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EXPLORING MENTAL SILHOUETTE TEST

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A well-developed spatial visualisation ability is essential in the design of engineering structures. It is introduced from the very beginning of undergraduate course as a basic skill that is necessary throughout all engineering education. Descriptive geometry and engineering graphics are the subjects where spatial imagination and the projection methods are developed. [3]

Both skills are highly correlated, as equally applicable to space and graphic record. Therefore many educators of descriptive geometry conduct research over the assessment methods of the level of spatial imagination. As a result of these studies a variety of measurement tools were invented, among which the most common are tests using 2D and 3D images of objects and manipulation of these objects. Widely recognized and applied are MCT (Mental Cutting Test) and MRT (Mental Rotation Test), both well documented in international literature. At the same time there is an ongoing exploration of new research tools. [1] [2]

The paper refers to a new concept of spatial imagination testing named by the authors as Mental Silhouette Test (MST) wherein the properties of 3D objects are examined by the shapes of their outline (silhouette). This type of test was proposed for the first time at the International Conference on Geometry and Graphics in Innsbruck in 2014 by Japanese scientists Akira Takahashi (Kyoto Centre for Community Collaboration) and Hirokazu Abe (Osaka University). They presented the results of their analyses with the use of probabilistic models IRT (item response theory) and the correlation coefficient between the MST and MCT. [4]

The typical MST test consists of 20 items, each representing different 3D model in an axonometric view together with five alternative silhouettes – four correct ones and one incorrect. The answers show the outline of the object observed from different directions. Therefore a test-taker should imagine the free rotation of the object and adjust the predicted silhouette to the given options. The option that cannot be obtained should be indicated in the answer sheet.

The presented idea has become an inspiration to own research which will be presented in the paper. The article will contain the results of the research on MST covering construction of several versions of tests, exploration of their properties and quantitative analyses.

The conclusions of the analysis will be used to answer the research questions regarding suitability MST for various purposes. At this stage it seems important to determine to what extent of complexity of the object it is still possible to recognize (excluding drawings) the proper silhouette after the rotation. It is also worth examining the importance of knowledge of descriptive geometry and methods of projection in giving answers. And thus the subject of inquiry will go towards the usefulness of the MST as a school achievement test. The achievement test attempts to assess how much a student has learned in school and to measure the extend of knowledge about a specific curriculum. Another area of concern is the possibility of the use of solids such as spheres, conics or cylinders in the model.

References:

[1] Górska R. A.: Investigation of the measures and means for the development of spatial skills. The Journal for Geometry and Graphics, vol. 15, 2005, pp. 35-38.

[2] Górska R. A.: Spatial Imagination – An Overview of the Longitudinal Research in Poland, The Journal for Geometry and Graphics, vol. 9, No 2, pp. 201-218.

[3] Sroka-Bizoń M., Terczyńska E.: Perception of View – How to Develop Spatial Imagination, The Journal Biuletyn of Polish Society for Geometry and Engineering Graphics, vol. 25 (2013), pp. 19-26.

[4] Takahashi A., Abe H.: Evaluation of Spatial Ability by using a Silhouette of a Solid Figure in Graphic Science Education, Proceedings of 16th ICGG, Innsbruck, Austria 2014, pp. 363-370.