation, democratic education, science education,

### **INTRODUCTION**

It is established that science education has the potential to transform students into motivated, scientifically literate global citizens able to interpret, and address life issues and environmental challenges. Not only does science education have utility through external deployment but also in identity authoring as students are spurred into becoming effective critical thinkers able to critique the discipline's societal niche (Brotman et al., 2010). Scholars posit that realisation of these utilities of science education hinges transformative pedagogies that nurture and nourish scientific habits of mind, creativity, inquisitiveness, and collaboration (Tan & Kim, 2012). Such pedagogies trigger and sustain student interest concomitantly promoting participation within mutually beneficial equitable communitarian relationships foregrounded on students' concerns, curiosity, experiences, unction and need to be part of global citizenry (Rascoe & Atwater, 2005). Despite the potential endowments in science education, disenchantment with the discipline persists with students characterising it as boring, irrelevant, difficult, and estranged to their lives (Aikenhead, 2004; Brotman et al., 2010). Student disenchantment is manifest in student apathy, lethargy in study and task completion, reluctance to mental exertion and low levels of motivation. These observations have been attributed to the promotion of technical jargon at the expense of understanding (Barton & Yang, 2000); the selective emphasis and reconstruction of students' voice (Eisenhart, Finkel & Marion, 1996); the peddling of decontextualised, mechanistic and fact-oriented science classes (Stanley & Brickhouse, 1994); hierarchically structured

with teachers dictating the script and students positioned as passive recipients of would have been dictated to count as knowledge. Thus, the way science is packaged through classroom discourse, how pedagogic settings are structured compounded by low motivation have been indicted as key contributors to depressed students' engagement, associated learning difficulties and the perceived incompatibility of science and student life worlds (Tan & Kim, 2012).

The expectations and challenges confronting science education prompts a metamorphosis of the discipline from traditional architecture and sedimented epistemes in ways that respond to contextual demands. How this metamorphosis materialises largely depends on how the demands are conceptualised. Perspectives which locate the problem in schooling look to the schools for resolution. Theories which foreground the community look for solutions in science as a human endeavour. Whilst theories which subscribe to the notion that students' experiencing and performance are socio-culturally nuanced and context-sensitive look for solutions in the sociocultural realities in those contexts. This work pursues no attributional locus but is premised on the notion that the challenges in science education can potentially be navigated through focusing on how pedagogic settings are structured. This posture is founded on two assumptions, firstly, that learning cannot be dissociated from contextual realities. Secondly, learning is mediated by student affective and epistemic endowments, not only regarding science content and process, but also to the discourse and types of interaction through which science learning occurs (Lukyx & Lee, 2007). These assumptions spotlight the need for alternative lens able to straddle theoretical chasms to scaffold practices responsive to student needs, problems, and possibilities in concrete terms. Such emergent transformative lens need to attend to the minds and hearts of the students as they create their own meanings and co-construct knowledge with other stakeholders in pedagogic settings. Resultant praxes are envisioned to help disengaged, and disadvantaged students achieve and participate; whilst assisting in classroom management through activation of student voice. Implicit in the constructs above is that what is learnt is inseparable from learning context and that scientific contexts are crucial above scientific concepts in conducting student intrinsic motivation and generating democratic pedagogic settings.

### **FRAMING THE CONCEPTS**

Intrinsic motivation and democratic practice in science education are the focus of this work. This work explores their disparateness, convergence and potential fruitfulness in optimising student academic potential and the furtherance of the science education agenda. Elevation of these two constructs is not a devaluation of aspects of direct instruction but hinges on the view that aspects of direct instruction are not enough, because whilst the teacher instructs, learning opportunities need to be recognised and seized by motivated or a motivated students who are subjectively experiencing the learning context. The latter aspects have ramifications in the domains of affect and socio-politics.

Falk and Dierking (2016) conceptualise learning contexts as comprised of three inter-linked domains, that is: personal, sociocultural, and physical. The personal domain encompasses the continuum of motivation with outcomes in the domain of affect and dependent on students' identities, desires, needs and expectations as well as the perceived role of the educational institution in their lives (Braund,

Reiss, Tunnicliffe & Moussouri, 2004). The social domain coalesces interactions within-group, facilitated mediation (Botelho & Morais, 2006) and authentic conversations (Braund et al., 2010). The physical domain as the name depicts is constituted by the diversity of learning environments that are amenable to scientific inquiry. The three domains above need to be structured in ways that students believe that their needs (intrinsic motivation), interests, participation, civility, rights, and socio-political concerns (democratic pillars) are accommodated and reflected (Falk & Dierking, 2016). Any structuring that negates these aspects risks expunging intrinsic motivation and being labelled as undemocratic resulting in education invariably continuing to be disconnected from intended beneficiaries.

In the following sections I discuss intrinsic motivation and democratisation of education outlining their key attributes and exploring their convergence and how they disparately and convergently have potential utility in science education.

### **INTRINSIC MOTIVATION**

Motivation is defined as that human cognitive and affective variable drawn from experiences and perceptions of reality that underlies agency, compels enactment, and sustains engagement (Broussard, 2004). Motivation is premised on notions of effectance or active organisms with an inherent need to deal effectively with their environment (Morgan, 1984). For social cognitivists motivation is a strong psychological drive in a specific subject (Linnebrink & Pintrich, 2002). As a process motivation involves goal-directed activity that is volitionally instigated and sustained (Valerio, 2012). From its various conceptualisations motivation initiates, sustains and drives engagement. Engagement in this regard being an abstract mental construct manifested in enactments which demand desire and sustained participation (Klem & Connell, 2004). Thus, engagement can be touted as the ideal quantifiable index of motivation, an internally directed commitment to learn and the determinant of the likelihood to succeed academically. This connection between motivation and engagement in education makes learning a self-regulated activity driven by cognitive drives and forces of affect. The translation of this inherent need into overt enactments constitutes engagement and non-translation constitutes disengagement, hence motivation and amotivation, respectively. Amotivation in this case being the absence of the intentionality to act due to not valuing the activity, not feeling competent to do it, or not believing it will produce the expected results (Ryan & Deci, 2000).

Self-Determination Theory (Ryan & Deci, 2000) distinguishes *extrinsic motivation*, which refers to engagement in acts because they lead to desirable consequences separate from the activity and *intrinsic motivation*, which refers to free engagement in something because it is inherently interesting and enjoyable. For the latter reason intrinsic motivation is also termed *enjoyment-based motivation* (Reinholt, 2006) or free choice motivation (Ryan & Deci, 2000) or a natural inclination toward assimilation, mastery, spontaneous interest and exploration, attributes critical for cognitive maturation and social development (Ryan & Deci, 2000) and as such associated with high value outcomes like creativity, quality, spontaneity, and vitality (Reinholt, 2006). The notion of *free choice* presupposes an active organism with a deep-seated internal locus of causality (Ryan & Deci, 2000). The location of

the locus of causality and choice resonates with Bourdieu's (1973) idea of *habitus* and Foucault's (2008) notions of *power*. *Choice*, *habitus*, and *power* as related causal constructs imply freedom and independence of the subject involving a selection of one option over other equally appealing available options.

The Cognitive Evaluation Theory (CET) which a sub-theory of SDT constitutes the social and environmental factors critical for intrinsic motivation that is, facilitators or constrictors respectively of the three universal psychological needs, namely, *autonomy*, *competency* and *belonging* or *autonomy*, *competency*, and *connectedness* respectively. The contextual amenability in addressing and meeting these three universal needs becomes the standard against which engagement contexts are examined and rated. The rationalisation of such a standard being that it is only through attempting to satisfy these universal needs that agents engage in any activity. Thus, the structuring of environments vis-à-vis this standard becomes a crucial enterprise in determining the nature (facilitation or constricting) and quality of engagement.

### **The Universal Needs**

A sense of *autonomy* or an "*internal perceived locus of causality*", choice, feelings of self-direction and feelings of volition facilitate intrinsic motivation (Ryan & Deci, 2000, p. 58). Autonomy captures the human desire to present itself as the epicentre of own actions whether in or outside groups and conduces feelings of ability (Ryan & Deci, 2000). Affirmation of ability through proffering autonomy or acknowledgement of personal volition provides for feelings of being in control of own progress, whether succeeding or failing. Research evidence suggests that student levels of intrinsic motivation increase when learning contexts are structured in a manner that supports autonomy such as being given responsibilities or tasks beyond what they feel they can handle (Valerio, 2012). Rendering autonomy is also associated with greater engagement, better performance, and higher quality learning. Evidence affirms that such contexts are self-empowering since they enhance engagement, trigger curiosity, and tenaciousness (Lavigne, Vallerand & Miquelon, 2007). Conversely, highly structured educational contexts expunge initiative and tenacity in task mastery, resultantly reduce learning opportunities and consequently diminish intrinsic motivation (Larson & Rusk, 2010). It is also argued that it is from the need for autonomy that rewards, threats, deadlines, and competition pressure diminish intrinsic motivation (Ryan & Deci, 2000). Thus, the degrees of autonomy in the classroom impact on students' intrinsic motivation as they are directly related to how students feel about their ability to enact and regulate their agency. The need for autonomy is closely related to the need for *competency*.

The desire to see oneself as *competent* is a catalyst for intrinsic motivation. A permeative postulate in CET, Achievement Goal Theory and Expectancy Value Theory is that individuals are inclined to be intrinsically motivated where there is a high probability for experiencing success, or affirmation as competent (Larson & Rusk, 2011). The latter is the desire to see oneself as able to make sound situational judgements (Valerio, 2012). This desire is associated with *self-efficacy* and *self-worth* which are indicators of individuals' confidence in task engagement. The need for competence compels individuals to set goals, develop values and articulate life purposes. Through setting their goals and

articulating life purposes they become connected to activities and are passionately engaged (Valerio, 2012). In the context of teaching, the challenge is to connect tasks or activities with students' life purpose so that they identify with the task and feel internally compelled to excel. When classrooms fail to address this need, students optimise their self-worth and protect their sense of competence through causal attributions, the latter being motivation by a mere awareness of potential satisfaction or end-states in enactments (whether positive or negative) and make choices about what activities to engage in to reach these states. In the absence of a motivating context student tend to enact disruptively to reach this end-state.

The third universal need is *connectedness* also termed *social relatedness* or the sense of *belonging* based on the notion that social beings are securely attached with a context they feel part of. Whilst intrinsic motivation is in individuals it is also external to individuals as it exists in relations between individuals and activities. For Valerio (2012) connectedness provides rationale for engagement and participation in settings that are perceived as not enjoyable. Learning contexts characterised by mutual respect, a strong sense of being there for the others, absence of discrimination and the presence of a secure relational base, have been observed to enhance intrinsic motivation (Wlodkowski & Ginsberg, 1995). Conversely, students who perceive their teachers as hostile, cold and uncaring and all other euphemisms of hate, have low levels of intrinsic motivation (Valerio, 2012). The need for connectedness is premised on three social preferences: reciprocity, inequity aversion and altruism (Fehr, Fischbacher & Gächter, 2002). Reciprocity being the alignment of agents' responses to external actions based on perceived social benefits. Inequity aversion is based on an implicit desire to be treated equally pursuit of procedural equity in resource allocation and treatment (Fehr, Fischbacher & Gaschter, 2002). In altruism, social relations are based on the pleasure of acting kind and the happiness that comes with it.

The preceding discussion highlights that student motivation is inseparable from the external variables constitutive of the pedagogic setting. Despite direct implications for education in the discussion above, determinants of intrinsic motivation are complex and include psychological, physiological, and cultural factors (Larson & Rusk, 2010). The complexity and diversity of its determinants provides a natural wellspring for learning and achievement that can be systematically catalysed or undermined by classrooms structure. The inherent belief being that when elements of teaching are holistically harmonised with students' psychosocial orientations, they evoke, encourage, and sustain students' intrinsic motivation hence maximising their learning opportunities. However, despite the internal logic of intrinsic motivation, tendencies associated with motivation and the propensities for enactments based on them are structural, context-bound, and dependent on temporal situational socio-political conditions external to the individual. This view then explains why there is variability in intrinsic motivation.

Consideration of the universal human needs and their educational implications above presents a challenge for classroom practitioners on how to structure pedagogy accommodative of universal needs whilst deconstructing the relational landscape for democratic spaces to emerge.



## DEMOCRACY

In *Metaphors to Live* Larkoff and Johnson (1980) contend that etymology is more than language because concepts define our everyday realities, structure what we perceive, how we relate, shape our ontological persuasions, epistemological inferences and existential enactments. Such pervasiveness of metaphors is important in conceptualising democracy and democratic education because both are floating signifiers (Sant, 2019) and problematic concepts (Vinterek, 2010) hence metaphorically contested domains. Delimiting the concept *democracy* presents a bi-pronged challenge; firstly, the absence of anything that commodifies the elementary meaning of the concept. Secondly, the manifold and eclectic nature of the concept. Cognisant of these problems scholars who have tried to define the concept have done so broadly, for example Vinterek (2010) makes the following cautious postulation:

Democracy is ... a method of conducting government, of making laws and carrying on governmental administration by means of popular suffrage and elected officers. The political and governmental phase of democracy is a means...for realizing ends that lie in the wide domain of human relationships and the development of human personality (p.368).

Providing an applied definition Dewey (1937) describes a democratic context as communitarian living premised on conjoined communicated experiencing and a repudiation of enslaving external authority by the plurality of humanity imbued with intrinsic interests who volitionally synchronise their actions to validate their points and direction of enactment. From both definitions democracy implies “a freeing of intelligence for independent effectiveness – the emancipation of mind as an individual organ to do its work” (Dewey, 1937 p.193). The variability of intelligence implies that democracy and democratic education as concepts: exist in multiple forms; provide for humane existence for all mankind and allow all mankind to name and change their realities. The power to name and dictate change captures the essence of democratic aspirations and democratic dispositions, as succinctly echoed in Freire’s (2000) logic “to exist humanly, is to name the world, to change it.” (p. 88). The antithesis of such a democratic arrangement is slavery in which agents have no authorship or personal interest in their conduct and purposes as these are externally determined by *significant Others* (Meital & Agassi, 2007). Without free and equitable social intercourse there is inhibition of diversified challenge to thought, hence results in a distortion of emotional life due to disengagement (Dewey, 1937).

### Democracy and Education

The democracy-education symbiotic linkage is established on the notion that hegemonic influences built on popular democratic suffrage are sustained by an educated populace (Sant, 2019) with education having epistemological and moral instrumentality. The latter dual instrumentality supposes that effective education produces rational and knowledgeable self-realising citizens capable of equal participation (Belcastro, 2015) in the maintenance of socio-political stability through habits of mind, collective regulation, and interest in social relationships (Dewey, 1937). Thus, in classrooms democratic education equips students to be functional and effective citizens in self-governance and social transformation. However, the unitarian utility of democratic education does not imply

singularity in its constitutive nature. The diversity of social organisations and plurality of political systems has given rise to myriad versions of democratic education.

### **The Multiple Faces of Democratic Education**

After extensive scholarly literature analysis Sant (2019) coalesced versions of democratic education each associated with a particular political discourse.

The first version is *Elitist Democratic Education* which is premised on the notion that elites are requisite for society to function. The role of education is therefore to select and differentiate curriculum to condition students for future placement in a structured society. Typically, *elitist* democratic education is two-tiered with a system for those privileged and another for the general populace.

The second version which dominates contemporary society is *Liberal Democratic Education* based on the notion of equality of all mankind whilst recognising the primacy of the individual over structuration and social arrangements. *Liberal Democratic Education* through universal education and mass schooling dispenses knowledge to all citizens for knowledgeable and rational living.

Whilst *Liberal Democratic Education* informs education systems *Neo-Liberal Democratic Education*, a third version of democratic education is the dominant discourse upon which current educational policies are premised (Sant, 2019). Postured oppositional to *Liberal Democratic Education*, *Neo-Liberal Education* negates equality in pursuit of choice, aggregation and accountability. Trellised on the logic of morals and economics the student within this version of democratic education is cast as a consumer and policy conversations are centered on school choice and parental involvement.

The fourth version, *Deliberative Democratic Education* is based on ideas of consensual rationality that foreground inclusive deliberation and equality. In this version teaching and learning is made inclusive and non-discriminative through the inclusion of stakeholders' voices in curriculum processes.

The fifth version is *Critical Democratic Education* which is based on Marxist-Frankfurt school propositions and is aimed at disrupting and dismantling subjugating hegemonies, concomitantly deconstructing, and reconstructing the social structure for equity (Sant, 2019). Teaching and learning within *Critical Democratic Education* is for empowerment.

The sixth version has been termed *Agonistic Democratic Education* which peddles the notion of a conflict-ridden democracy and a provisional commitment to stability due to constant dissension to prevailing contexts. Within pedagogic settings agonists argue for the freeing of students' voice and the creation of spaces for agonism.

### **Democracy in Curriculum Planning**

Despite the mutual constitutive synergy between education and democracy there are three approaches by which the education-democracy nexus has materialised in curriculum frameworks, that is, *education for democracy*, *education within democracy*, *education through democracy*.

In the first invocation, *education for democracy*, education is the vehicle through which democracy is transmitted and established as an imperative for societal advancement. Though indicted for social reproduction the curriculum objective of this approach is multi-pronged and includes the nurturing of knowledgeable, rational, active citizens expected to function as informed decision makers. The second invocation, *education within democracy* is connected to neoliberal and elitist political discourses and focuses on individual choice and competition a moral imperative for education. In the third invocation education and democracy are conflated as *education through democracy*. According to Stevenson (2015) education through democracy foregrounds the individual with knowledge being transactional and experiential in a context of inclusivity and mass participation. Within this invocation students' voices are promoted and inserted into democratic processes as *de facto* citizens. Such insertion efforts involve deconstructions and reconstructions of discourses of knowing and being, serve to scaffold responsive pedagogies, singularised subjectivities, and classroom participation for all students.

### **Principles of Democratic Education**

Despite the existence of epistemological and ontological continuums among the versions of democratization of education, the democracy-education nexus is anchored on fundamental principles. These principles constitute the framework undergirding democratic practice and provide the rationale for the democratization of education. These principles include:

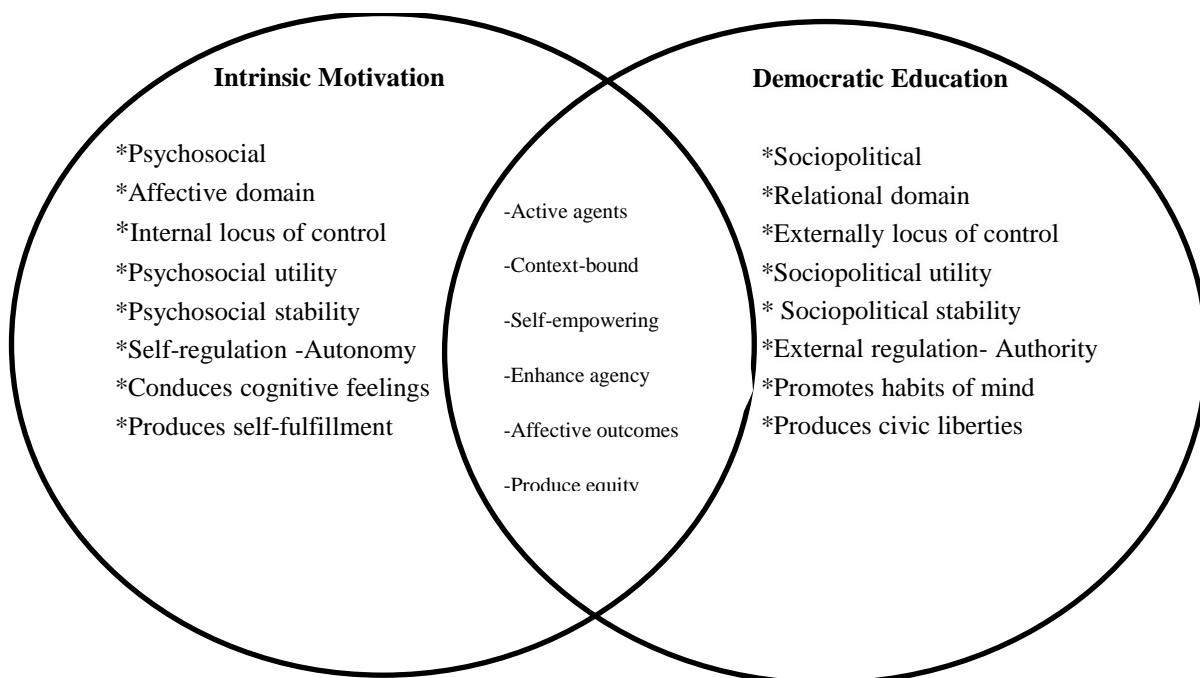
- the sanctity of individual human rights
- the power of the collective
- elevation of individual voice
- the multi-nodality of power
- imperativeness of equity and equal opportunity for human existence
- inclusivity in diversity and participatory decision-making

From the outlined democracy principles, it is apparent that democracy is more than sociopolitical order but empowerment and opportunities for empowerment. Through association with empowerment democracy appeals to the domain of affect as it provides opportunities for Socratic self-fulfillment also known as *self-realisation* or *self-actualisation*. Thus, democracy becomes a constructive force propelling the self towards greater autonomy, *self-responsibility*, *self-empowerment*, and *self-determined* ends (Rogers, 1961). Oriented on this trajectory individuals within the democratic context reflex and enact towards the attainment of the highest levels of personal development, *self-fulfilment* (Gewirth, 2009) with limited external urging but rather on volitional strength and the resilience in working towards and the attainment of self-set goals (Cheng & Ickes, 2009). From preceding ideas motivation overlaps and intersects with democracy only empowered agents can engage in rigorous internal dialogues and through independent thought critique the status quo whilst championing progress in social environments they are part of. Such agents are flexible and exude high levels of self-efficacy which enables them to be active change drivers.



**INTRINSIC MOTIVATION AND DEMOCRATIC EDUCATION**

Making sense of the intersection of these two constructs involves invoking Wertsch (1998) unity of disciplines. Instead of creating a mosaic from partial pictures Wertsch (1998) postulates that a more complete gestalt can be obtained through mediated action. Mediated action refers to a way of existence that straddles a central axis through the creation of a holistic picture from consideration of separateness and connectedness of different disciplines or constructs beyond the myopic strictures of treating them as isolates. Mediated action accommodates the premium in the psychological, sociocultural without negating the political discourse, needs for analysis of power and discourses appended in these domains converge in classrooms. The figure below illustrates the divergence and convergence (intersectionality / overlap) of intrinsic motivation and democratic education.



*Fig 1* Comparison of Intrinsic motivation and Democratic Education

From the figure above it is possible to visualise how intrinsic motivation and democratic education are disparate, mutually construct each other and are conflated in pedagogical settings.

**Intrinsic Motivation and Democratic Education – The Convergencies**

From figure 1 above precepts from intrinsic motivation and democratic education converge in the zone of overlap. Both domains rely on or assume communities of practice constituted by individuals with a “capacity to determine and make meaning from their environment through purposive consciousness, reflective and creative action” (Parsell, Eggins & Marston, 2017, p. 239). Intrinsic motivation is predicated on an individual with an active locus for enactment and democratic education banks on the active participation or the willingness to participate by free individuals as part of the collective.

Both domains contend that the environment and context are crucial in democratic deliverables and agentic realisations. Intrinsic motivation and democratic education both embrace the power of the sociocultural in mediating the psychological and political. In embracing the sociocultural both domains affirm the dialectics of structure and agency and the view that individuals influence the environment and are in turn influenced by the environment in a dialectical manner. As intrinsically motivated individuals interact with their environment and make their history; they impact those environments in ways that conduce further motivation and further democratisation of the setting. Thus, both intrinsic motivation and democratic education are dependent on the environment and influence the architecture of the environment.

Intrinsic motivation and democratic education overlap with regards to their self-empowerment effect. Intrinsic motivation has been associated with psychosocial outcomes such as enhanced intellectual performance, assertive engagement, enhanced creativity, higher levels of self-esteem, achievement, and survivorship (Ryan & Deci, 2013). Through conducting these outcomes intrinsic motivation results in self-empowered agents who can attend to their contextual demands whilst meeting their psychosocial needs (Kirk, Lewis, Brown, Karibo, Scott & Park, 2016). Scholars in the domain of socio-politics contend that there is a symbiotic relationship between democratic education and self-empowerment (Siegel & Rockwood, 1993) since democratic pedagogic settings produce empowered students who are aware of their potential to impact their communities and drive change. The intersection of intrinsic motivation and democratic education therefore lies in their potential to conduce self-empowerment. Self-empowerment in this case is a triad of the psychosocial, socio-political, and power deployment. In a psychosocial sense it involves an increased control or mastery of one's own life and the decisions that affect their lives. Socio-politically self-empowerment involves an equalisation of power differentials (Lawson, 2011) enabling individuals to insert themselves into socio-political roles being skilled enough to effectively function in their social and political worlds. Lastly, self-empowerment involves the acquisition of power and a situated awareness of individuals' own experiences (Lawson, 2011).

Lastly, intrinsic motivation and democratic education intersect in making power multimodal hence establish equity. Such devolution of power metastasises into affective outcomes such as elevated student voice, task appreciation, exercise of choice, participation, and leadership.

### **Intrinsic Motivation and Democratic Education – The Divergencies**

In spite of the conflation outlined above intrinsic motivation and democratic education diverge at multiple points. Intrinsic motivation is a psychosocial approach to understanding human development and enactment. As a psychosocial approach it looks at individuals' well-being and functionality as a product of the combined influence of psychological factors (mind, thought, emotions, feelings) and the surrounding environment. Conversely, democratic education is a socio-political approach to education. The socio-political context combines the social and political inclusive of laws, policies, regulations, practices, ideologies, and traditions that define and frame human ecosystems.

Intrinsic motivation is domiciled in the affective domain with an internal locus and combines sensations of feelings, perceptions of well-being which can be positive or negative and activation of enactments towards risk aversion whilst searching for rewards. Thus, the affective domain contributes to social engagements and the development of positive relationships (Brett, Smith, Price & Huitt, 2003). On the other hand, contemporary theorists contend that democratic education has its locus in “qualitative, ethical relationships manifest in mutual respect, empathy, and solidarity on all levels of public life (Dallmayr, 2017, p.ix). Opposed to an intrinsic motivation’s internal locus, democratic education centres relationality and potentiality with democratic power being in latent potentialities defined by relational equality.

Through being domiciled in the domain of affect intrinsic motivation has an internal locus of control. Implicit in an internal locus of control is the notion that an individual’s life outcomes hinge on their own personally efficacy, agency, and volitional mastery of their environment. By virtue of an internal locus of control intrinsic motivation becomes a coping resource associated with positive thinking and productive engagement (Gray-Stanley & Muramatsu, 2011) for self-regulating and autonomous in intrinsically individuals. Democratic education on the other hand is an externally induced socio-political structural arrangement determined by external variables such as chance and significant political others. The locus of control is beyond the control of the individual who is positioned as a subject or beneficiary. In democratic education authority figures define the parameters of engagement hence causation becomes external and dependent on situational factors.

Intrinsic motivation conduces cognitive feelings of autonomy, competence and belonging. By conducting these feelings intrinsic motivation produces psychosocial stability and self fulfillment in intrinsically motivated individuals. Democratic education though at times convergently is associated with psychosocial benefits has socio-political utility, strives for socio-political stability, promotes citizenship habits of mind, and establishes and protects civic liberties.

### **POSSIBILITIES FOR SCIENCE CLASSROOMS**

The entrenchment of intrinsic motivation and democratic tenets in practice has been associated with improved academic performance, enhanced engagement, unleashing of creativity, excellent achievement, and maximised interest in basic education (Jang; Reeve, Ryan & Kim, 2009). Though the tenets are generically theorised this study entertains the notion that the incorporation of these tenets in lesson preparation, instructional decision-making and classroom engagement optimises students’ interests, achievement, and participation in science classrooms. It is important to note that the realisation of these spinoffs hinges on teachers evolving strategies for integrating them in science classrooms. Without claiming an exhaustive list this work suggests ways that intrinsic motivation needs of autonomy, competence and belonging can be juxtaposed with precepts from democratic education to create productive pedagogic settings in science classrooms.

### **Levelling the playing field – Relatedness and Equality in the Science Classroom**

The first challenge that confronts the science teacher on the first day of schooling is the structuring of the classroom in ways that make students feel welcome and legible to be active and equal partners in the learning venture. This challenge emanates from the understanding that internalisation of knowledge and associated practices by students is dependent on associations they form with the specific environments related to the epistemes and practices (Ryan & Deci, 2013). When this challenge is related to intrinsic motivation and democratic education it's constituted as the needs of relatedness and equality respectively. Relatedness emerges when students feel safe, respected, valued, and emotionally connected with others (teachers included) as well as their physical environment. Relatedness is diminished by belittlement, physical and emotional neglect, absence of respect and presumed disconnect.

According to Dewey (1937) equality entails the deployment of physical and institutional resources to facilitate inclusive practices which include the opportunity to relate and engage with others as well as access to supportive resources. Equality is based on three democratic principles, that is, all citizens are moral equals; all citizens are intelligent agents with an ability to enact and rationalise, reflex, and make informed choices and lastly, all citizens can be part of a problem-solving collective (Osborne, 2001). Thus, democratic education trellised on equality manifest in the equal participation of students in their own learning, co-operating with each other, practising respect whilst recognising each one's worth and entitlements. The following are some strategies that can be employed in promoting relatedness and affirming equality in the science classroom.

- a. Getting to know students by names as unique but equal individuals. Theorising on how to win friends and influence people Carnegie (2017) posits that we need to remember that a person's name is to that person the sweetest sound and most important sound in any language. Names are connectors to identity and individuality because identity though complex is engrafted in a name (Russell, 2014). Knowing names is the foundational block of social relationships and it sustains feelings of being welcome, a social atmosphere, establishes accountability, increases positive behaviour, cultivates empathy, and optimises opportunities of multilateral communication in the science classroom. From precepts above it emerges that conducting relatedness and establishing equality may be promoted by the mastery of names. Names can be mastered through annotated class rosters, name tents, using seating charts, self-introductions with fun facts, peer interviews with peer introductions and the use of mnemonics.

Getting to know students not only involves name recall but also involves a deliberate effort in getting to know students' stories and histories. Advocates of culturally relevant pedagogy argue that alienation is minimal, and equality promoted when students' cultural stories and social realities are reflected in classroom structure (Gay, 2018; Ladson-Billings, 2014). Thus, introductory lessons need to glean students' life stories and cultural understandings. As students see themselves reflected in the classroom from the outset, they feel dignified and placed on equal footing. This strategy is argued by Giroux and McLaren (1986, p.229) as they

posit that “empowerment is gained from knowledge and social relations that dignify one’s own history, language, and cultural traditions”.

- b. Equalisation of access and diminishing alienation through induction by cold canvassing. Empowering students begins with the creation of a non-threatening classroom environment. As opposed to full exposure to hard science concepts from the beginning cold canvassing involves assuming students have no science knowledge so that they all have the same point of departure. Assumptions of complete ignorance may be accompanied by using a drip-feed approach to introduce all students to science. Introductory lessons may involve a tour of the science laboratory, familiarisation with apparatus, making simple observations and drawings. Such overtures have potential in eradicating assumptions of science being stoic and fact laden whilst simultaneously creating a welcoming atmosphere through equalising opportunities for participation and interaction amongst those who may be culturally different and having different psychosocial endowments. Such a repertoire increases relatedness, inclusion and guarantees socio-political stability in the science classroom.
- c. One way of guaranteeing a sense of belonging is through registering high expectations for all students in the science classroom. The latter involves tailoring the pedagogic setting for students’ individual endowments in ways that place every student in Vygotsky’s (1978) Zone of Proximal Development. The architecture of such a setting involves packaging tasks in ways that are challenging but manageable whilst progressively scaffolding them to guarantee success. The optimisation of achievement through scaffolding renders a sense of accomplishment, a build-up of self-confidence and a strong sense of belonging in the learners. Going through the task with the students and being with them as they make mistakes builds a sense of community and a realisation that they are safe and secure in as much as they may not be sure of their competence. Such a realisation engenders the knowledge that they will not walk alone on the journey they would have embarked on.
- d. Relatedness may also be established by becoming embedded in one’s students’ world. Through surrendering their power and becoming part of the learning community the teachers become team members rather than the sole arbiters of classroom discourse. Such positionality breaches isolating barriers and students are encouraged to become co-owners and co-authors of the pedagogic setting. Such disruptions usher in a novel classroom discourse that reinforces psychosocial bonds whilst placing all players on the same pedestal.

### **Setting them free – Autonomy and Democratic Independence**

In his seminal work Dewey (1937) contends that democracy is a catalyst for freeing intelligence and the emancipation of the mind materialising as freedom of action. Such postulates make setting students ‘free’ in the science classroom a pedagogical imperative. Freeing students provides stimuli for the development of a sense of ownership and a sustained drive to satisfy personal goals and curiosities (Sternberg and Williams, 2002). It can be argued that mankind, students included is more tenacious and self-directed when it perceives choice. It can be inferred that the power of the psychological need for autonomy and democratic independence lies in their ability to motivate students to desire success



and empower them to pursue the accomplishment of own goals. Degrees of choice and control hence autonomy in pedagogic settings impact levels of participation and intrinsic motivation through making learning more personal and relevant to the student. Below are some suggestions of how autonomy and democratic independence can be established, enhanced, and sustained in science classrooms.

- a) Using inquiry-based learning particularly the use of self-directed investigations allows students to set their questions and develop designs and provide students with more opportunities for exploration and proving their competency. This strategy implies teachers assuming a more facilitative role and emphasising less on concept mastery as an indicator of competence. Whilst concept mastery is necessary in examination-centred curriculum this is obtainable through ensuing discussions and engagements from self-directed explorative activities.
- b) Operating by consensus and democratic collectivism. Autonomy and democratic independence can be promoted when students are involved in the decision-making process wherever possible. Such negotiations can extend from determining laboratory rules, setting learning goals, scheduling learning activities and assessment tasks and modes for grouping. This strategy does not imply permissiveness but rather negotiated pedagogic contexts with science teachers planning for choice and co-generative dialoguing.
- c) Hands-on and Minds-on activities provide the flexibility prerequisite to autonomous and democratic engagement. Hands-on and minds-on activities provide for vital participation for all abilities through the medium of freed intelligence and the deployment of physique in the exploration of phenomena first-hand rather than the transmission of acquisitions of the past. Such classroom architecture positions the students to construct their knowledge hence freeing their intelligence and individuality actively and independently.
- d) Letting students play and freely explore their environment provides fertile ground for cultivating niches and independence. Getting students out of the laboratory provides opportunities for them to experience themselves as independent elements of the natural wider ecosystems and motivates them to organise their experiences vis-à-vis the world they are part of. Other than the freeing of their bodies from the strictures of formal arrangements outdoor exploration has the propensity to become open laboratories as matters progress from simple observations to complex scientific experimentation with rigorous intellectuality and logical processes.
- e) Varied modes of presentation and feedback are one final strategy that may enhance autonomy and promote democratic independence. Students are unique individuals and as such have diverse ways of responding and expression. Cognisant of diverse modes of expression science teaching must provide for various forms of expression. In the classroom students need to be encouraged to express themselves and present their responses in modes they are most articulate in. Such modes of expression may include artistic expressions like poetry, songs, drawings, clay modelling, painting, various digital formats and storytelling. According to Dewey (1937) such a paradigmatic shift is also a socio-political shift as it usurps the subjection of the mind to

external modes of control and routine whilst promoting the freeing of the mind to subjugate the subject matter for the upbuilding of the *self*.

### **Fanning the Flame: Competence and Citizenship**

Other than perceptions of relevance, positive emotions and healthy productive rapport students need to experience academic success through their own autonomous endeavours and teacher facilitation. In the same vein students need to sense the utility of the academic enterprise towards their insertion into society and participation in civic duties. Through science as a human endeavour or science-technology-society modules students are provided with opportunities to actively engage with contemporary societal issues including aspects that question and improve democracy. Such opportunities dovetail with competence in that students develop critical thinking capacities. Whilst competence focuses on academic results, citizenship pursues capabilities in collaboration, appreciation of diversity, negotiation, empathy, self-awareness, and tolerance.

The following are some strategies that can be deployed in the science classroom to cultivate a sense of competence and citizenship in students.

- a) A culture of recognising and celebrating competence as well as citizenship needs to be nurtured in the classroom. According to Hipkins and Satherley (2012) the existence of such a culture nourishes self-efficacy and sustains resilience in task completion when the student is later presented with challenging tasks. Competence can be celebrated through open acknowledgement in class, e-mails to parents, statements of affirmations and non-intrusive or discriminatory rewards systems. In a classroom 'A citizen of the week' can be recognised and celebrated for endeavours that model espoused citizenship traits.
- b) Content packaging and alignment to build citizenship and competence. Science content needs to be packaged in ways that are manageable for competence and challenging to student value systems for citizenship. In both regards students can be assigned societal challenges for example vaccination, genetic engineering to investigate. Through such tasks they have the chance of honing their academic prowess whilst grappling with pertinent and relevant issues of human survival and quality of life. Such lessons sustain intrinsic motivation through relevance and the prospect of far-reaching changes beyond the four walls.
- c) Planning for creativity and collaboration. Olson (1997) posits that learning opportunities built on the provision of opportunities for employing critical thinking and chances for being creative conduce a sense of competence. Such opportunities may involve loosely structured or open-ended assignments through which students take ownership from the beginning with thinking and opinions not constrained by an assessment memo though they may be guided by a rubric. Of late creativity and collaboration can be sustained through educational digital adventures and games.
- d) Strengthening the science-society connection. Students are most likely to be motivated whenever they perceive a connection between content and their real-life experiences. Using

positive questioning styles, practical work in the form of design experiments or assignments teachers can enhance the chances of students succeeding hence experiencing competence whilst carving a niche for themselves in society.

- e) Designing curricula for success is another strategy for enhancing a sense of competence. Such designs include positive classroom climates characterised by multimodal communication. Secondly, providing well calculated guidance at critical moments in a students' learning journey. In this regard teachers closely monitor students' conceptual development and would scaffold through customised explanations and sustained rigorous feedback to maximise chances of success. Designing curricula for success may also involve affordance of engaging, captivating and stimulating learning activities that are most like to captivate student focus and increase their propensity to engage with the task driven by the desire to succeed and be relevant to the society they are part of. Lastly designing for success involves giving students enough time to plan, execute, reflect on tasks and their learning journey. Other than content mastery provisioning of time allows for participatory collaborative engagements which are a key aspect of citizenship and democratic education.

## CONCLUSIONS

The exploration above is not academic argument but an attempt at praxis through reconciling two disparate constructs critical for education in the 21<sup>st</sup> century in general and science education specifically. This exploration has captured the disparateness of the constructs as well as their convergence with the latter hinting their utility in contemporary science classrooms. The implications of this exploration lie in the potential strategies that can be deployed in classroom to sustain student motivation whilst promoting societal democratic aspirations. In terms of significance this exploration extends the notion of mediated action in epistemic integration and the promotion of holistic multipronged strategies in pedagogic settings to enhance teacher practices and enrich learning experiences.

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