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FUTURE OF SPATIAL ABILITY RESEARCHES AND EDUCATION: A REVIEW

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Abstract:
The present paper deals with the future trends of researches in the area of spatial ability and its implication on education. Researches on spatial ability are predicted to continue with two concurrent themes: its association with intelligence and the influence of technology and computer in redefining and molding spatial ability. Current technologies like 3D Imaging, virtual reality, simulations are redefining and molding spatial ability.

Keywords: spatial ability researches, education, future research

1. Introduction

1.1 What is spatial ability?

In 1880, Sir Francis Galton, discussed about certain mental pictures (mental imagery) in his reports. Since then, spatial ability has been defined in different ways, for example, discussion of its various constituents and methods through which it can be measured. Every research perspective viz Psychometric, Developmental, Differential and Information Processing researches have added significantly to understanding about spatial ability. Psychometric studies are contributory studies in describing spatial ability while developmental studies have traced the development and transition of spatial ability with age. Differential studies highlight the differences in spatial ability based on sexes. Lastly, information-processing literature focused on strategies chosen by individual and the way they are processed.

Now, spatial ability has become a significant aspect in the research of other disciplines as well.

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1.2 Future trends of researches in the area of spatial ability

Spatial ability research is predicted to continue with two concurrent themes. The first of them is retreat where the research begun. In other words, its association with intelligence. And the second of them is examining the influence of technology and computer in redefining and molding spatial ability.

1.3 Refocusing on Intelligence

Gardner's Theory of Multiple Intelligences provides a definition of the entire attribute, which contribute to the intelligence within an individual. These include bodily-kinesthetic, linguistic, logical mathematical, interpersonal and intrapersonal musical and spatial abilities. Recently two more capacities have been put forward by Gardner: 'naturalistic' and 'existential' intelligence. However, the reasoning that supports the two capacities as intellectual competences are not yet concrete. Gardner present a comprehensive discussion for each of the seven areas in order to justify the validity of each built upon biological and cognitive research.

One of the relevant parts of Gardner's work is the discussion on spatial ability. He defines spatial intelligence as an ability of an individual to make picture or visualize images mentally. It is an ability of perceiving, transforming, and recreating different aspects of a visuospatial world. It also contains sensitivity to graphic details and ability of drawing or sketching them.

For measurement of visuospatial ability, Gardner illustrates several ways. From familiar paper-pencil tests, such as Guildford –Zimmerman Spatial Visualization Test or Vanderberg's Mental Rotation Test, to verbal exercise of recitation of events or tasks could be used. In order to visualize verbal descriptions and instructions, the same cognitive facilities are utilized as those used during graphical based visualization tests.
Gardner's contribution is extremely significant as it mentions spatial ability as a primary component of intelligence. It is at-par of linguistic and mathematical ability. Gardner justifies his statement by stating that intelligence is discontinuous but at the same time, it is interrelated and adjoined. Indeed, it is both dependent and independent aspects of the intelligence. For example, when studies conducted with exceptional students, it was seen that their spatial intelligence works in accordance with logical mathematical ability, or in other words, mathematical ability along with ability of resolving.

However, in the end, the primary aim of Gardner's work is to explain intelligence in a more accurate manner. In order to achieve this, researchers needed more extensive measurement and testing. As noted by Gardner, today's tests generally undermine measuring all constituents except mathematical and logical constituents. But it is important to note that measuring spatial ability is equally important. Thus, it can be stated with confidence that research of this field, though not specifically focused on spatial ability, will carry on to enhance spatial ability researches indirectly.

1.4 Utilizing Technology

Many of the present computer based tools are suitable for remediation and enquiry and to visualization for instructions. The desktop is a setting providing development and delivery for both static and dynamic material in a more instant way as compared to the past (Anglin et al., 1997; Wiebe, 1993; Park, 1998). The computer acts an extension of mind, allowing students to consider their cognitive domain at one time. And at other times, as an instructor for mental routes which are habitually difficult to find and investigate using conventional method.

Intricacy in some environment along with the excess of the human senses increase cognitive load of a student. Consequently, it becomes a barrier in acquiring visualization skills or any other cognitive ability (Metallinos, 1994). The focus of the mind should neither be on digital tool nor how to access information but rather on exercising visual skills, which a student must acquire.

It is observed that digital tools may become burden the learning process, particularly on initial contact. Digital tools provide an environment for visualization. Therefore, any digital tool must provide supportive environment and conceptual ideas in order to allow students to develop a mental correlation with the physical world. This will assist them in easily operating within the environment. In other words, this will help them in practical applications within the present environment. Students should grasp the milieu and methods for controlling computer upon its usage. Furthermore, numerous methods used for improving visual ability have further led to new discoveries of mental capacity that compromise cognitive spatial ability as well as the ways in which the students can improve these abilities.

With the advancement and improvement in technology, students can readily exercise and project cognition through technology. However, there is a gentle equilibrium amongst disabling and enabling learning. As long as the computer, its controls, and interface do not contrast with the paths of learning, utilizing technology for the advancement of the spatial ability is advantageous (Mohler, 1997).

It is important for a learning strategy to take into account different learning styles.

Where one method seems to be fitting for some learners, the same method may not be completely adequate for others. Therefore, the learning strategy must include various styles of learning. Technology permits the learners to best understand and assist in developing visualization and spatial ability skills.

For instance, Millar (1992b) noted noteworthy dissimilarities between two types of learners: visual and haptic. These learners were tested and differed on how one used computer-generated models assisted them. Miller suspected that the outcomes were under the influence of other factors. However, he continues recommending using advanced technology, as it brings interest and motivation among the learners. Motivation is a signification variable that contributes to learning. It has been observed that advance technologies can increase motivation of students. It helps students to learn conceptual & applied information (Bertoline, Miller, & Mohler, 1995).

Many technologies used in recent studies indicate lower degree of attainment of spatial ability due to digitalization. On the other hand, they highlight such technologies

have been able to give same results as given by the previous methods of instructions. Most computer tools are as useful as traditional instructional methods and exercise, as proved by several studies (Braukmann & Pedras, 1993; Bertoline, 1991; Celements et al., 1997; Geban, ASkar, & Ozan, 1992; Devon et al., 1997; Mackenzie & Jansen, 1998; Monoghan & Clement, 1999; McCuistion, 1990; Thomas, 1996; Yang & Greenbowe, 2003; Trethewey & Zavotka, 1987).

Virtual reality (VR) is one of the capable tools among new technologies. In other computer-based strategies, the students are at a distance from the environment or objects. Conversely, virtual reality is advantageous as it assists people to extend their perceptions about the real world in ways that were formerly thought impossible (McLellan, 1998). According to McLellan, it is a cognitive tool that allows for immediate dynamic interaction with the environment along with deep mental involvement. It is, therefore, extremely beneficial in augmenting and refining spatial abilities.

Ross and Aukstakaluis (1993) projected several situations for expanding visual abilities through virtual reality technology. More precisely, the ability of visualization and spatial orientation of students are enhanced considerably. Spatial orientation includes both static and dynamic relationship of the environment and user. Spatial ability includes rotation as well as translation. Thus, this technology appears to provide a better option to test, enhance, and possibly improve both orientation and visualization skills. However, to assess the extent to its impact, and its nature, more research is needed in this area.

Virtual reality a prime example of technology that can be effectively utilized for research in spatial ability. In the coming years, indeed, many new technologies will find abode in the literature of spatial ability. Some of them might include augmented reality – where there is a combination of virtual reality with physical devices, hepatics, holographs, wearable devices, and among others, pervasive computing. It will not be unusual to expect the research in spatial ability will continue with greater involvement of the aforementioned technologies.

2. Conclusion

The history of spatial ability could be traced back to 1880. Since then it is being researched and every research perspective viz psychometric, developmental, differential and information processing researches have added significantly to understanding about spatial ability. Now, spatial ability has become a significant aspect in the research of other disciplines as well. Researches on spatial ability are predicted to continue with two concurrent themes: its association with intelligence and the influence of technology and computer in redefining and molding spatial ability. Current technologies like 3D Imaging, virtual reality, simulations are redefining and molding spatial ability.

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