GLOBE MAPS: NOVELTY OR CARTOGRAPHIC EDUCATION NECESSITY?

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ABSTRACT

A globe map is a faceted sphere that can be laid totally flat and therefore can be printed on one side of a flat sheet of paper and show the entire surface of the planet Earth as a flat map. Smith's RealEarth GlobeMap™ is discussed and is used as the basic projection for a set of atlas maps for students and for a card game called Mapa™. Characteristics of all three of these learner support materials (LSM) are discussed. The three LSM items were presented at as series of workshops for teachers in Western Cape Province, South Africa, in February 2003. Results of a survey of workshop participants reveal a highly favourable opinion of the helpfulness of these three items for geography education. Considering the financial limitations on education worldwide and especially in the Developing Countries, availability of low-cost flat-printed items should be seriously considered for support of geography education, and not be overlooked as mere novelties.

1. INTRODUCTION

Geography education should utilize a strong base in cartography at multiple scales. Large scale products (such as highly enlarged aerial photography discussed by co-author Anderson in a separate ICC presentation) provide perspective for local-area studies, while medium scale cartography (such as topographic maps at 1:250,000 and 1:50,000 scales discussed by co-author Innes in another ICC presentation) is useful for studying transportation networks, land reform, etc. Our focus in this current presentation is on the smallest of the small scales, specifically for globes and atlases. Small scale cartography supports geography education on issues such as national position, globalisation, and the concepts associated with the spherical earth (such as axis of rotation, plane of revolution, latitude and longitude, antipodal points, and great circle routes).

It is easy to agree that instructional cartographic materials at small scales (and at other scales also) are needed for school purposes. However, the availability of globes and atlases in schools is highly variable, depending on the financial support of the schools in each country or province. In affluent communities, globes and atlases are usually abundant, even to the point of globes being common, decorative, or even novelty items, as when the globe has features such as special themes, interior lighting, raised relief, or other unique construction. But to not have any globes in affluent schools would be unthinkable. Perhaps globes are under utilized in our educational systems, but globes are certainly considered to be among the necessities of geography education.

However, in vast areas of the world, a globe is usually not present in the classroom. Of course, the concepts of a globe and the spherical planet are clearly in the school curricula and textbooks. Students can be told about globes as scaled reductions of our spherical planet, can see pictures of globes, can simulate globes with oranges or other spherical fruits, and may occasionally see or perhaps even touch a real globe. But many students in the developing countries have no significant learning experience with globes. In such situations, every effort to provide sufficient globes needs to be considered, including the provision of "globe maps."

2. "GLOBE MAP" DEFINED AND ILLUSTRATED

The definitions here are intended to be general, easily understood, and functional, not "technical" to make issue of words like elastic, non-paper, sphere, other planets, and digital cartography.

A *map* is a flat surface, usually of paper, that shows the spatial relationships at a reduced scale between locations, and which, if showing the entirety of the planet Earth, can be called a "mapamundi" or "world map."

A *globe* is a spherical surface, usually of a rigid material, that shows the entire surface of the planet Earth in correct spatial relationships at a reduced scale between locations.

A *globe map* is a faceted sphere, (that is, a near-sphere with flat sides), that can be laid totally flat and therefore can be printed on one side of a flat sheet of paper and show the entire surface of the planet Earth as a flat map. Likewise, it is a flat sheet that can be folded and assembled into a near-sphere on which is shown selected surface features of the planet Earth.

The traditional construction of globes is with multiple gores ("wedges" or strips) that can be placed over the surface of a sphere with modest amounts of stretching. Although it starts as a world map and ends as a globe, it cannot be opened and laid again flat. Therefore, it is not a globe map.

Throughout the past two centuries, several configurations for globe maps have been advanced. All of them are essentially "interrupted" projections, having numerous edges or cuts visible when laid flat as a world map. Most are primarily for constructing "near-spheres" and not for presentation as flat world maps. Only two true globe maps have enjoyed reasonable popularity.

The most well-known globe map is the "Dymaxion Map"™ by Buckminster Fuller. It has twenty (20) facets each with three sides, but several have been further cut and attached to the adjoining facets so that very few of the cut edges pass through land masses. The Dymaxion Map has very little distortion by projection on each of its twenty facets. Therefore, when the pieces are laid flat and printed in one specific configuration, the result is an impressive and quite functional mapamundi. As a faceted globe, it is rather complex in construction and, once assembled, is seldom flattened. Its impact appears to be primarily as a novelty item purchased by people who already have access to a variety of globes and world maps.

A globe map with fourteen (14) facets is the "RealEarth GlobeMap"™ developed by Thomas Smith in the 1980s. The eight hexagons and six squares cover areas slightly larger than Fuller's facets, so each of Smith's globe map facets has slightly greater distortion due to projection. However, the Smith product is significantly more simple in construction and assembly, and has led to additional applications of his fourteen facets.

3. THE SMITH "RealEarth GlobeMap" CHARACTERISTICS

Once it is seen, the construction characteristics of Smith's globe map are quickly appreciated (Figure 1). Eight hexagons and six squares are joined by folds and tabs to become a fourteen-facet globe. Each facet can be named

Figure 1. Smith's RealEarth GlobeMap (13 cm or 5 inch diameter) flat, flexed, and assembled,
because each matches well to a specific continent, major ocean, or sub-region (such as the Middle-East). Substantial information is available at the Internet site http://realearth.com.

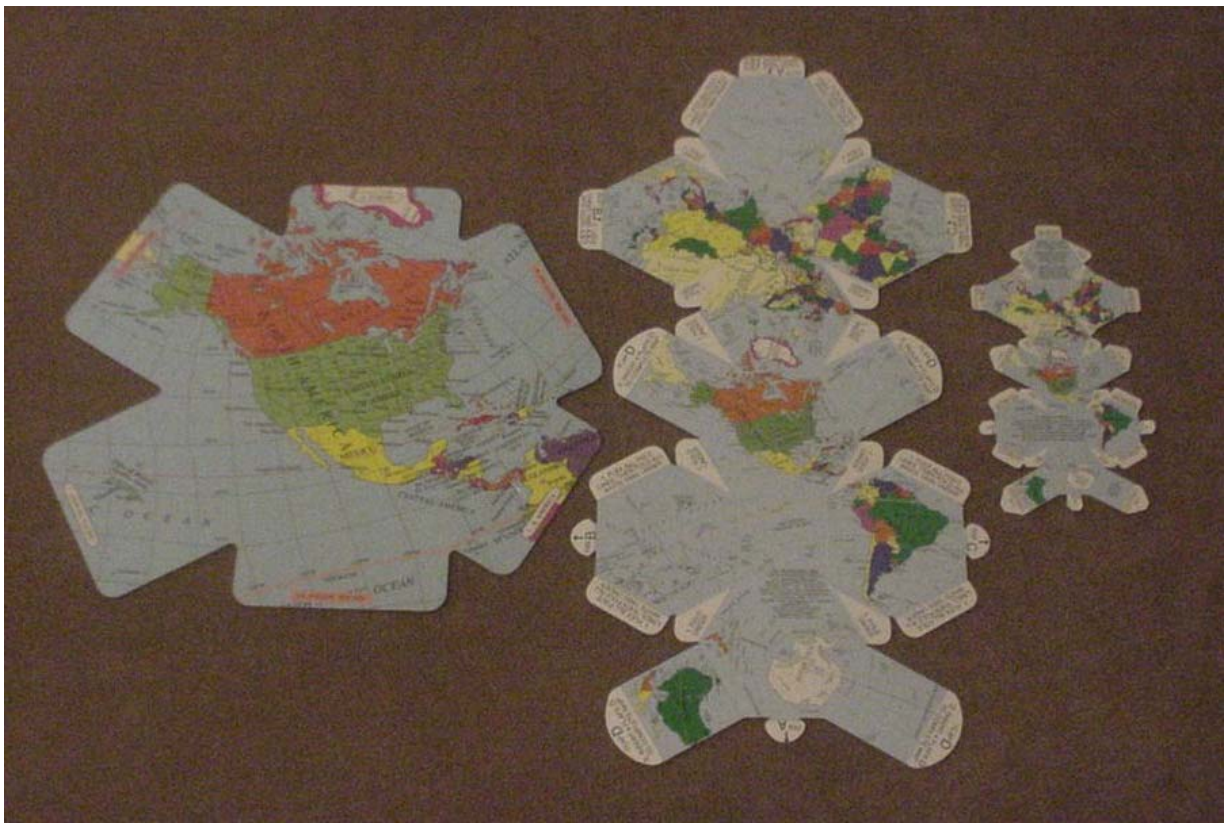

Figure 2. The three sizes of Smith's RealEarth GlobeMap. Note that the shown North America facet of the 30 cm (12 inch) diameter globe has cartographic detail on each of the six tabs (extensions) that are used to join the facets. Three sizes are available: the smallest is like a golf ball and the largest is like a basketball.

4. ATLAS MAPS FROM SMITH'S PROJECTION

Because each of Smith's fourteen facets basically expresses an azimuthal projection, each could be extended indefinitely to become a world map with extreme distortions at the outer edges. But the low distortions close to the area of the specific facet could permit making atlas maps for individual continents, with Smith's contribution merely being the location of the fourteen centre points. However, extensions beyond each edge of each facet could be made with the projection of the respective adjoining facet. This would result in "interruptions" as evidenced by the "notches" in the large North America facet in Figure 2. In other words, the Greenland area shown on the extension (tab) from North America actually is the correct representation of Greenland on the Europe facet. Likewise, the Alaska, Hawaii, and South America extensions are from the projections of their respective facets.

The concepts of "interruptions" and multiple centres of projection are well established in atlas cartography. The best known example is Goode's interrupted Homolosine world map.

Applying the above concepts to Smith's projection for his globe map, Anderson has produced a set of atlas maps for all of the continents. The most complicated one extends nearly half the globe from Australia to Europe (Figure 3). The shaded wedges indicate the approximate location of the edges on the faceted globe, except that to reduce the size of the wedges, duplicates of some areas (such as the North Pole, some Arctic islands, and western Sudan) are printed.

The atlas maps have been assembled into a set of eight sheets. As a highly economical "Mini-Atlas" for school usage, they are printed on the front and back of a single A4 (approximate "letter size") sheet of paper. (See Figure 4.) By folding the paper twice and cutting along the resultant top edge, an A6-size booklet is produced. If A3 paper is used initially, the resultant Mini-Atlas will be size A5. The Mini-Atlas was originally produced by co-author Anderson to address educational needs in under-resourced classrooms in Mozambique.

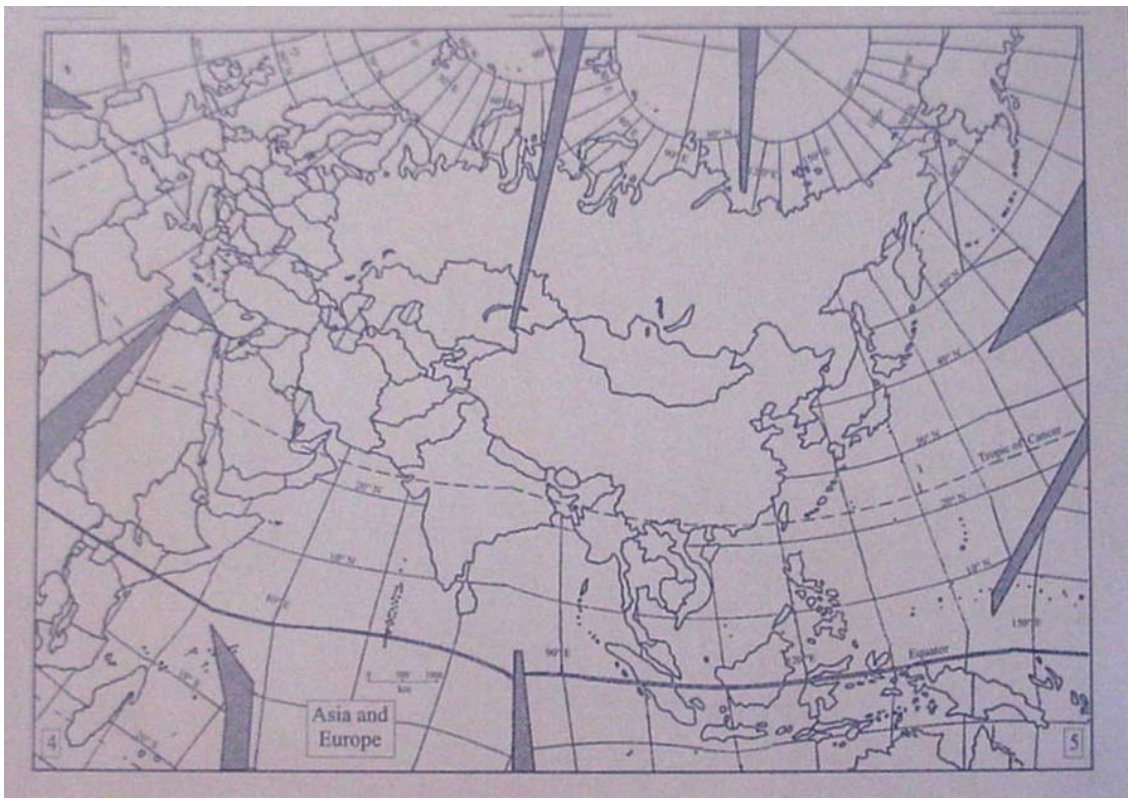

Figure 3. A Smith-Anderson interrupted projection showing Europe and Asia to northern Australia.

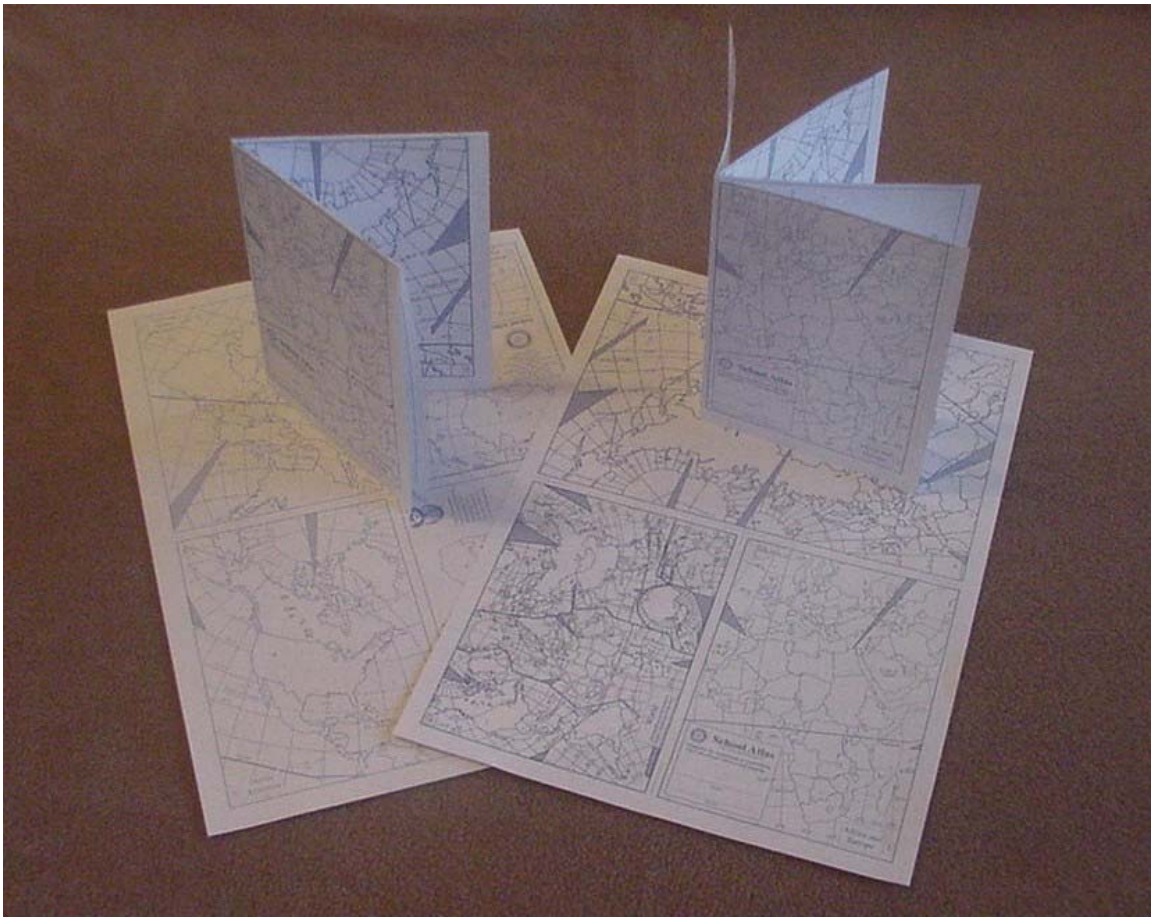

Figure 4. The School Atlas or “Mini-Atlas” with the Smith-Anderson interrupted projection. Note the world map in the lower centre of the figure.

5. THE “Mapa” GEOGRAPHY GAME FROM SMITH’S GLOBE MAP

Co-author Anderson subsequently developed from the RealEarth GlobeMap a world-learning game called Mapa™. In essence, the eight hexagons have been cut in half in a specific way, producing sixteen trapezoids. Those plus the six squares become a total of twenty-two (22) quadrilaterals, commonly referred to as “quads” or cards (as in a deck of playing cards.) (See Figure 5.) Each quad has a geography-based name.

Figure 5. The 22 Mapa quads in one of thousands of possible arrangements.
Note that each arrangement would technically qualify as a “globe map” that starts as a flat map and could be cut, folded, and taped to become a near-sphere.

A useful but not obligatory addition was to have a thin coloured border around each quad, thereby producing “suits” of cards (red, yellow, green, and purple). Suits can also be created by having different geographic themes, such as political, physical (land-forms/sea floor), climate, or socio-historical themes, as done for the “Global Pursuit” game from the National Geographic Society. The availability of an assembled RealEarth GlobeMap also adds to the appeal of the Mapa game (Figure 6).

The cards of the deck, or the playing pieces, are clearly defined and reproducible in various sizes and materials. The rules of the games (plural) have been started but not totally finalized. There are at least six distinctly different games possible, plus numerous versions that are friendly or competitive, multi-player or solitaire, single deck or multi-deck (multiples of 22 cards), and essentially entertaining or obviously educational. Although many versions of games can be very easy to play and suitable for small children, other versions can utilize the complexities of a 22-card “spherical deck” (versus the linear arrangement of the regular 13 “ace-to-king” playing cards).

Figure 6. RealEarth GlobeMap and Mapa game pieces with coloured borders.

6. CARTOGRAPHY EDUCATION INITIATIVE IN SOUTH AFRICA

The development of spatial competence at global, continental, national and local scales is a required learning outcome of South Africa's new curriculum. Although 'mapwork' has been in the geography syllabus and examined in the geography practical paper set for matriculating school leavers since the seventies, performance has generally been poor due to poor teacher training and lack of resources. In a country where land rights were denied to the majority of the population for so long, there is limited appreciation amongst the general public of the importance of information about how land is represented. In a proactive attempt to implement the improved education policies outlined in the Streamlined Curriculum for 2005 documents, the Chief Geography Subject Specialist for the Western Cape Education Department undertook to provide selected schools with a range of educational resources and to offer geography educators training in their use.

As part of the drive to improve education delivery in this province, the Western Cape has been divided into 8 districts each served by an Education Management and Development Centre (EMDC). From the 2002 geography matriculation results, the 3 EMDC's with the poorest performance were identified. From these 3 districts, 124 schools were each invited to send 3 educators responsible for teaching geography to GETC (General Education and Training Certificate offered after 9 years of schooling) and FETC (Further Education and Training Certificate offered after 12 years of schooling) levels. In collaboration with the national mapping organisation of South Africa (the Chief Directorate of Surveys and Mapping in the Department of Land Affairs) the Western Cape Education Department ran 8 workshops titled *"Developing spatial competency at global, continental, national and local scales"*, during February 2003. Included in the range of spatial information resources provided to these schools were Smith GlobeMaps and Mapa Games. This paper outlines the methodology used for introducing these resources and educators' responses to them.

Although 124 schools were invited to participate in the training workshops where the resources were handed over, only 90 schools sent representatives. In many cases less than 3 representatives per school arrived; 192 geography educators attended the workshops. For one hour of the four hour workshop the group was divided into two. While 108 educators, responsible for preparing learners for the final (FETC) geography exam, participated in the collaborative writing of advanced map use exercises for MapTrix (a self-instruction programme for topographic map reading) 94 educators played Mapa, used the Smith GlobeMaps and assessed the accompanying Mini-Atlas referred to in the following as the globe map materials.

7. METHODOLOGY FOR INTRODUCING THE GLOBE MAP MATERIALS

On arrival, each educator was given a flat globe map and asked to follow the instructions for construction. This activity led to interaction and amusement, immediately getting the workshops off to a good start.

Amongst other items, each school was provided with a conventional plastic skinned, hard shell globe on a stand and a large, political wall map of the world using a Mercator projection to show time zones. (The selected schools also received maps of Africa, South Africa, the Western Cape and a number of local 1:50 000 topographic and 1:10 000 orthophoto maps as well as MapAware Training and Test maps and MapTrix Kits.) All the materials were on display and the advantages of using the conventional globe and wall map for geography teaching were highlighted. Attention was drawn to the disruption of shape, size and scale on the wall map, the exclusion of Antarctica and the distorted enlargement of the countries of the northern hemisphere both latitudinally and longitudinally. The apparent reduction in size of the Pacific Ocean when comparing the globe with the wall map was clear. The advantages of the projection used for the globemap were then demonstrated as a means of overcoming these distortions. The comparative prices of the globe maps and conventional globes were discussed; educators indicated that despite their fragility the greater number of globe maps that could be purchased with limited resources was a significant advantage because many learners could handle the globemaps and thus become more familiar with the world as opposed to only one conventional globe on display. Due to the high cost of the latter educators are reluctant to allow learners to handle conventional globes.

The globemap materials presented to each school were packaged as follows: two flat globemaps, two sets of four Mapa Games i.e.8 Mapa Games (each game is identified by a different colour border on the map quads) and two copies of the rules for the Mapa Dice Game and the Mapa Name Game. Groups of 4 educators were each given one Mapa Game to use during the demonstration and they had their globemaps as a guide.

As time was limited it was decided to structure game rules so that educators had a starting point for their assessment. Limited time and research staff meant that educator reactions could be observed but not documented. During the first few workshops, building the Mapa puzzle was very slow, it was clear that educators were very reluctant to place pieces ‘upside down’. They kept trying to build a world map in the familiar wall map format. They neglected to use the graticule pattern to match edges and their attention had to be drawn to the highlighted equator, tropics and polar circles before they used these clues. The rules seemed to inhibit them and they proceeded very cautiously rather than just enjoying putting the world together. During the later workshops they were encouraged to put the world maps together and then walk the floor to observe the maps built by other groups to see how many different shaped maps could emerge and still be ‘correct’. Only once they were familiar with the puzzle pieces were the rules introduced. Having played Mapa for about 20 minutes, educators were asked to evaluate the Mini Atlas. They then completed evaluation sheets assessing all three globe map materials.

all participants received materials to take back to their schools (for which a follow-up survey is intended, possibly with results by the August ICC conference).

The results below are viewed a very preliminary and not as rigorous proofs. However, main trends are clearly evident and can lead to more refined studies as needed.

8. RESULTS OF THE SURVEY ABOUT THE GLOBE MAP, GAME, AND MINI-ATLAS

Eighty-eight (88) workshop participants provided responses in a matrix of twelve (12) geographic concepts (including location issues; latitude-longitude usage; projections; and planetary rotation/revolution) in relation to five learner support materials (LSM) for small scale maps and globes (Spherical globe = SG; Wall map of the world = W; RealEarth GlobeMap = G; Mapa game = M; and Mini-atlas = A). For each of the 60 cells in the matrix, the participant classified for each geographic concept whether the specific LSM was 1 = very helpful; 2 = helpful; or 3 = not helpful.

Of the 88, eight were too incomplete to be useful, and another one was removed because of too many obvious inconsistencies, suggesting invalid responses. For the remaining 79 participants, the initial analysis was to establish a base line concerning the perceived usefulness of the normal spherical globe (SG). Sixty-six (84%) considered the SG to be at level 1 (very useful). This included a few respondents who had marked some matrix cells as level 2. The remaining 13 (16%) were at level 2. Because 6 of the 13 actually gave a higher ranking (level 1) to the facetted globe map than to the spherical globe, we examined them closely. Several had inconsistencies, one seemed to have reversed the 1-2-3 codes throughout, and in general they would imply an unusually favourable results toward the three new LSM (G, M, and A). Therefore, favouring a conservative analysis, we decided to set them aside, and our final sample consist of 73 respondents

Concerning the helpfulness of the faceted globe map, not one of the 73 respondents rated it as level 3 (not helpful). Three out of four respondents (53 of 73 = 73%) rated it as level 1 and therefore as having a level of helpfulness approximately equal to that to the spherical globe.

When comparing the responses for the faceted globe (G) versus wall maps of the world (W), two-thirds (66%) rated them as equally helpful, an additional 22% said the faceted globe was more helpful than the wall map (66% + 22% = 88%), leaving only 12% (9 respondents) preferring the wall map.

The results concerning the mini-atlas (A) level 1 = 32%, level 2 = 45%, and level 3 = 23%. Three-quarters (77%) of the respondents considered the mini-atlas to be helpful or very helpful. Considering the extremely low cost of providing a single sheet of paper to each student, further trials about use of the mini-atlas appear justified, including possible variations with printed names and additional or other features (such as rivers).

The Mapa game was rated as level 3 (not helpful) by only 4 (5%) of the respondents. Most (50 equals 69%) replied with level 2 (helpful). And the remaining 19 teachers (26%) thought the game would be "very helpful." Although the results are overwhelmingly favourable, we note that this is the first time ever that the Mapa game has been taken to a large audience. All previous experiences with the Mapa game have been with groups of ten or fewer people. Therefore, our cautious observation is that further experiences and the coming follow-up survey to this initial group will be very important for confirmation of these initial favourable results.

9. CONCLUSION

Three related but different very small-scale cartographic products have been discussed as learning materials for geography education. The 14-facet globe map by Thomas Smith is the starting point. From it have been derived a set of atlas maps and a card game that utilize the unique projection characteristics of Smith's globe map. These materials have been used in a series of African workshops, and the results have been highly favourable. We believe that these learning materials have a potentially great role, in part because their production costs are very low. Considering the financial limitations on education worldwide and especially in Developing Countries, availability of these low-cost flat-printed items should be seriously considered for support of geography education, and not be overlooked as mere novelties.

10. REFERENCE

[1] Winston, Barbara J. (1984) *Map and Globe Skills: K-8 Teaching Guide*, National Council for Geographic Education, USA