University of Michigan
Undergraduate Research Journal

THE ZINE

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Letter from the Editors

January 2011

Dear Readers,

The UM Undergraduate Research Journal has prided itself on being a student-run organization focused on the potential of interdisciplinary research. Our mission has been to provide an outlet for the superior work being done by University of Michigan undergrads in humanities, social sciences, natural sciences, and engineering. We hope to reflect the variety of research efforts done in the UM community in both of our publications as well as our staff, who come from a multitude of backgrounds from Psychology to Molecular Biology.

We introduced the 'Zine' last year in an effort to allow our staff to showcase this variety in our published material. In this second issue, we have aimed to highlight the practicality and scope of research in real world applications from the deserts of Africa to our own backyard here in Ann Arbor to the future of digital culture itself.

On behalf of the entire UMURJ Editorial and Production staff, we would like to thank you for reading this publication. It is the product of a creative and dedicated team with the hope of not only increasing awareness of what UM student researchers have accomplished in various fields but also of furthering your appreciation and interest in the dynamic world of research.

Sincerely,

Sandhya Simhan and Ahmed Al-Khafaji

Co-Editors-in-Chief, UMURJ

MICHIGAN Undergraduate Research Journal

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Our Digital Future:

An Interview with UM Dean of School of Information
Jeffrey MacKie-Mason

Compiled by Allison Peters, Julia Wang, Lily Zhang

The Internet has come to dominate the lives of the current generation. Many of us cannot imagine living in a world without instantaneous communication, entertainment or immediate access to information. But are we too dependent on this technology? What is our future as citizens of a digital world?

UMURJ discussed these issues with the Dean of the UM School of Information Dr. Jeffrey Mackie-Mason. Recently a speaker at the Future of Technology Conference held at Rackham Auditorium, Dr. Mackie-Mason is also the Arthur W. Burks Professor of Information and Computer Science and a Professor of Economics and Public Policy. As his research combines economics, computer science and psychology, his insight into the pros and cons of technology forms an interesting commentary on our digital lives.

UMURJ: As technology advances—and what we once valued as personal becomes shared via social spheres such as Facebook or Twitter—do you think public spaces will become more detrimental or more beneficial to us?

Dr. Jeffrey MacKie-Mason: It's going to be some of both. Humans adapt and change with their environment, and that environment includes technology. We have to communicate with each other. Public spaces are going to change—it's going to be good in some ways and bad in some ways, and we're going to have to deal with it. Having common, shared public spaces, available at almost any time, almost any place—that's a good thing. People do better when they communicate. Society does better when people interact with each other more.

But there are going to be some problems, too. People are going to make mistakes. Some people are going to be harmed because it will be so easy to observe them: because we will have less privacy. Spaces will be more public, but just because it's happening doesn't mean it's all good. The changes that are enabling us to be in community more easily and have common experiences with more people are very compatible with the social nature of humans, so on balance I think we'll be better off, but we have to be vigilant.

UMURJ: With the increased accessibility of information, are we becoming more aware of the societal problems around us, or are we suffering from information overload?

JMM: Yes and no. Information is what determines our actions; it's what determines our ability to adapt to change and threats. It enables us as humans to develop our culture and social relationships. More access to information—almost necessarily—has to be a good thing. But people have to know how to use that information. What has happened in the past twenty years is that technology has gotten ahead of us. We don't know yet what to do with all the information available to use, how to sort out the reliability of different information sources, or how to make good credibility judgments. We're going to make mistakes, and we have to learn. But societies have been through things like that before—for example, with the advent to telephone, the telegraph, and radio. All the sudden information was made available from different locations, and people didn't know how to process or make good use of it. But society had to adapt—and there were problems along the way. But we learned and are still learning. Information is fundamental to all species; we learn how to use the information around us to help us and how to improve our literacy and our fluency in new types of information.

UMURJ: Thanks to digital communications technology, humans are now essentially able to manipulate time, as we can have conversations via email, text, chat, etc. Because we can communicate faster and more efficiently on the web, do you think there is a higher and higher standard of what we can accomplish, not only in a single day, but also in our lives?

JMM: Probably. Maybe not standard, but expectations. There is always some pressure to do more, particularly for professionals who don't have fixed time schedules. People who want to succeed want to satisfy their bosses so there's a tendency to try to do more. Technology has enabled us to do more. For instance, I can send my staff emails during the weekend, and even if they don't normally read emails over the weekend, they can either respond to them over the weekend or come in Monday morning and see they have ten emails from me. The expectation builds up that they are available to me at different times of the day. The evidence suggests that professionals are working more hours. But it's not good for me as a leader of an organization to expect people to work so many hours that they burn out or are unhappy or that their personal lives fall apart. Managers and leaders have to learn not to ask too much of their workers—but there is this tendency to want to ask more and more because the immediate result is that we get more work done. The greater ease of communication has been enabling in the codependency sense.

UMURJ: What are your thoughts on the quintessential postmodern complex—

the ideology of living in a "mash-up" culture, where, so they say, nothing is original because everything has been created? Does this worry you at all?

JMM: That does worry me a lot in certain ways. A number of us teachers are puzzled and concerned about whether or not youth is learning as well as they used to. It's the difference between original ideas and repeated ideas—coming up with their own thoughts, their own ideas, versus finding someone else's ideas and reporting them or combining them. But I think there's an enormous amount of creativity expressed through mash-ups: in music, the art of sampling is enormously creative, and some fascinating art has been created that way. Piecing together, refactoring, and remixing the culture and the ideas around you can stimulate creativity and can produce some wonderful things for individuals and for society. But I'm a bit concerned about whether we are helping younger people understand the difference between creating something new—even if it's a mash-up or mixture of previous ideas—and just replicating somebody else's work. That's something else we have to figure out.

UMURJ: During your presentation for the Future of Technology, you hypothesized that, in the future, all space will be public space. In a January 2010 interview in front of a live audience, Facebook founder Mark Zuckerberg said if he were to have made Facebook today, he would not implement privacy settings, and all information would be public by default. What are your thoughts on the value of privacy as we look toward the future?

FACEBOOK, with more that 500,000,000 active registered users, is the most popular social networking site in the world. During his presentation at the UM Taubman College sponsored Future of Technology conference this September, MacKie-Mason revealed that if Facebook were a country, it would be the third largest country in the world. TWITTER. According to MacKie-Mason's research, the popular 140-characters-or-less status-updating network Twitter, averages 40 million "tweets" per day.

JMM: It's going to be much harder to provide privacy or to be private: that's just a fact—it's more or less out of our control, it's the nature of communication technology, and it's the urge to communicate with people. We're going to be living in public much more as time goes on. But we're still going to want privacy some of the time, so the questions is how do we get that privacy even though we're in public, and how do we facilitate privacy in public: what technologies do we create to carve out bits of privacy?

UMURJ: People of Generation Z—those born after 1990 and before the late 2000s—are nicknamed "digital natives." Compared to previous generations' relationship with new technologies (radio, TV, etc.), is Generation Z's relationship different? How so?

JMM: Speaking and communicating is a natural part of the general part of human existence, but now we're seeing a generation growing up that takes for granted much greater opportunities to communicate. The difference is in the way people express themselves in their interactions with other people, how they form attachments and how they see the world. My generation still tends to talk about the "virtual world," but I don't think it's meaningful to distinguish between the "virtual world" and the "real world" for a lot of what we do.

For people who grew up digitally, it is the world. Communication is always "real", but now it is easier to share and communicate without being physically co-present. It is so much more dynamic, interactive and easy to connect with people than it used to be that it is changing the way we live. That's really what is having an impact on Generation Z.

UMURJ: The way we communicate both professionally and personally seems to be increasingly depersonalized with the utilization of social technologies. How is that affecting the way we communicate with others?

JMM: One of the really important changes is that we are not only more connected, but it is easier to time-shift. With the development of email, a lot of people wondered: Why are young folks using email so much? It takes longer to type than it does to talk, so where is the advantage of typing out your message? Wouldn't you rather just pick up the phone and talk to somebody? Well, it turns out to be wonderful that we can have asynchronous conversations—that you and I can have a conversation in which 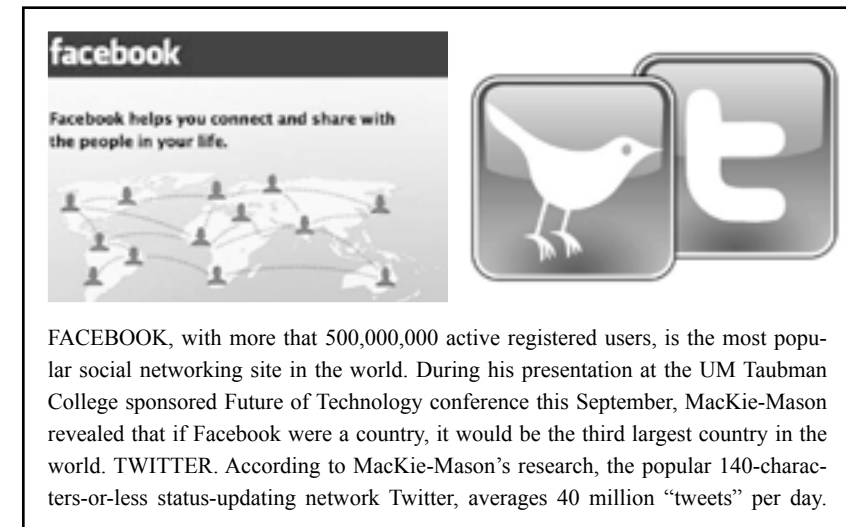I may write now, and you may answer twenty minutes later, and I may answer four hours later—and it's all part of the same conversation. Many of these conversations would never occur before because we weren't available at the same time.

I think a lot of the concern about depersonalization is a myth. It's true that in different forms of communication we can express ourselves with greater or less richness. There's a lot we can communicate when we're face-to-face; plain text is not nearly as expressive. So for certain types of communication we lose texture, context, richness—but I wouldn't call it "depersonalizing." It's a trade-off: we can communicate more frequently, we can communicate with more people. It's not damaging human relations that we have more communication mediated through technology; in many cases, human relations are improving because you can communicate in ways you didn't before.

UMURJ: How do you see this digital culture in fifty years?

JMM: What is interesting to me is how we will deal with the changes that we are already engaged in—technology gets ahead of people, gets ahead of society. The advancement of technology generally is a wonderful thing. Technologies are tools; with them, we have greater capabilities. We can do more; we have more opportunities. That means we have more opportunities for good. If we want to have better individual lives, greater justice, a better understanding of the world—it's going to be easier because of the technologies, as long as we use them well. Of course, new technologies can also be used for bad. It's a cliché, but it's true: technology does not cause good or bad; we decide how to use the tools. The tools will be fabulously better decade by decade—there's no question that the speed of technological progress is going to continue to grow. Since I tend to be an optimist, I see that as opportunity—an opportunity for good.

Dream Big, Nanotechnology Today
Think Small:

By Alex Myong, Connie Shi, Neethi Srinivasan

Imagine the following scenarios: You accidentally spill your coffee, but luckily your pants are stain-resistant. You ride your bike straight into a car, only to find the vehicle scratch-free. You repeatedly use the same tennis ball during practice, but notice that the ball has not lost its bounce. It may be hard to believe, but all of these circumstances are possible thanks to the promising field of nanotechnology [1] [2]. Nanotechnology is an interdisciplinary science that entails engineering systems and structures at the molecular scale. Investigations in the field are grounded in the potential of nanoscale materials to perform a variety of tasks more efficiently than other materials currently in existence.

Before we can further explore nanotechnology's potential, we must first understand the level at which nanomaterials function. Nanoparticles, which measure up to 100 nm in diameter, are one-thousandth the diameter of a single strand of hair [3]. Because nanoparticles and other nanomaterials work at a microscopic level, the manipulation of atoms and molecules using nanotechnology could revolutionize the way we understand the physical world. Nanotechnology has the potential to significantly improve the design of consumer products and advance such fields as transportation, computer science, communications, environmental science, energy, and medicine.

The Possibilities

One prominent application of nanotechnology research is in the field of medicine. According to Dr. James Baker, Jr., Director of the Michigan Nanotechnology Institute for Medicine and Biological Sciences (M-NIMBS), "The real impact for nanotechnology in medicine is based on the fact that biology is a nanoscience. The structures that actually make cells work are on a nanoscale and if we're going to interact with them … we have to make structures that are in the nanoscale size range."

Medical treatments utilizing nanotechnology have shown tremendous promise in targeting a variety of diseases. Studies performed by scientists at Cedars-Sinai's Maxine Dunitz Neurosurgical Institute have demonstrated the capabilities of nanobioconjugate drugs to treat inaccessible brain tumors such as gliomas. Though this type of malignant brain tumor is especially challenging to treat because of its "resist[ance to] chemotherapy and radiation therapy," nanobioconjugate drugs are able to "deliver… antitumor drugs within tumor cells" rather than "at the site of a tumor" like previous nanomedicines. Engineered to only activate within tumor cells, nanobioconjugates reduce the amount of "harmful residue" left in the body following treatment. Because they prevent unnecessary stimulation of the immune system, these novel drugs could become viable alternatives to chemotherapy and radiation therapy, two common treatments for gliomas [4].

Nanotechnology's ability to effectively manipulate molecular structure and composition is not only beneficial in medical research, but also when tackling environmental issues such as water quality. Access to sanitary drinking water is a topic of much concern in the developing world, and recent research has shown that nanotech has the potential to provide impoverished nations with clean drinking water at an affordable price.

Water is purified through the desalinization of water via reverse osmosis.

Unfortunately, current reverse osmosis membranes "have a lot of back resistance," which increases the energy requirement and decreases the accessibility of the technology. However, according to Dr. Baker, nanotechnology has enabled researchers to create a new membrane that is effective in producing clean water and has low energy costs. This membrane has the potential to provide purified drinking water to "a greater portion of the population."

Applications of nanotechnology also extend into the natural gas industry. According to Seid Mokhatab and Brian Towler of the Chemical and Petroleum Engineering Department at the University of Wyoming, "nanotechnology could help us extract more fuel and feedstock hydrocarbons from dwindling resources." Both scientists have explained that such advancements could be achieved by using "related nanomaterials…to improve purification and storage of hydrocarbons." In addition, they hypothesize that nanotechnology could also be used to tackle the issues associated with the effects of oil and gas on the environment [5].

These innovative applications of nanotechnology are especially relevant in today's global climate as energy resources are quickly disappearing, and efforts to tap into the Earth's resources are proving to be detrimental to the planet's natural environment.

Photo courtesy of LNF
The University of Michigan Lurie Nanofabrication Facility located in Ann Arbor, Michigan.

THE LATEST NANOTECH INITIATIVES AND BREAKTHROUGHS FROM THE UNIVERSITY OF MICHIGAN

- *Plans to construct a $46 million facility on North Campus to house the Center of Excellence in Nano Mechanical Science & Engineering [7]*

- *Development of novel nanoemulsion vaccines through the Michigan Nanotechnology Institute for Medicine and Biological Sciences (MNIMBS). Nanoemulsion vaccines are safer to administer than needle injections and are currently being tested in clinical trials [8].*

- *Creation of a new type of LCD screen that can display the block M logo in a space of less than 9 microns [9].*

- *Manufacturing a novel surface coating made of nanoscale polymers that can extend the life of brain implants for patients afflicted with diseases like epilepsy and Parkinson's [10].*

- *Additionally, Michigan is one of 14 member universities of the National Nanotechnology Infrastructure Network (NNIN). Institutions affiliated with NNIN are recognized as leaders in the field of nanotechnology research.*

Uncertainty and Lingering Questions

But for all of nanotechnology's potential, some have called for a more rigorous evaluation of the long-term impacts of exposure to newly developed nanomaterials. Unlike fields in which there are decades or even centuries of background research to call upon, nanotechnology is a comparatively new area of study. "With any new technology, you don't always know what the consequences are going to be, and what implications the technology is going to have," explains Dr. Fritz Allhoff, a visiting Associate Professor in the Department of Philosophy and co-founder of the Nanoethics Group, a nonpartisan research group based in California.

In recent years, several organizations, from governmental agencies to non-profits, have sought to better explore the far-reaching social implications of nanotechnology. Groups like the International Center for Technology Assessment, the Center for Food Safety, and the Environmental Defense Fund have all taken an active interest in the health and safety effects of nanotech.

Though the scale of nanomaterials is responsible for their usefulness, it is also a potential cause for concern. Some worry that nanoparticles could potentially penetrate our own tissues and membranes, leading to harmful health effects. "We don't always know the implications that these small particles can have in complex, environmental systems," Dr. Allhoff says. "You can use nanoparticles to clean water systems ... [but] how would fish interact with these particles?"

Part of the uncertainty about nanotechnology could also come from a lack of awareness about the field. Polls conducted by the Project on Emerging Nanotechnologies in 2007 found that approximately 70% of American adults had heard "just a little" or "nothing at all" about nanotechnology [6]. This is surprising given the potential it has to significantly revolutionize a variety of scientific disciplines.

Dr. Allhoff agrees that nanotechnology is not as well understood by the public as it could be. "When you have something like an iPod nano, and you have people think[ing] it is nanotechnology, something weird is going on," he said. "I don't think the public understands what the technology is and what it does. That's a worry."

The Message

Nanotechnology has advanced exponentially within the past few decades, and is now poised to be a groundbreaking area of research in future years. "It's a really exciting time to be at the cusp of emerging technology," Dr. Allhoff says. "The potential for social good for this technology is profound. Nanotechnology, particularly in its implications for water purification and energy generation, will really have dramatic applications."

Both Dr. Allhoff and Dr. Baker encourage those interested in nanotechnology to read further and become more educated on the topic. "I would suggest that very early on … you take courses in the different disciplines so you're truly cross-disciplinary," Dr. Baker advises. As the potential of nanotechnology continues to grow, knowledge of nanoparticles may become necessary in a diverse array of studies – and could even be subject material for your next exam.

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USAID Millennium Development Goals: Current Progress and Future Directions

By Emman Dabaja, Jimmy Li and Jana Pohorelsky

*T*he United States Agency for International Development (US AID) dates back to 1961 when the Foreign Assistance Act was signed as part of the reconstruction of Europe post-World War II. Since then, this national program has been a principal agent in extending assistance to other countries and helping to facilitate democratic reform around the world. The Millennium Development Goals (MDGs) are eight developmental targets that were agreed upon by 192 countries in September 2000. Here's a brief look at what those goals are, what US involvement entails, and what progress remains to be seen in the decades to come.
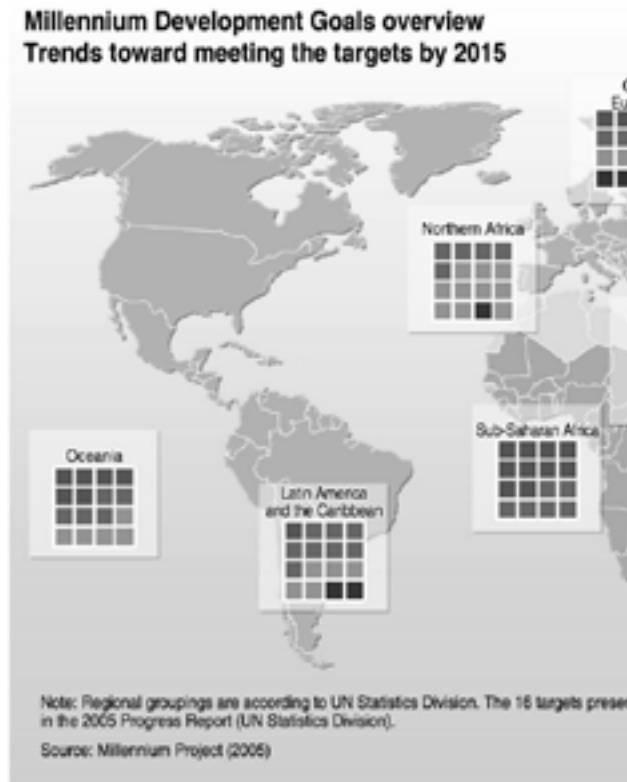
GOAL 1: ERADICATE EXTREME POVERTY AND HUNGER

USAID reports that more than 1 billion people in the world today, or about one-sixth of the global population, suffer from chronic hunger and that 3.5 million children die every year from malnutrition. In order to end hunger, the United Nations has also committed to tackling the extreme poverty that accompanies and perpetuates it. Therefore, their goals for 2015 include halving the proportion of people who earn an income of less than $1 per day, to accomplish decent employment for all people, including women and young people, and finally to halve the proportion of people who suffer from hunger. While worldwide efforts have found success in the goal to raise wages to more than $1, the number of people suffering from hunger is declining more slowly. Some of the initiatives that have helped to reduce levels of poverty and hunger around the world include nationwide subsidies on fertilizers and seeds in Malawi and Ghana, the Jefes y Jefas de Hogar employment program in Argentina, and the investment in agriculture research in Vietnam [2].

GOAL 2: ACHIEVE UNIVERSAL PRIMARY EDUCATION

Reading and writing are critical skills required for participation in our increasingly globalized world. However, more than 700 million adults are illiterate and about 72 million children throughout the world are not in school. As a result, the UN has pledged to ensure that children everywhere complete primary schooling by the year 2015. Among their initiatives to meet this goal, US AID emphasizes the importance of improving teacher training for pre-primary, primary, and secondary levels of education as well as for adult literacy programs, and of increasing educational opportunities for females. While enrollment in primary education increased from 83 percent to 89 percent in developing regions between 2000 and 2008, this pace will not be enough to achieve universal primary education by 2015. The numbers of school-age children who are not in school continue to be especially high in sub-Saharan Africa and southern Asia. However, some successful strategies include abolishing school fees in Burundi, Ethiopia, Ghana, Kenya and Tanzania, and increasing access to education in rural areas of Bolivia and Mongolia via mobile schools. The Girls' Education Initiative and Food-for-Education program in Egypt also creates and provides new school environments that welcome girls [3].

Millennium Development Goals overview
Trends toward meeting the targets by 2015

Note: Regional groupings are according to UN Statistics Division. The 16 targets present in the 2005 Progress Report (UN Statistics Division).
Source: Millennium Project (2005)

GOAL 3: PROMOTE GENDER EQUALITY AND EMPOWER WOMEN

The USAID recognizes that women are intrinsic to the development of any society. Thus the US AID is focusing on providing economic opportunities to women, increasing female political participation and leadership, providing basic education to women, combating human trafficking, and preventing the spreading of HIV/AIDS in young girls. Currently, initiatives in Africa strive to curb violence against women and illegitimate child marriages. Anti-trafficking efforts in Asia have also helped to raise awareness. Finally, the Young Women's Initiative: Confronting Girls Vulnerability to Prevent HIV is helping to combat the overwhelming occurrence of HIV in sub-Saharan Africa, where approximately 58 percent of all people living with HIV are female [4].

GOAL 8: A GLOBAL PARTNERSHIP FOR DEVELOPMENT

The final MDG reminds us that progress occurs best through international cooperation. According to the UN, global partnerships can be achieved by developing a more open, non-discriminatory financial system, dealing with developing countries' debt, working with pharmaceutical companies to deliver essential drugs, and making information and communication technologies available to more people worldwide. One example of international cooperation is the Global Alliance for Vaccines and Immunization, which consists of WHO, UNICEF, and the World Bank, and strives to increase access to vaccines and deliver new immunization technology to numerous countries. However, progress is lacking in terms of access to the Internet: the proportion of populations using the Internet in developed regions remains significantly higher than that of people living in developing regions. Moving further into the twenty-first century, Internet use by more people worldwide could enhance the sense of global partnership and cooperation that can help advance the other development goals [9].

GOAL 7: ENSURE ENVIRONMENTAL SUSTAINABILITY

This goal consists of four targets: integrating sustainable development into policy and programs, reducing the rate of biodiversity loss, halving the proportion of the world's population without access to drinking water and basic sanitation, and improving the lives of at least 100 million slum dwellers. The UN has assisted many countries in implementing sustainable development programs. For example, the 1989 Montreal Protocol initiated the phasing out of ozone-depleting substances, especially hydrochlorofluorocarbons. In Europe, South America, and Asia, countries have developed new clean water programs and substantially increased rural access to clean water. According to the UN, more than 200 million slum dwellers have gained access to improved water or sanitation. Furthermore, the UN leads the "Decade of Education for Sustainable Development," a program seeking to incorporate principles of sustainable development into culture and learning [8].

GOAL 6: COMBAT HIV/AIDS, MALARIA, AND OTHER DISEASES

In 2008, approximately 33.4 million people were living with HIV and 1.8 million people died from TB worldwide. In 2010, malaria continues to kill a child in the world every 45 seconds. The UN aims to stop and reverse these epidemiological trends by 2015, as well as achieve universal access to HIV/AIDS treatment for those in need by 2010. Yet the rate of new HIV infections still surpasses the expansion of antiretroviral treatment for those living with HIV. Changing sexual norms and practices among young people, such as having sex later with fewer partners as well as the increased use of condoms in 15 African countries, has helped to reduce the advancing number. In Botswana, free access to antiretroviral treatment has helped patients receive aid. In India, the Revised National Tuberculosis Control Program has provided treatment to over 11 million patients and contributed to a 43% decrease in mortality from TB in the country between 1990 and 2008. Ongoing efforts to stop the spread of HIV/AIDS include educating young people about the virus and encouraging condom use to reduce the risk of transmission [7].

GOAL 5: IMPROVE MATERNAL HEALTH

More than 350,000 women die annually of complications from childbirth, and 99% of them are in developing countries; yet most of these deaths are avoidable. Progress in developing countries has run short of the MDG goals, because many women lack essential access to prenatal care and skilled assistance during delivery. Although the percentage of women seeing a skilled healthcare provider has increased, many women still lack necessary care especially in remote and rural areas. By preventing early pregnancies, maternal deaths could be cut by a third. To counter preventable maternal deaths, the goal is to increase access and resources for care. In Egypt, 32 rural maternity homes were built to aid women in remote areas. Mobile maternal health clinic have also been set up in Pakistan to provide skilled birth assistance to 43% of pregnant women in rural areas. Through these programs and others women are offered an array of resources and care, including post-miscarriage complications, caesarean sections, and antenatal consultations [6].

GOAL 4: REDUCE CHILD MORTALITY

Currently, child mortality rates have decreased by 28% worldwide, which means that 10,000 children are saved each day from dying of preventable causes. Since 1990, mortality rates have been more than halved in places like Northern Africa, Eastern and Western Asia, Latin America, and the Caribbean. But in sub-Saharan Africa, high fertility rates and slow progress has led to an increase in the number of children dying under the age of five. The causes of child mortality are many and include malnutrition, malaria, diarrhea, pneumonia, and lack of primary health care. One step that has been taken in Egypt, Viet Nam, and Bangladesh is a significant expansion in vaccination coverage for children. Breastfeeding, which is known to strengthen children's immunity, is being promoted in rural villages in Cambodia, where an initiative has increased the amount of breastfed babies from 13% to 60%. Finally, malaria is being combated with the "Nothing But Net" program in Sub-Saharan Africa.

Each box represents the status of one MDG target.

- No progress, deterioration or reversal
- Not expected to be met
- Expected to be met
- Target already met, or very close
- Insufficient data

As the USAID proceeds with efforts to reach its goals, the University of Michigan offers its innovative research to this 8-pronged agenda. Take a look on the next page to see what the UM is doing to address Goal 7 and create a sustainable environment.

Spotlight: UM Research On Sustainable Development

*W*alking into any building on campus, it is impossible to miss the numerous garbage bins lining the walls. But each of these bins does not simply accept all garbage. Chances are that you will find one for paper disposal, cardboard, and plastic bottle recycling before you find the bin labeled 'trash' for your sandwich wrapper. M Recycling sponsors these bins, and is one of the many initiatives striving for sustainability on our campus.

One of the greatest challenges of our times is achieving a sustainable society that balances burgeoning human activity with the processes and resources of nature. The University of Michigan has stepped up to this challenge with programs such as M-Recycling and Planet Blue, which engage the campus in environmental and energy initiatives. But to fully achieve the seventh Millennium Development Goal (MDG) of environmental sustainability, we must also rely on education and research to spread knowledge and practice around the world.

Environmental sustainability education and research at U of M exists in several tiers. The College of Engineering's Mechanical, Chemical, Electrical, and Nuclear engineering programs are full of students and faculty interested in energy research. A proliferation of new Masters and Doctoral programs, such as those in Sustainable Systems and Energy Systems Engineering, reinvigorate the University's tradition of innovative education and research. In the college of LSA, the School of Natural Resources adds the "Program in the Environment" to the growing playbook of environmentally focused coursework options. With plenty of centers and degrees, the UM has no shortage of programs addressing environmental sustainability.

It was in 2006 that the University realized the need to organize this offense. For this purpose, the Board of Regents created the Michigan Memorial Phoenix Energy Institute on North Campus. The institute aims to coordinate the energy research, policy, and education activities at the U of M. For each area of energy science, it identifies faculty members and their research projects and helps them find funding and manage facilities. It creates list after list of courses and degree programs related to energy. The institute also produces summaries of academic proceedings and industrial research from around the world, thereby connecting the University with the global energy scene and serving as the University's hub for energy issues [10]. Research in energy science enables more sustainable living, but it also takes social and corporate initiatives to integrate these principles into policy and programs. Taking the lead on these areas of research are the Frederick A. and Barbara M. Erb Institute and Graham Sustainability Institute.

The Erb Institute was established in 1996 to address sustainable enterprises. It primarily focuses on the economic aspect of these endeavors by producing the knowledge, tools, and leaders to develop environmentally sustainable businesses [11]. While renowned for its integrated MBA/MS program through Ross and the School of Natural Resources and Environment, the Erb Institute does some of its best work in research. Institute director Thomas Lyon recently published a book titled Good Cop Bad Cop: Environmental NGOs and Their Strategies, which is a collection of the perspectives of leaders in social science, policy, and business assessing the state of knowledge on environmental NGOs. In addition to such publications, the Erb Institute conducts case studies on a variety of enterprises. Their profiles on BP, Guayaki, and Clorox elucidate the practices and trends in green markets, corporate responsibility, and corporate influences on climate change [12].

On the social science and policy side, the Graham Environmental Sustainability Institute focuses on bridging research and policy. The institute applies a method called "Integrated Assessment", which is a structured dialogue between research scientists and policy makers to assess key policy questions. Researchers gather and examine both natural and social science knowledge to help policymakers answer each question. The Institute currently applies Integrated Assessment to the U-M campus, but it has also partnered with the Center for Global Health to elicit proposals for a pilot study of Integrated Assessment applied to a global, environmental health issue. The Graham Environmental Sustainability Institute engages U-M in transforming environmental science into informed policy [13].

The Phoenix Energy Institute, Erb Institute for Global Sustainable Enterprises, and Graham Sustainability Institute lead the way in understanding and promoting environmental sustainability. They target energy science, corporate practices, and social issues surrounding the environment. Yet while education and research help develop the tools and knowledge to address this issue, ultimately all people must take initiative to care for the natural world. The Leaders and Best strive to help reach the seventh Millennium Development Goals. You are one of them.

WHAT WILL YOU DO?

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Don't Miss This Opportunity to Publish Your Research!

Good Idea?
...No Job? Make One!

By Hasenin Al-Khersan, Olivia Chitkara, Sameer Oak, and Leslie Rubin

*I*t's inevitable that you'll find a stockpile of baby clothes in every household with children. Whether they're spilling out of a closet, stacked haphazardly in boxes in the basement, or stuffed so tightly into drawers you can't even open them, they maintain a strong presence years after they become useless. Someone might take the initiative twenty years later to give them to a pregnant family friend, only to find out that Rugrats are vintage. This familiar problem has been virtually solved by University of Michigan junior, Allen Kim, who started the baby clothing rental company, Bebaroo.

Parents first pick a plan for baby clothing, with prices ranging between $14.99 and $99.99 per month. Depending on their plan size, Bebaroo ships them a certain amount of clothing that parents keep for as long as they want. Low rental prices and not having to buy clothes every two months result in a worthwhile amount of savings and very happy customers. It's ideas like these that are making entrepreneurship what it is today. People are recognizing problems and inefficiencies, and finding their solutions. In particular, a great deal of college students, spurred along by creative ideas, hopes for a better tomorrow, and the economic recession, are starting companies with bright and innovative ideas for the future.

Another one of these entrepreneurially inclined students is Zach Markin, a junior in the College of Engineering. Markin is a co-founder of the company, Get Fresh Detroit, whose mission is to increase the availability of high-quality fresh and healthy foods in Detroit. Get Fresh Detroit currently supplies seven various neighborhood corner stores in Detroit with affordable vegetable packs equipped with fresh produce and a recipe to help families prepare a healthy meal serving up to four people. Originally an assignment in Markin's Social Venture Creation class, the idea for Get Fresh Detroit won Markin and his business partner $2,500 in grant awards that ultimately led to the functioning startup. "At that point, I didn't know our idea was actually going to become a business. Once we generated the idea, it seemed really good. We had done a great deal of research of [and] I wanted to see if the idea could work," says Markin.

Professors Moses Lee and Nick Tobier established Social Venture Creation, a winter class available through the Center for Entrepreneurship. Lee says that this class provides an environment that encourages the students to "incubate and launch ventures" aimed at solving social problems. He is hopeful that more amazing things are to come out of Michigan, not just in academia but in actual practice. With theory, he said, "You may be inspired, but you don't do anything. You give money or raise awareness, [but] why not develop a sustainable solution?" Those that have become involved with entrepreneurship, notes Markin, "are getting into tech startups. You also see a lot of social entrepreneurs with ideas for the developing world, like ways of getting clean water and solar chargers for cell phones".

For most current students, a mention of the economy conjures images of plummeting stock quotes, foreclosed homes, and meager job reports, creating a

Photo courtesy of Zach Markin Vishal

Get Fresh Detroit provides fresh fruits and vegetables to convenient stores in Detroit.

hostile atmosphere for any type of business, including entrepreneurial ventures. However, the economic hardships that the country faces have led people to seek otherwise overlooked opportunities for employment. With the financial, real estate, and commercial sectors suffering huge blows during the recession, there has been an obvious rise in unemployment. Eager to find a job, some unemployed may turn to less traditional means of employment. Dr. Lee points out that the recession has led people to take bigger risks with their career aspirations. In essence, the present economic situation has forced some people to take a serious look at entrepreneurship as a solution to their struggles with unemployment. In this way, Dr. Lee views the economic downturn as a catalyst fostering growth in the social entrepreneurial scene. The notion that any growth exists in this economic climate is at odds with the general conception of the business environment. This highlights the fact that social entrepreneurship in Michigan lacks the attention that it deserves. Dr. Moses and his colleagues are countering this trend - successfully one might add - through the classes and support they offer for newcomers into the world of social entrepreneurship.

Entrepreneurship is not immediately considered as an alternative for a traditional job because most people do not have an accurate understanding of what it means to launch a venture. Entrepreneurship is concerned with identifying problems in a community and launching ventures aimed to fix them. The most successful ventures are those that can be sustained over a long period of time. Entrepreneurs view profit as the mechanism through which they may achieve their larger goal of solving a problem over a greater period of time. In essence, profit is a source of sustainability, which is vital for success.

If you want to get involved in entrepreneurship, the University of Michigan is the place to do it. The university offers numerous classes and has multiple resources for entrepreneurship regardless of the major you are pursuing. The Entrepreneurship course offered through the Industrial Operations and Engineering department provides a broad overview of issues in the field. Students develop a business plan and confront ethical problems in class. In addition to courses, many resources are available to students. The Wolverine Venture Fund, run through the Ross School of Business, aims to invest in early-stage companies. An additional resource is the TechArb, which is a business accelerator facility that gives ten companies office space to advance their ideas. There are also a number of entrepreneurship contests that the Center for Entrepreneurship offers for students.

How to Get Involved in Research

Types

Science
Chemical, Medical, Psychological

Humanities
History, Languages

Engineering
Material Sceince, Civil Electrical

Social Sciences
Economics, Political

To get Started

- Ask your professors about their exciting research
- Search department websites for PI's in your field of interest
- Search Student Employment Website
- Join or visit the UROP office to streamline the whole process
- Steps for getting an interview:
  - Identify a research project
  - Due diligence: background research and network
  - Send email cover letter and attach a resume

Looking Ahead

- Summer Opportunities:
  - Summer Research Opportunity Program (SROP)
  - Research Experience for Undergraduates (REU)
  - Social Sciences & Humanities Summer Fellowship Programs
  - Summer Biomedical and Life Sciences
  - Professors seek research assistants year round

Benefits of Research

- Contributes to the advancement of human knowledge
- Builds a unique set of hard skills and hands on experience
- Helps identify your academic and career interests
- Prepares you for graduate opportunities
- Provides a steady income or academic credit

Photo courtesy of Lily Zhang

Market Research in Global Health

By Jilly Plonsker

Global health initiatives have not seen near as much success in the past few decades as the world would like. With so much of the public eye turning toward these gross disparities, this article examines what needs to be done to address the disconnect.

The Problem

"It is clear that UM students want to change the world." Dr. Kathleen Sienko, a professor in Mechanical Engineering that is pioneering research on global health related technologies has run into this time and again with her overeager, idealistic students. Many students want to change the world; that is why we all engage in research in the first place. The allure of discovery, the ability to shift paradigms with new knowledge or creation, or the desire to affect change in a population or a modality of thought all bring us into this ever evolving field. In global health and development, a different but incredibly powerful desire to help the poor and underprivileged motivates thousands of people to waste time and money every year changing the world with policies that do not work, technologies that are not used, and by perpetuating dependence on aid money from outside wealth.

Global health related deficits form a major component of the United Nation's Millennium Development Goals. Maternal and infant health, the spread of infectious diseases such as HIV/AIDS and Tuberculosis, and mal or undernutrition, are all significantly more problematic in developing countries and though the UN reported some progress in their 2010 MDG Report, there is far less improvement than expected or considered acceptable. Every year, over 4 million infants will die before they reach 4 weeks of age due to inadequate care and ineffective detection of preventable complications [1]. In 2008, the infant mortality rate in sub-Saharan Africa (which sees the highest rates in the world) was 144 deaths under five-years-old per 1,000 live births. For comparison, in developed regions, this rate is 6 per 1,000 live births [2]. 41 out of the top 50 countries, including Ghana, (which was the focus of our study) are located in sub-Saharan Africa, which shows how dramatic the difference in healthcare between a developed and developing setting still is [3].

Frequently, the disproportionately high rate of maternal death in developing countries is due to different culturally accepted birthing practices and other complications that advanced healthcare systems don't struggle with because they do not need to address them. By far, the most frequent cause of maternal death is developing regions is hemorrhage, which could be avoided by the presence of a skilled birth attendant with the proper equipment. Unfortunately, this is difficult to come by, especially in rural areas. Preeclampsia, which is hypertension directly caused by pregnancy, can evolve into eclampsia and seizures, and is the second leading cause of death. Preeclampsia treatment is simple, and the rate of success is high once detected, but women that do not have regular prenatal visits or do not seek healthcare early enough are often not treated until it is too late. Fertility rates are highest in the regions with the highest maternal mortality rates. Cultural norms to produce as many children as possible paired with the fear that children may not survive motivates women to get pregnant more frequently, putting themselves at greater risk for complications.

Twenty years ago, the World Health Organization (WHO) attempted to launch a major initiative called "Health for All by 2000." The justification for this lofty goal was that inexpensive, effective, and known technologies could easily be implemented in the developing world to address major needs. In the end, the infrastructure and culture of these communities simply did not support even the simplest interventions. Vaccines could not be properly stored when there was no power source for refrigerators or other storage devices. Water pumps and sanitation devices in rural communities broke and were never repaired. Local perception of therapies caused patients to reject them. Decades of these failed interventions have firmly shown us that we cannot try to superimpose what works in the United States on a developing setting. The landscape is unique and requires innovation specific to that setting.

For example, Robert Malkin, a professor of Biomedical Engineering at Duke University, published a study to systematically define why donated medical equipment does not work in developing settings and what the major barriers are to effective transfer of medical practices.4 He found that when equipment breaks, it is more often left broken than repaired. In some cases, it is more worthwhile to the hospital to request a new donation than to invest in

> *"Designers, engineers and policy makers always sat in offices and decided they want this specific thing but haven't ever traveled there, have never felt their pain, never put themselves in their shoes. We must be part of the community and have a community based approach."*

repair. In other cases, there is a perception (or reality) that it is impossible to obtain the necessary spare parts. If the donated equipment is outdated, the company likely no longer produces the parts, and shipping to many of these places can be incredibly unreliable, difficult, and expensive. Along those lines, many hospitals in the United States prefer disposable supplies. They don't have to worry about cleaning between patients and it cuts down on time. However, replacing disposable supplies in a developing country is nowhere near as simple [4].

There has been a lot of public attention focused on girls missing school due to their menstrual cycle. Various groups from the Clinton Foundation to smaller NGOs have donated millions of dollars to provide these girls with sanitary pads and methods to more easily manage their bleeding. Professor Rebecca Thornton, an economics professor here at University of Michigan, published a study on her work after living in rural Nepal showing no significant increase in school attendance with better access to sanitary equipment. Girls were missing school due to premenstrual symptoms, especially cramps [5].

In all of these cases, the failure stems from a lack of understanding between the creators and the end users. Amir Sabet, a graduate of the Biomedical Engineering department now working in Sienko's Laboratory for Innovations in Global Health Technology (LIGHT), said, "Designers, en-

gineers and policy makers always sat in offices and decided they want this specific thing but haven't ever traveled there, have never felt their pain, never put themselves in their shoes. We must be part of the community and have a community based approach." This was his approach when traveling to Uganda and Tanzania last summer to show his prototype to the actual potential users of his device in villages and hospitals. He admits that at first he was guilty of the same problem plaguing development workers everywhere: that people often enter situations with a preconceived framework instead of an open mind. Throughout the interviews, he discovered that tribal and ritual leaders had a strong voice in dictating their needs, and he was able to learn more from them than the other way around.

There are downsides to this community-based approach. Scientists, engineers, economists, and other experts in their fields are considered experts for a reason. While people in the community have a better idea of what they want and need, they do not always have adequate knowledge about what will work best or understand new technology. This is especially true in medicine, where witchcraft is often seen as legitimate and alternative medicine and treatment is preferred until the condition has reached a critical state. Field work can be inefficient. Transportation, communication, and internet can be unreliable. Everything takes longer and time schedules tend to be more flexible. Communication barriers, especially in the lower economic classes, can make it challenging and time-consuming to get anything done. These logistical difficulties it clear that field work cannot be the only source of research and development.

How the University of Michigan is Trying to Contribute

Arguably the best and only way to address this disconnect is through co-creative efforts. Dr. Sienko emphasizes this to her students in the Global Health Design Specialization that she has created with Aileen Huang-Saad. In this program, students going into their senior year travel to Ghana to perform intensive collaborative research with staff at a hospital. After identifying needs with the help of the staff, these students return to campus to design a solution based on what they learned. Professor Sienko's personal experience with this was shaped while obtaining her PhD and developing a vibrotactile sensory stimulation device for the MIT $50K Entrepreneurship Competition. She said in an interview that, "the experience that our team had with prospective patients permanently changed my approach to design: their feedback, both in solicited and unsolicited forms, was invaluable and a necessity for developing a technology that would truly transform their quality of life."

Photo courtesy of Vishal Sonthalia

Global Health Design students in front of Komfo Anokye Teaching Hospital in Kumasi, Ghana summer 2010.

Recently, especially on this campus, there has been a shift in focus toward social venture creation. The Social Entrepreneurship Initiative, under direction by Moses Lee at the Center for Entrepreneurship, has partnered with several departments on campus, including the Global Health Design specialization, to foster innovative solutions to global disparities. In theory, these ventures can help people reduce dependence on handouts, spark economic activity in a country, and and be self-financing in the long run so that funds do not run out (as is the problem with many NGOs).

A social entrepreneur leveraged technology, human values, and business principles to develop innovative, sustainable ventures that specifically address social need. Therefore, there is a measurable incentive to see a positive outcome, which places importance on our golden word: market research. Market research is a buzzword in the business world, but is equally critical that it be applied with as much importance to the global health and developing world. If development workers were to use the same principles as in business, the voice of the consumer would be heard over the preconceptions of the creator. This information can be incorporated into the design or concept, allowing for innovation solutions that not only have the potential to work but are supported but a much greater probability of succeeding outside of the laboratory.

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