

GigaPan Conversations

Diversity and Inclusion in the Community

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Abstract

GigaPan Conversations is jointly organized by the UNESCO International Bureau of Education (IBE) and Carnegie Mellon University (CMU) in collaboration with the UNESCO Associated Schools Project Network (ASPnet). The objective of this project is to promote empathy and understanding between cultures. Through inquiry-based and participatory practices in the curriculum, this project aims to promote dialogue and exchanges between school-age students on selected topics such as inclusion, Learning to Live Together, equity, cross-cultural inclusion and environment. This is with a view to foster a more in-depth approach to cultural and social issues, as well as enhanced inter-cultural understanding across different geographical regions and cultures. A major focus of the project is to use GigaPan technology and integrate it within a curricular framework to establish a robust Information and Communication Technology (ICT) in Education project capable of delivering tangible improvements in both classroom experience and learning results. This report details the motivation behind this work and initial experiences based on the first pilots conducted between Soweto township (South Africa) and Pittsburgh, Pennsylvania.

1. Background

GigaPan Conversations proposes to study how a new panoramic imaging technology, coupled with a designed curriculum, can enable learners to interact meaningfully across borders to learn about community, culture and the history of their respective regions. The development of a deeper understanding of self, of one another and a consideration for the beliefs and values of others all represent long-term goals of this project. This brings the themes of Learning to Live Together and inclusive education to the table with new opportunities for dynamic, web-based and interactive learning that makes positive use of new digital media. One of the pedagogical strengths of the project is in creating a classroom dynamic of participatory learning. The specific objectives of GigaPan School Exchange are:

1. develop and share good practices in linking curriculum and new technologies (GigaPan),
2. empower students to use new technologies in the context of motivating participatory and productive learning experiences,
3. explore local and international issues pertaining to inclusion and Learning To Live Together with a view to foster constructive exchanges, cooperation and solidarity,
4. develop inquiry and research skills in students and teachers,
5. promote inclusive school settings,
6. encourage exchanges and sustainable networking.³

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2. GigaPan Technology

The GigaPan technology is comprised of three major components: (1) a robotic device that holds any low-cost digital camera and uses the camera repeatedly to capture a scene both panoramically and at great detail; (2) software that combines the resulting high-resolution images into a massive panoramic single image with billions of pixels of resolution; and (3) a web-based platform for storing, annotating and sharing the resulting explorable scenes. Because the resulting panoramas have billions of pixels in detail, they introduce new dynamics in the relationships between photographer, photograph and viewer, presenting an entire virtual *scene* to explore through zooming and searching. Finally the viewer is not interpreting a single, linear media product; rather, the viewer actively must decide how to explore the GigaPan-based scene, discover details, and then become an author herself by providing annotations on any part of the scene.

2.1 School Selection

This article documents a first pilot introduction of the GigaPan by UNESCO-IBE and Carnegie Mellon University to evaluate the usability of the technology and to begin the process of documenting how school classroom based projects and interactions may or may not occur across cultures. Initial candidates for the Pittsburgh schools were the Falk Laboratory School of the University of Pittsburgh (Falk), the Creative and Performing Arts High School (CAPA), and the Miller African-Centered Academy (Miller). These schools were selected based on past participation in UNESCO projects, flexibility in their curriculum, and an interest in incorporating an international component into education. Falk was approached in December of 2007, and quickly agreed to participate.

Selection of the international schools, once UNESCO's Associated Schools Project Network (ASPnet) had helped identified the countries, was made by the respective UNESCO National Commissions. The Lavela Secondary School in Soweto, South Africa was approached and became the South African partner school. Naparima Girls' School on Trinidad and Bishop's High School on Tobago were later selected by the ASPnet Coordinator of Trinidad and Tobago based on past successful participation in UNESCO projects.

2.2 Falk Laboratory School (Pittsburgh, Pennsylvania)



Falk School during in-school training and use

The Falk Laboratory School of the University of Pittsburgh has 275 students, serving grades K-8. The GigaPan Conversations project was initially integrated in the Technology curriculum,

³ GigaPan Letter of Agreement between UNESCO-IBE and Carnegie Mellon University

beginning in January of 2008. Falk School runs its technology classes in 5 intensive cycles of approximately 6 weeks, normally focusing on ICTs and touching on emerging technologies; all students are enrolled in one cycle per year. Two middle-school classes meet for 35 minutes each day for the duration of the cycle. One of the target classes was a 6th-grade class and the other is a combined 7th-8th grade class. The US based education team worked with the instructor to create several layers of curriculum and lesson plans. The following general strategy was suggested:

- Week 1: Learn to use the GigaPan robot, incorporating both teacher-student and peer-to-peer instruction. Take and stitch a “personal items” panorama, where each student brings in 3 items of significance. Incorporate instruction on digital photography and image processing.
- Week 2: Learn to use the website, including image browsing, marking areas of interest for further conversation (snapshotting), posting and deleting comments. Students find and describe their own personal items. Incorporate instruction on internet privacy, online communication, and descriptive writing.
- Week 3: Discussion of community: What defines community at a city, school, and personal level? With this in mind, what locations in Pittsburgh would the students choose to take GigaPans of to share with a school in a different country? Incorporate online research of Pittsburgh communities and mapping.
- Week 4: Planning and execution of field trip to take panoramas in Pittsburgh communities. Create field surveys to compare communities. Stitch and upload panoramas; annotate by adding general description, snapshots with comments, and results of the surveys. Incorporate instruction on Word (building surveys) and Excel (recording and graphing survey results)
- Week 5: Create a website, print document, or video documenting the experience.
- Week 6: Closure on any technology curriculum goals that were not met in the context of the GigaPan experience.

2.3 Lavela Secondary School (Soweto, South Africa)



GigaPan Soweto/Lavela (South Africa) student portrait

In April 2008 representatives of UNESCO IBE and CMU traveled to Lavela High School in Soweto (Johannesburg, South Africa). Lavela High School is comprised of some 1200 students, ages 11 to 23 and grades 8 to 12. The school has 42 teachers. Currently about 25 students use ICTs regularly. The students differ in the amount of ICT exposure they receive.

An initial conversation with the instructors was used to better understand the general school context and how ICTs had thus far been integrated into the classroom. It was determined that computer technology was mainly integrated into the curriculum as a supplementary competency; enabling students to augment the breadth and depth of research. There are approximately 7 teachers who have provided students regular research work using computers. The teachers remarked that there are three teachers who are generally perceived to have very advanced computer skills while the rest are themselves still in the early learning stages of using ICTs.

Finally, the conversation focused on barriers to learning and expectations concerning the new technology. One of the biggest impediments to using technology is that load sharing can slow the network. As a result, sometimes web sites can't be accessed at an adequate speed. Furthermore, recently electricity had become more of an issue in South Africa. These impediments were fairly rare and the school was relatively happy with connectivity and functionality of the computers. The teachers' biggest concern was that many of them did not feel confident in using new technology. As a result, they said it was tricky to understand what sort of ICT work they could assign and how such work could be adequately assessed and integrated into the rest of the curriculum.

During initial training students were divided into 3 groups of approximately 10 and were given a basic interactive introduction to the requisite technologies. Each of the groups was given the assignment to take one panorama documenting pollution near the school consisting of a least 30 photos. Following this introduction, the students were introduced to a dedicated website for posting panoramic images and annotations to their U.S. counterparts and for exploring U.S. panoramas, annotating subregions in those panoramas and generating asynchronous comments between the two schools.

Both at Falk and at Lavela, every student subgroup was able to create GigaPan panoramas, annotate and upload to the educational website with ease. This established the desired ease of use for the system, and in particular verified that prior experience with robotics or photography was not required for the GigaPan acquisition process to proceed smoothly.

3. Sample Conversations from Soweto Panoramas

There were five GigaPans taken of Soweto from April 29th until June 12th, four by the students of Lavela High School and the first from a tower was taken by instructors to get the discussion started. The pictures themselves covered three main themes: (1) Soweto (Soweto from Tower, Twin Cooling Towers), (2) the Soweto riots of 1976 (Tsietshi Mashini Memorial, Regina Mundi) and (3) General culture (traditional Xhosa meal).



Regina Mundi church (Soweto, South Africa)



Tsietsi Mashinini Memorial (Soweto, South Africa)



Soweto from tower (Soweto, South Africa)



Valuable personal artifacts (Pittsburgh, USA)



Graffiti on playground- all legible in panorama (Pittsburgh, USA)



Typical urban graffiti and pollution (Pittsburgh, PA)

For each panorama the students took numerous snapshots, totaling 200.⁴ Fifty five of the conversations consisted of the students exchanging with each other.

Life Style: Comments on how people live	51
Public Buildings: Public sectors buildings	33
People: Comment were often about people and what they were doing	19
Random Object: Often there were inquiries into what a miscellaneous object was	19
Flora/Fauna: Comments on Plants and Animals	18
Environment: This category included both concern for the environment and general climatic observations	17
Commerce/Industry: Comments on Businesses	17
History: Comments providing additional perspective on the photo or history of the surrounding area	15
Food: Comments on the food	12
Leisure: Comments on Leisure activites	10
Legend: Comments on local legends (for example Nelson Mandela)	10
Transport: Comments on local transportation	9
Socio-economic: Comments on socio economic factors	9
Jokes: Students made jokes about some of the images	6
Geography: Comments on where things are geographically	6

⁴ A snapshot refers to the student selecting a sub area of interest within the panorama. Once the sub-area is selected the student can add a title and comment. Snapshots are the building blocks around which conversations regarding the panoramas take place.

The conversations could be summarized in terms of 15 categories: life style, public buildings, people, flora/fauna, environment, commerce/industry, history, food, leisure, legend, transportation, socio economic, jokes, geography and miscellaneous objects. Categorizing the conversations provides several useful insights, for example:

- (1) the fact that there are so many categories illustrates the versatility of the GigaPan to allow students to cover numerous topics,
- (2) categorization allows one to see which topics occurred most often,
- (3) it provides an example of how various conversations fall within various school subjects like history, geography, social studies, biology, etc.

Often one comment could fall into several categories. For example consider the following conversation:



Why is a trash bag up there? A.R.L

Comments:

1. no thats not a trash bag

-Posted 3 months ago by [Lavela School \(lavela\)](#)

2. yes that one was left by father christmas when he fell

-Posted 3 months ago by [Lavela School \(lavela\)](#)

3. Is that a trash bag?CD

-Posted 3 months ago by [PIC3 Falk \(p1c3\)](#)

4. Is father christmas the person that leaves presnts at night on christmas? If so here he is called santa. MR

-Posted 3 months ago by [PIC3 Falk \(p1c3\)](#)

In this conversation the student from the Falk school begins the conversations by referring to a trash bag on the roof of a building which could be classified as a random “miscellaneous object” that the student discovered. A student from South Africa responds by making a “joke” by stating that it was left by Father Christmas. The student from the United States asks if Father Christmas is the same thing as Santa. This final comment could be classified as “lifestyle” since it teaches the students about the similarities and differences in culture and lifestyles between their two communities. As a result this particular conversation was classified in three categories: random object, jokes, life style.

3.1 Successes of the Conversations:

Finding Similarities

The students in Soweto and Pittsburgh recognized similarities between each other from mundane subjects like they both drink Coca Cola and coffee to a general concern about pollution and protecting the environment. Similarities help the pupils see that they share things in common and that their interests and concerns are familiar to students across the globe. As one student put it, “yea we also drink a lot of coke, we are not so different after all”.

Exploring similarities is an important aspect of Learning to Live Together. “One of education's tasks is both to teach pupils and students about human diversity and to instill in them an awareness of the similarities and interdependence of all people.”⁵ The GigaPan students not only began to see similarities between their communities but also used these parallels to understand commonalities and develop a better mutual understanding and dialogue together.



Air Pollution

When is it gonna end? I wish it would end very soon.

Comments:

1. I hope air pollution ends soon too. Our world will be very polluted soon.- V.Y. -- Posted 3 months ago by [PIC3 Falk \(p1c3\)](#)

2. Is this pollution? B.D.

-Posted 3 months ago by [PIC3 Falk \(p1c3\)](#)

3. AIR POLLUTION ITS DAMAGING OUR OZONE LAYER WE NEED TOO DO SOMETHING VERY SOON AND FAST

Posted 3 months ago by [Lavela School \(lavela\)](#)

Differences

The GigaPan conversations were also successful in allowing students to explain and explore differences that they perceived between their communities. For example, the conversation below begins with US students asking if like in the US there are coins in the fountains in Soweto. A student from Soweto students responds there are no coins in the fountains and in the ensuing conversations explains the reason for this difference.



Water Fountain

That is a nice Water Fountain. Do you throw coins into the Fountain?A.D.

Comments:

1. No we dont, why do you ask?

Posted 2 months ago by [Lavela School \(lavela\)](#)

⁵ <http://www.unesco.org/delors/ltolive.htm> (August, 2008)

2. It is common in the United States to throw coins in fountains for good luck. This comes from the folklore of the wishing well (http://en.wikipedia.org/wiki/Wishing_well). It is not very good for the fountain and any fish that might live in it, so recently we see "donation boxes" next to popular fountains to put coins in. But children still like to throw them in the water.

Posted 2 months ago by [Laura Tomokiyo \(lmt\)](#)

3. Well thats verry interesting you know,we don't do that.People would still [steal] the money, don't they still it there?

Posted 2 months ago by [Lavela School \(lavela\)](#)

Learning about differences can be as important as learning about similarities. This is especially important when students are able to see the variations within the context of their own frames of reference. "...students learn more and more easily when academic knowledge and skills they are expected to learn are filtered through their own experiential and cultural frames of reference"⁶

Exposure to another Culture

Exploring similarities, differences and joking together meant the students were sharing their community and culture with students in other regions. Cultural awareness and exposure is an important part of Learning to Live Together. "For peaceful coexistence on this planet, knowledge and appreciation of other cultures is important. Children learn prejudices from the world around them. Ongoing exposure to other cultures can help to increase tolerance and good will as children learn to acknowledge and appreciate the differences in people that create our interesting world. This also enriches the educational experience."⁷

3.2 Weaknesses of the Conversations

Additional Perspective needed.

There needed to be more perspective around the panoramas. For example, a short text describing the background of the photo and why it was taken would have provided more context for each photo enriching the cross cultural conversation. To begin with the conversations were somewhat cursory in nature. Specifically the conversations were either very short consisting of a few words or sentences or did not contain much back and forth dialogue between the students.

⁶ Mankolo Lethoko, *Curriculum Development and education for living together: Conceptual and managerial challenges in Africa*, International Bureau of Education Geneva, 2003 p14

⁷ M. Oluwakemi, L. Banks *Curriculum Development for Learning to Live Together: The Caribbean Sub-Region* International Bureau of Education, Geneva 2002, p43.

Additional directions were provided to the schools during the semester to help improve the conversations. These directives help form the base of the “Instructions for enriching the GigaPan Conversations” document which was developed to help improve the comments and provide guidance and incentive to include additional perspective to the conversations. Below one can see how effective the instructions were. The conversation begins with a fairly casual comment and after the school received the principles for enriching the conversations the response provided both context and background for the photo.



Cool

What does this park stand for!

Comments:

1. It is a memorial park its dedicated to the school kids who gave up their lives on 16 june 1976. When the government introduced the new cillabus that stated that all learning should be done in Afrikaans the school kids of that year rebelled against the government. They marched to the re-union buildings in Pretoria, Now in doing so the were police shooting these kids telling them to dismiss, many kids lost their lives that day our brothers and sisters. learn more on www.soweto.uprising.com. - SAMM

Posted 2 months ago by [Lavela School \(lavela](#)

Sustainability of Conversations

Another weakness was the sustainability of the conversations. Many snapshots were unanswered or commented upon. After the semesters ended the schools were provided with the “Instructions for enriching the GigaPan Conversations”. One idea is to make sure students respond to at least one snapshot a week. When one considers the whole class this means at least twenty five to thirty snapshots should be responded to, thereby nourishing the conversations.

Additional Research

Students should integrate more research into their GigaPan conversations. Providing links to additional research not only provides other students additional material to consult if they wish to know more about a subject, but also adds to the academic rigor surrounding the GigaPan conversations. The additional research should be able to bring more context and content to each GigaPan conversation.

4. Program Evaluation

4.1 Successful Outcomes

1 High Level Support

At the beginning of the project both the principal John Mngadi and deputy principal Lulama Thobejane expressed the fact that they fully supported the GigaPan project. As a result of this support, the school’s management team was flexible in receiving new communication instructions and relaying them to the students. Support from the principal and vice principal was also

important in terms of ensuring a high degree of flexibility in the program implementation. Because Lavela was the first school to receive and be trained in the technology internationally⁸ there were several last minute changes to the program. The fact that the school, administrators was able to rapidly adapt their schedules meant that both students and teachers were able to maximize the exposure to the program.

2 Hands-on training of every student

At Lavela, the first day consisted of breaking the class up into three groups to learn the general functionalities of the GigaPan on the three available robots. It quickly became clear in such large groups that only some students quickly took the initiative to try a use the camera; others were content to stand back and allow their peers to test the different functions. As a result, it was unclear whether all students accurately understood all the tasks required to create a GigaPan photo. This posed a potential risk to the sustainability of the project. If only some students could understand the basics of operating the GigaPan it meant not all of the students would be engaged in creating the panoramas.

3 Elimination of dead time

One important success factor for the April 2008 visit to Lavela was the ability to eliminate dead time in teaching. The fact that the class was broken into groups of three or four meant that there were six groups with only two trainers. In practical terms this meant that while two groups were being trained four groups were not. Instead of having the groups sitting around waiting for training, the GigaPan team developed a method of rotating all teams through various activities.

The table below helps illustrate how the rotation strategy worked. The top vertical row represents time in 15 minute increments. The classroom time was divided into 15 minute periods with six periods in total this means the entire exercise fit into an hour and half. In the other cells there are numbers that representing the six groups of students. In other words reading the table from left to right one can see what activity each group was engaged in every fifteen minutes.

	15 min	15 min	15 min	15 min	15 min	15 min
ACTIVITY						
Comment Training	1,2,3,4,5,6					
Commenting exercise	3,4,5,6	5,6				
Robot Training	1,2	3,4	5,6			
Team exercise		1,2	3,4	5,6		
Stitching Training				1,2	3,4	5,6
Commenting exercise			1,2	3,4	1,2,5,6	1,2,3,4

The various activities were meant to teach the students in small groups all aspects of the GigaPan activity. For example in the list of activities, students were first taught how to create comments on existing GigaPans and create a conversation with students in other parts of the world. They then worked on creating their own first comments by themselves to see that they could accomplish this step without supervision. Second, they were given a more in depth GigaPan training on the intricacies of using the GigaPan Robot including some of the technology’s special features.

⁸ Since the GigaPan development team is based in Pittsburgh they were able to introduce local students to the GigaPan. Levala was the first school outside the United States to receive the technology or the first internationally to be part of the project.

4 Project prestige

The prestige of the project has been one of the reasons that developing the GigaPan project was successful. The prestige associated with the project can be attributed to several factors such as: the fact that UNESCO was supporting it; the professor and an inventor of the robot were there in person at Lavela; the national education commission had been contacted; and the arrival of members of the press and the planning of local art galleries on hosting exhibits of the students work seemed to entice the school management to state that the GigaPan project had their full support. The school officials were clearly aware that their school would be in the spotlight both professionally due to the interest of the South African Department of Education and visibly by being highlighted both by the press and having their students work on display in a prominent national gallery.



Soweto students, families and teachers at the Gallery Opening

5 Engagement

Nearly every middle-school student at Falk is now comfortable using the GigaPan robot. The robot was sufficiently easy to use, and interest was adequately strong, that such a new technology quickly found its way into the hands of *every* student throughout a set of grade levels. This is an unusual and hopeful trajectory for a new, university-created technology.

6 Connection with community

The GigaPan process and curriculum demands that learners develop a deeper understanding of their neighborhood, their history and their community. This in turn triggers more meaningful relationships between the learners and other community organizations and individuals. For instance, Falk students have visited a number of Pittsburgh communities to take panoramas, and have learned about them through online research and visiting speakers. The school has also developed a relationship with the Frick Art and Historical Society, a Pittsburgh institution with strong community ties.

7 Growing quality of comments

Early comments reflected the students' initial excitement at using the website. At first text was very short, conversational in style, and often as simple as "what is this?" As the students became more involved in the project, they tended to make more reflective comments and probing questions. At least three factors contributed to this growth: change in teacher instruction; subject

material of panoramas; and development of student perception of what they could learn from the exchange.

4.2 Challenges and Risks

Below we list and describe factors that have been ascertained as important risk factors in the implementation of a GigaPan School Exchange project.

1 Teachers Unaccustomed to Computers

At Lavela, teachers are not yet accustomed to using computers. Lavela High School received its computer lab only eight months prior to the GigaPan training. As a result, the teachers and the school administration have not yet developed a strategy to integrate ICTs in classroom activities and within the curriculum. Furthermore, while it appears that the students have mastered being able to research topics on the Internet, teachers have not yet become comfortable using the Internet.

This was not an insurmountable challenge. Students went from essentially not having computers to mastering the GigaPan, stitching and the Internet, often faster than teachers. As a result, the students' newness to computer demonstrated that the GigaPan can help impart ICT skills by creating an exciting project that enables the students to put into practice and effectively master computer skills. This demonstrated the expanded the scope of what can be learnt through the GigaPan technology.

2 Little Experience of ICTs within the Curriculum

Computers have not yet been integrated into the Lavela curriculum. Apart from teachers telling students to research some topics on the Internet, it appears that regular classes are not yet using computers for standard classroom assignments. This was a potential challenge because there isn't a school culture of using ICTs within the curriculum. As a result, GigaPan Conversations was essentially the first major school project using ICTs and the Internet.

This challenge was mitigated by the realization that the research part of the project does not necessarily need computers to start. As a result, the research component can start early on providing time to improve ICT competencies.

3 Communication Protocol

Initially communication between the schools and the GigaPan team was not very consistent or continuous. For example, sometimes it took a considerable amount of time to hear back from the schools. This could be because of school holidays or in Lavela's case because the teachers and administrators are new to the internet and email.

There were a few ways in which communication was ameliorated. First the GigaPan team had three levels of contact the Principal/Vice Principal, the teacher in charge of the GigaPan class and a student leader. As a result, if there was no communication from one of the parties the second or third contacts could be used to expedite a response. This also helped by keeping all parties better abreast of what they were each doing.

4 Bottom-up structure

While the administration at Falk was very supportive of the project, the Director did not require or invite particular teachers to participate in the project, but rather gave the GigaPan development team the freedom to approach individual teachers directly. Adoption of the program within a school has, in our subsequent experience, been smoother when a principal or vice principal takes

an active role in advocating for a project, in particular providing release time for a cross-curricular team to meet.

Strategies used by the GigaPan development team to directly engage teachers included presentation at faculty meetings, informational presentation open to all faculty, and a letter sent to all middle-school faculty. In all cases, examples of GigaPan Conversations projects in relevant curricular areas were described, as well as possibilities for after-school activities.

5 Inter-discipline dynamics

The technology program at Falk is part of a “humanities team” separate from the core subjects. There appears to be excellent communication and a good support structure within the humanities team, but efforts to integrate GigaPan Conversations in curricular areas like Social Studies may have been helped by a stronger connection between Technology and core subjects.

6 Incorporating pre-existing technology topics

Because GigaPan Conversations was being integrated into Technology curriculum at Falk (at Lavela, students worked with GigaPan in an after-school setting), care had to be taken to ensure that all topics that were already part of the Technology curriculum were not pushed aside by GigaPan. Particular challenges were:

Identifying relevant skills

The GigaPan can be used to introduce and build on many basic technology skills, including digital photography, word processing and online composition, file organization and manipulation, robotics, hardware and software maintenance, and web interaction. Skills not inherent to the process are also easily integrated.

Handling perception of replacement

Concern that GigaPan was replacing more important topics in Technology came from students, parents, and other faculty. While parents did not oppose GigaPan per se, they wanted to be sure that their children were prepared for high school, for example, being familiar with Office software like Microsoft Excel and Word.

These challenges were addressed by refining the implementation over subsequent semesters, and the Technology teacher responded to questions and concerns from parents at a parent-teacher association meeting.

7 Technology vs. content focus

Addressing the above challenges in the context of the Technology program meant that the Falk School implementation heavily emphasized the technological components. The end goal of GigaPan Conversations, however, is not just to have students use the robot and website to contextualize technology topics, but also to have meaningful dialogue with students in other parts of the world, and to develop their own analytical and communications skills. The real substance needs to be in developing a structure for students to discuss, reflect, and collaborate on the taking of local GigaPans, and to use the panoramas posted by the other site as a springboard for learning.

A collaboration between the Technology and Science programs at Falk is emerging, with GigaPan being used to document field work (soil and water analysis) and share results across schools.

8 Stitching bottlenecks

To further the goal of maximizing each student's hands-on technology time, a class would often go out into the field with several GigaPan units, take several panoramas each, and then come back to the classroom to stitch them all. At Falk, there were typically two sections of middle-school technology running back-to-back at any given time, and the second class would need to come back and start the stitching process on computers that already had processes running from the first class. Only some of the computers were able to handle this load, but the organization of the class did not make it easy to restrict which computers were used for stitching.

This challenge has been mitigated by recommending a collaborative selection process in which students first stitch a "draft" panorama and then discuss which single panorama to stitch in finer detail.

9 Mismatched school schedules

The Falk students were very eager to have direct communication with their peers in Soweto, but there were many mismatches in the school schedules. For example, although the US spring semester runs from January through May, Falk has a theatrical production that involves the entire middle school for most of the month of April, causing a long gap in the dialogue. End-of-term exams interfered as well, and while the Lavela students returned from their winter term in July, Falk students were by that time out of school until September.

5. Conclusions

Program-level recommendations can be made based on the experiences at Falk School and Lavela School:

- Secure involvement of the administration and its commitment at the school level
- Identify a cross-curricular project team of teachers and provide opportunities for project planning. At least two teachers, ideally a minimum of three should be working together at a school to execute an exchange. This allows them to:
 - Develop ideas for GigaPan projects in their own classrooms and across classrooms, or jointly in an after-school setting
 - Support each other in content enrichment as conversation topics arise
 - Support each other in logistics such as field trips and sharing of resources
- Identify and select relevant topics and develop specific projects in the context of curricular and/or extracurricular activities. This gives students and teachers a chance to use the GigaPan tool and the website in a meaningful and productive way, thus avoiding the limitation of the student conversations to simple chatting.
- Integrate meaningful assessment and evaluation strategies. Both students and teachers are in need of relevant feedback based on which fine tuning of the project can be undertaken, and the overall quality of the project inputs, approaches and results be improved. Meaningful assessment furthers the project goals of providing students with systematic and meaningful learning opportunities so that they can be adequately equipped with the relevant values, knowledge, skills and attitudes implied by Learning to Live Together, social justice, fairness and inclusiveness.
- Find ways to support collective participation. A stitched panorama should be a success for the whole class, not an individual. Commenting in conjunction with a class discussion can raise the quality of the comments as well as develop communication skills.

- Present schools with a data management plan – when and what to archive, where to store images and GigaPans. Are images deleted from the computer? Backed up on disk? Most schools have very little experience with accumulating and archiving large amounts of data, so they will need specific instructions, such as “save all files to desktop. Every week, burn a DVD with all images and .GigaPan files and delete files from the computer.”
- Synchronize exchanges in the context of school calendars and priorities.
- Account for both real-time and asynchronous communication
- Account for both formal and informal communication

5.1 Future Developments: Class Room Projects Leveraging the GigaPan to Study Environment

Currently, in the fall 2009 there are two GigaPan projects addressing sustainable development and the environment, entitled "Waste Management" and "Environmental Learning". There are several schools in the US, South Africa and Trinidad involved in these particular discussions.

The teachers involved in projects expressed the hope that using GigaPan technology on themes like the environment and waste management would make discussions not only clearer but more pertinent to students' lives. As result, students play a role in the quest for solutions.

The application of the GigaPan technology not only provides a more illustrative rendition of reality but also acts as a sort of advocacy tool empowering children to address ideas that can make a difference at a local level while also learning the scope of the global problem is something that can be addressed in concert with their peers across the globe.

"The Gigapan technology acts like a microscope. It brings into focus what is overlooked or it makes the extent of the problem much clearer. Waste or pollution can frequently be overlooked or pushed aside, maybe even airbrushed. The Gigapan technology allows the viewer to see very distinctly and, with respect to waste management, makes it obvious that waste is a problem that must be addressed." - Justin Guess, Teacher at Connellsville Highschool in the USA.

Finally, with regard to Education for Sustainable Development one of the outcomes attained is the GigaPan project was selected by the UNESCO ASPnet as one of the Good Practices in Education for Sustainable Development in 2009.

Improvements to the Conversations

Based on early indications of success, and thanks to additional funding from Benedum and Pittsburgh foundations, the program is now expanding through the addition of schools in Indonesia, Trinidad, Tobago, Brazil, the Cape Town region of South Africa and five public schools in rural southwestern Pennsylvania.

6. Acknowledgments

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7. About the Authors

The CREATE Lab (Community Robotics, Education and Technology Empowerment) is dedicated to the application of new technology for socially positive change. Projects include the Global Connection Project, technology education programs for girls in middle school and a community-centered electric car innovation program. UNESCO International Bureau of Education acts as UNESCO's centre specialized in contents, methods and structure of education. It builds networks to share expertise on curriculum development in all regions of the world and aims to introduce modern approaches in curriculum design and implementation, improve practical skills and promote informed policy dialogue at national, regional and international levels.