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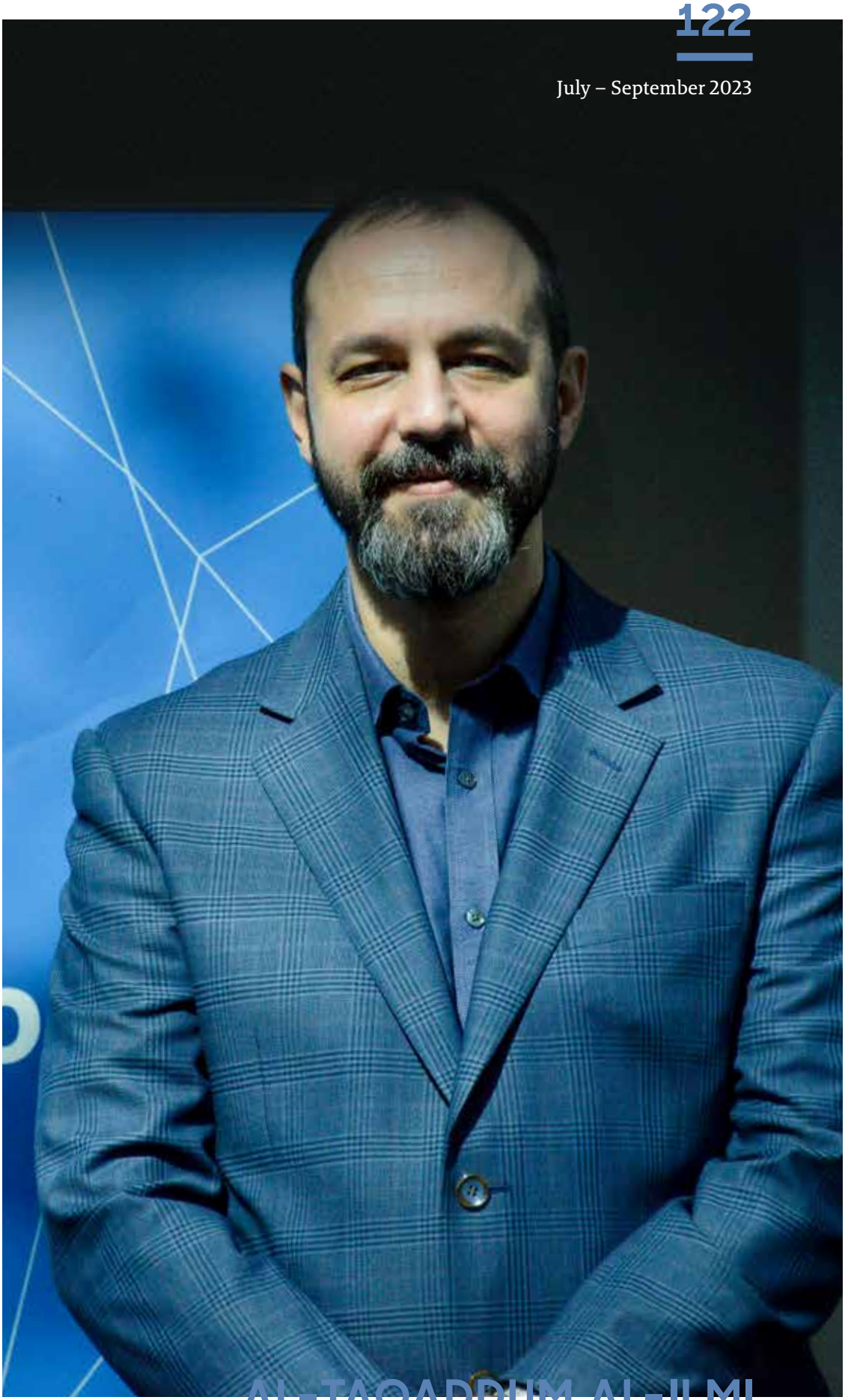

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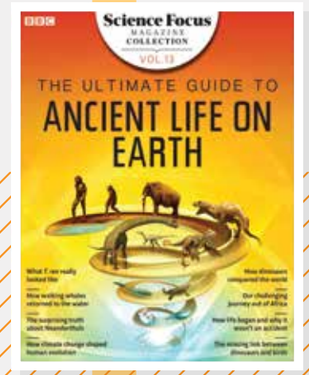
Kuwait Foundation for the Advancement of Sciences

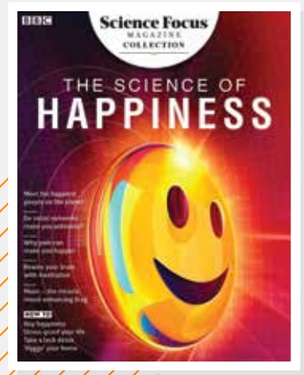
Vision

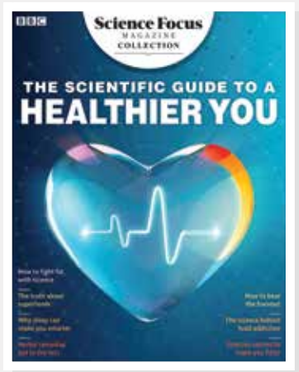
Empowering science, technology, and innovation for a thriving future

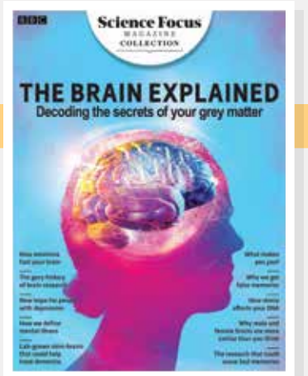
Mission

Fostering science, technology, and innovation in Kuwait through initiatives and grants









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التقدم العلمي
AL-TAQADDUM AL-ILMI

Issue 122
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aspd التقدم العلمي للنشر

KFAS Empowers Young Kuwaiti Scientists for Global Engagement

In a rapidly evolving world of scientific and technological breakthroughs, where innovation takes center stage, the nurturing of young talents in science and technology becomes indispensable for a nation's advancement. KFAS remains dedicated to empowering young Kuwaiti scientists and researchers enabling them to excel on the global stage. Through various initiatives and research programs, KFAS demonstrates its commitment to enhancing the capabilities of young researchers and cultivating a culture of scientific innovation in Kuwait.

In its commitment to facilitating the growth of emerging scientists and their global networks, KFAS actively promotes the participation of promising researchers in international conferences. Recently, four Kuwaiti scientists seized a valuable opportunity to engage in the Science and Technology in Society Forum (STS) in Kyoto. This prestigious global event provided a platform for early-career scientists to establish connections with Nobel laureates, present their research findings, and gain fresh perspectives on global scientific challenges. The transformative experience proved inspiring, motivating these scientists to further amplify their future contributions.

In collaboration with the London School of Economics and Political Science (LSE), KFAS has launched the Kuwait Programme, aimed at supporting research and efforts that address local challenges within a global context. One notable project under this program focuses on tackling the issue of urban sprawl in Kuwait, characterized by excessive reliance on private transportation due to limited public transit options. The project's objective is to create more sustainable and livable urban environments in Kuwait by identifying and mitigating these urbanization patterns and their associated consequences. As a result of this research, the team developed "Kuwaitscapes" an innovative initiative designed to raise awareness about the importance of sound urban planning. Kuwaitscapes serves as a unique and interactive tool that facilitates discussions and reflections on the challenges and opportunities facing Kuwait's residential neighborhoods and public spaces. It engages individuals of all ages, including children and adults, in a fun and educational manner, fostering a deeper understanding of the complexities of urbanization.

Under the auspices of the Kuwait LSE Programme, another noteworthy project was undertaken, aiming to assess digital inequalities in Kuwait. The research subsequent report, titled "Kuwait's Digital Inequalities Report 2022," was a collaborative effort between the Gulf University of Science and Technology (GUST) and LSE. Acknowledging the pivotal role of digital literacy and technology access in the country's transition to a knowledge-based economy, the study's findings shed light on the disparities in digital skills and access prevalent across Kuwait. With the support of KFAS, this comprehensive research constitutes a significant stride toward ensuring equitable opportunities for all Kuwaiti citizens in the digital era. By addressing and mitigating digital inequalities, Kuwait can unlock the full potential of its human capital and derive advancements within its knowledge-based economy. The outcomes of this study serve as a compass guiding policymakers and stakeholders in designing interventions that bridge the digital divide and foster inclusive digital empowerments for all segments of society.

As we envision the future, KFAS remains steadfast in its commitment to fostering the growth of young researchers, driving Kuwait to new heights in the realm of revolutionary science and technology.

Ameenah Farhan
Director General

Contents

Breaking Down the Barriers to Academia with Café Scientifique

Making scientific research more accessible with informal opportunities to meet scientists

Scientific research and academia can sometimes seem like mysterious professions that many of us don't fully understand. Café Scientifique aims to change that. This worldwide initiative originated in the United Kingdom to give people from all walks of life the opportunity to connect with scientists and researchers and discover more about their work.

Café Scientifique in Kuwait was launched as part of Kuwait Oloom Month in December 2022. The sessions are organized by Maryam Aljoaan, Program Officer for Capacity Building at the Kuwait Foundation for the Advancement of Sciences (KFAS).

"Everyone is welcome, regardless of their career path or educational level," said Aljoaan. Whether that's a high-school student interested in a specific topic, or an interested member of the public who simply wants to discover more about science, the goal is to encourage and inspire.

The location depends on campus activities, said Aljoaan, but sessions are always held in public spaces, and always involve plenty of coffee. "We keep sessions between 20 and 25 people, so everyone can feel involved," she said. The goal is to run Café Scientifique sessions every three to four months, and these are advertised both on social media and through the mailing list. "If people are interested in attending, all they need to do is scan a code to register," said Aljoaan.

Initial sessions have proved a huge success, with associate professor Entesar Al-Hetlani being the first scientist invited to participate in this initiative. Based in the Department of Chemistry at Kuwait University, Al-Hetlani's current research into analytical and forensic chemistry has been funded thanks to an international collaboration between KFAS and the University of Albany. "I wouldn't have achieved what I have without the help of KFAS," said Al-Hetlani, who liked the concept of Café Scientifique as a way to connect and network with the public informally.

"The experience was very enjoyable and I still think about it to this day," she said. Al-Hetlani added that the atmosphere was fantastic, and a great mix of people attended her session, from former students and their families, to younger high school students. "I would definitely encourage other scientists to get involved in Café Scientifique," she said.

Café Scientifique sessions feature sponsored researchers who are recipients of a KFAS grant and will be run up to four times a year.

By Emma Stenhouse

From left: Dari Alhuwail, Naser Burahmah, Fahad Zaman, Sulaiman Marafie

Forum in Kyoto Inspires Young Kuwaiti Scientists

Four of Kuwait's best young scientists participated in the Science and Technology in Society Forum in Japan last year and came away with big ideas for the future

By Marianne Dhenin

Hundreds of scientists, policymakers, business leaders, and other changemakers from around the world gathered in Kyoto, Japan, in October 2022. The occasion was the Science and Technology in Society (STS) Forum, an annual event that aims to develop innovative solutions to some of the world's most pressing problems using science and technology.

Among the attendees was a delegation of four young Kuwaiti scientists. The Kuwait Foundation for the Advancement of Sciences (KFAS) organized their trip to the forum. "It was a great opportunity to represent the young scientists of Kuwait and explore the latest and greatest research," said Dari Alhuwail, one of the four early-career Kuwaitis who attended. "It would not have been possible without the support of KFAS."

Alhuwail was accompanied by Sulaiman Marafie, Fahad Zaman, and Naser Burahmah. The group has expertise in various fields and was selected based on their leadership skills, past achievements, and future research potential.

One of the most exciting features of the annual STS Forum is an informal networking event where young leaders meet Nobel Laureates. At the event, Burahmah spoke to David Gross, one of three physicists to win the Nobel Prize in Physics in 2004. For Burahmah, also a Nuclear Engineer, it was a life-changing conversation. "I was most interested in listening to his stories and the difficulties he overcame to get to the Nobel," said Burahmah. "That, for me, was the highlight of the conference."

The Kuwaiti delegation also attended presentations from top researchers on topics ranging from sustainable development to big data, followed by discussion sessions that allowed for in-depth questions and further networking. Burahmah said his favorite session was about energy technologies, hosted as part of the forum's commitment to responding to the climate crisis.

Meanwhile, Alhuwail found inspiration at a session on science communication. The discussion reaffirmed his belief that solving the world's problems requires more than scientific solutions; the public also needs to understand and trust those solutions. "That's where science communication comes into the picture," he said.

After the conference, the attendees had time to explore Kyoto and meet local researchers. Visiting Japan was a bucket list item for Burahmah, who said he also learned from the cultural exchange during the trip. Burahmah and Alhuwail are now collaborating together on a citizen science project after meeting in Kyoto.

Altogether, Burahmah said, "seeing other perspectives, exchanging ideas, and gaining knowledge" made the experience unforgettable.

On the Road to Tomorrow with Al Oloom Bus

The Al Oloom Bus engages Kuwait's next generation of innovators to acquire science, technology, engineering, and mathematics skills

By Marianne Dhenin

PHOTOS: OMAR ALSAYED OMAR

A classroom of 11th-grade students at Jumana Bent Abi Taleb School in Abdulla Al-Salem traveled to outer space this March. Accompanied by their science teacher, Fedhah Almosallam, their vehicle into the stars was not a rocket ship, but a bus parked outside their school — Kuwait's new Al Oloom Bus. "It was the first time my students had a field trip without leaving the school," said Almosallam. "They were so excited."

Aboard the bus, students learned about the stars, the moon, and the galaxy and how to use a telescope. The galaxy is one of several themes available to students and teachers aboard Al Oloom Bus, a project developed by the Advancement of Sciences Publishing and Distribution (APSD), one of the Kuwait Foundation for the Advancement of Sciences' (KFAS) centers, and the Kuwait Innovation Center (KIC).

While the bus launched this year to coincide with the 62nd anniversary of Kuwait's independence and the 32nd anniversary of its liberation, development on the project began in 2020. It was part of ASPD's commitment to expand its production of high-quality science, technology, engineering, and mathematics (STEM) content for K-12 students and make science engaging and accessible to young people across the country. "We try to make science an experience — not just about reading, but being involved in science," said Layla Al-Musawi, Deputy Chairman and CEO of ASPD.

The project was made possible by the skills and technology at KIC, an SME dedicated to advancing Kuwait's knowledge economy through research development, and training; focusing on social impact projects. Al Oloom Bus is aligned with the KIC's social impact work. Mohammad AlRefaei, KIC's CEO, said working with youth is vital to the center's mission, and Al Oloom Bus is one of its largest undertakings to date.

Developing Kuwait's Al Oloom Bus

It took three years to bring the Al Oloom Bus to life. The pandemic slowed the process but even during COVID-related closures, Al-Musawi said her team continued to develop the curriculum and coordinate with the KIC on the design. "We selected the themes and content from leading international content providers based on STEM curriculum in schools in Kuwait. Then we asked KIC to accompany activities to contribute to enhancing the skills of the Fourth Industrial Revolution," said Al-Musawi.

ASPD launched Al Oloom bus with three goals: Allow youth to explore their passion for science, help students bridge the gap between theory and practice through engaging activities, and include digital fabrication technologies for students to learn Fourth Industrial Revolution skills, utilizing the wow factor incorporated in the interior design of the bus.

"We wanted students to step into a unique environment, so when they get onto the bus, they would be amazed," Almousawi said. Almosallam said the bus accomplished this for her students, who were "surprised" when they boarded Al Oloom Bus and "loved the environment."

AlRefaei said teaching Fourth Industrial Revolution technologies like 3D printing, laser cutting, embedded systems, and robotics, prepares students for career success, "We want students to think outside the box and understand the Fourth Industrial Revolution, so they can use these theories and tools in the future, for example, for opening their own business."

Al Oloom Bus made its first visits to schools this year. During its pilot stage, the Al Oloom Bus visited more than 30 schools and worked with hundreds of students. At each school, the bus parks, and groups of students rotate through stations set up outside and inside the bus. “There is a reading or theoretical station, and then the students have implementation stations inside the bus, as well as a station for STEM career paths awareness” said Al-Musawi.

Almosallam said lessons on the solar system made a big impression on her students when Al Oloom Bus visited in March 2023. The theme also connected to lessons she had been teaching in her classroom. “During the first semester, we studied the galaxy, the Big Bang, and the life of a star, so Al Oloom Bus was related, and the students learned to like the subject even more,” she said.

Meanwhile, many middle school students enjoyed learning wave theories and hearing physiology, some of Al Oloom Bus’ other themes. These students began by reading about the human ear, then assembled a simulation of the human brain and eardrum to see the theory in action. There were also inspiring narratives that recounted the journey of studying and practicing medicine, as shared by Dr. Bashayer Al-Saeedi and Dr. Sabika Al-Wazzan from the Department of Ear, Nose, and Throat at Jaber Hospital. “When they start speaking to the ear model, the simulated ear takes the sound and converts it into a signal that students see on a screen,” said AlRefaei. “The reaction from the students was amazing.” Next year, the bus will offer more themes ensuring every student can find something that sparks their interest.

Driving the Future

Having finished its pilot phase, Al Oloom Bus is gearing up for the upcoming academic year. It will host new themes and activities and STEM professionals, like doctors and engineers, will be invited to travel to schools with Al Oloom Bus to speak to students about their work.

While the themes were limited during the pilot phases, next year teachers will be able to request specific topics when they schedule a visit from Al Oloom Bus, so the activities correspond to what students are already learning in class. The bus also has plans for the summer, including visits to public libraries, children’s hospitals, and special needs care centers to provide enrichment to young people outside schools.

Almosallam said she hopes Al Oloom Bus will return to her school next semester so that more students can take advantage of the unique learning experience. Only Almosallam’s 11th-grade students visited the bus during its first stop at the school, and as they talked about it with their peers in other grade levels, interest grew. “Everyone wants the bus to come back,” said Almosallam.”

Al-Musawi said the team is excited to meet this growing demand. “We want to reach as many schools and communities as possible, hoping to spark their interest and curiosity about science when they are still young,” she said. “We hope it will inspire the next generation of scientists and innovators.”

Reimagining Public Spaces in Kuwait

By Reham Alawadhi

In a colorful, vibrant room at Sheikh Abdullah Al Salem Cultural Centre, a group of kids was asked to draw what they thought was missing from Kuwait's streets. The drawings that resulted were full of trees, flowers, bicycles, bicycle lanes, and animals – things you rarely see in Kuwait's urban landscape. The main element in almost all the drawings? People; randomly meeting in public spaces, walking, and running.

"It was eye opening; these are just basic needs that kids can intuitively recognize are missing," said Sharifa Alshalfan, an architect and educator.

Shalfan; together with Alexandra Gomes, a Research Fellow at the London School of Economics and Political Science (LSE); Asseel Al-Ragam, an associate professor of architecture; and Tanushree Agarwal, a London-based Urban Regeneration Consultant, created Kuwaitscapes – a card game to raise awareness about the importance of sound urban planning, as one of the deliverables of research project, "Public Space in Kuwait: From user behavior to policy-making", under the LSE Kuwait Programme research project funded by the Kuwait Foundation for the Advancement of Sciences (KFAS).

Kuwaitscapes encourages engaged reflection and discourse about public space in Kuwait through a fun game of cards, allowing children and adults alike to understand what challenges and opportunities face Kuwait's residential neighborhoods and public spaces.

The research project first required identifying Kuwait's urbanization patterns, the main being Urban Sprawl, which is the growth of urban developments, such as housing, commercial development, and roads, on undeveloped land near a city, with little to no comprehensive urban planning. Another form of Urban Sprawl that applies to Kuwait is Leap-frogging, which refers to the lack of a relationship between subdivisions that are separated by undeveloped land.

Due to the Urban Sprawl of Kuwait, there is a great dependency on cars, according to Gomes, because of the structure, Sprawl, distances to the center, and the lack of alternative public transport beyond buses.

"Chronic diseases, diabetes, [high] cholesterol, all of those are born out of a car dependent city," said Al-Ragam. "We've got air pollution because of, again, car dependent city planning."

It also leads to rare positive use of public space, according to Al-Ragam. Streets and public parks are neglected because they're not used often – giving rise to a severe lack of walkable areas.

A less tangible negative effect is quality of life, said Alshalfan. Your standard of living is raised because you can afford to buy a nice car or house. "However, I can raise your standard of living as much as I want, but if I don't fix the street in front of your house, your quality of life will be affected," Alshalfan said.

With a car dependent city, you also end up with lots of traffic. "Being stuck in traffic is also not fun," Alshalfan said. "You get stressed, annoyed, and lose valuable time that you could have used productively."

These are things that need to be given more attention because according to Alshalfan, quality of life should be taken into consideration by the relevant governmental entities.

"If you engage public spaces, streets, and parks, you begin to understand the conditions they're in," said Al-Ragam. They're in dire need of maintenance. If you don't engage them, you won't demand for better spaces."

Often left out of the conversation are kids and non-nationals in Kuwait. "There are a lot of people that need public spaces, but their voices are not carried to decision makers," Al-Ragam said.

Another issue is walking in the streets, or even taking the bus doesn't feel safe, according to Alshalfan. The bus barely pauses at a stop, you often have to hop on while it's still moving, and the driver is speeding to get to as many stops as possible, Alshalfan said.

"Once we were doing field work and we almost got run over by two cars during the same day because we had to walk in the street rather than the sidewalk as the sidewalks don't exist or are occupied by cars," Gomes said. "Curbs in particular; visbility is very short. Why would you walk if you put your life in danger or your kid's life in danger?"

Many believe the reason people don't walk in Kuwait is due to the heat but what they demonstrated in the study is that even when the weather is acceptable, people still don't use public spaces.

"We are not saying the weather doesn't influence because it does in extreme temperatures," said Gomes. "But most of the year, it's quite comfortable to be outdoors but because the public spaces are not prepared, people end up not using them."

However, there are many ways to try and reduce the extreme temperatures, according to Alshalfan.

"We can use materials that don't radiate heat, use shading and misting, plant more trees in urban settings," Alshalfan said. "There's studies that have shown the temperature can be lowered by 15 degrees Celsius by applying some of these changes."

From their analysis, the team discovered they had to look at urban

PHOTOS: BANDELE ZUBERI

Tanushree Agarwal and Alexandra Gomes

It was eye opening; these are just basic needs that kids can intuitively recognize are missing

design, urban planning, and individual behavior. Applying some of their suggested changes would introduce more environmentally friendly mobility patterns.

"If you create a city that is friendly to pedestrians and cyclists, people don't need to take their car to do these activities," Alshalfan said about driving to the supermarket or local park.

It can start to change people's perceptions of what streets and public spaces are. "Because of the car-centric society, they're seen as a means to an end," said Agarwal. "It changes the community as a whole, once you have that slight shift in thinking."

They're hoping this would lead to more random interactions with people, better mental health and well-being, and more exercising outdoors, among other things.

"Without LSE Middle East, the LSE Kuwait Programme, and KFAS providing that connection, we would not be here," Gomes said. "The programs that KFAS is funding are really important and valuable when it comes to research. They add to evidence-based policies here in Kuwait. I think our work is a testament to that collaboration."

Closing the Digital Divide: a Key Step Toward a Knowledge-based Economy

Identifying and removing digital inequalities is the first stage in Kuwait's transition from tankers to tablets

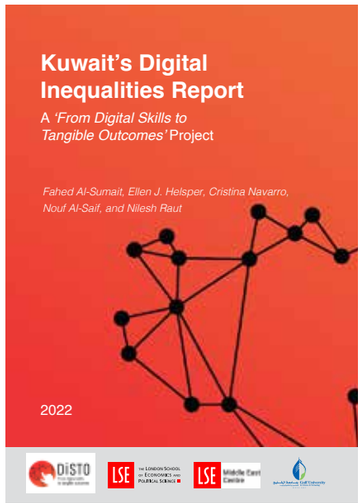
By Emma Stenhouse

As society harnesses the power of Information and Communication Technologies (ICT), the digital transformation of the global economy is well underway. As one of the world's most digitally connected nations, Kuwait is well placed to make the most of this transformation, which is also known as the Fourth Industrial Revolution.

As Kuwait transitions from an economy that heavily relied on hydrocarbon exports toward a knowledge-based economy, these digital connections will only become more crucial.

In Kuwait, internet access is almost universal, with 99 percent of the population having access. Despite this, digital inequalities still exist. As a result, certain communities and individuals are at risk of being left behind during the digital transformation. Until now, the connection between access to ICT and variations across specific communities within Kuwait hasn't been explored. "There's very little reliable data either from local or international organizations about the state of Kuwait's digital environment," said Fahad Al-Sumait, president of the Association for Gulf and Arabian Peninsula Studies and associate professor in the Department of Communication and Media at the American University of Kuwait. "This is one of the most notable gaps in our understanding of digital capacity throughout Kuwait's very multicultural society," he said.

To address this knowledge gap, Al-Sumait and his coresearchers Ellen J. Helsper, Cristina Navarro, Nouf Al-Saif, and Nilesh Rau conducted a national survey, as part of the wider project known as 'From Digital Skills to Tangible Outcomes' or DiSTO. The findings of the DiSTO-Kuwait project were published as 'Kuwait's Digital Inequalities Report 2022.' The research and subsequent report are a collaboration between the Gulf University of Science and Technology and the London School of Economics and Political Science (LSE) and were made possible by a grant from the Middle East Centre (MEC) at LSE, supported by the Kuwait Foundation for the Advancement of Sciences (KFAS).



As the first report of its kind for a Middle Eastern country, the goal was to uncover a baseline understanding of digital inequalities within Kuwait. This knowledge can then be used to inform policymakers, businesses, and others, to fully understand the impact of digital technologies and where to focus efforts when addressing inequalities.

In the first stage of the project, Al-Sumait and his team had plenty of work designing a suitable survey. Al-Sumait said that this was a challenge, as they had to not only create an accessible survey but also consider the significant power dynamics within Kuwait and how these might affect the administration of in-person interactions. The goal was to survey a diverse range of communities, to better understand patterns in access to internet-accessible devices, digital skills, and motivations for use of the internet across all demographic categories.

But just as this first stage of the project was nearing completion, the COVID-19 pandemic hit. "We trained an entire team of enumerators to conduct interviews, and were all set to administer the survey, then we had to postpone because we couldn't run the interviews face to face as planned," said Al-Sumait. Instead, the team had to postpone the administration of the project until they found an alternative solution.

The decision was made to switch to an online survey that could either be self-completed or completed with the help of a trained administrator. "We created an online scheduling system where anyone who interacted with our social media campaigns could schedule an interview slot with someone who spoke either Arabic or English," said Al-Sumait.

The national survey was conducted between October 2020 and January 2021 and yielded results from just over 700 adults. It found that the distribution of

Internet Users
(% of population)

Kuwait	Qatar	Egypt	Jordan
99%	99%	57%	67%

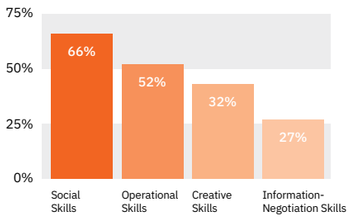
Households with Computers
(% of population)

Kuwait	84%
Qatar	87%
Egypt	64%
Jordan	43%

Mobile Phone Connections
(Subscription per person)

Kuwait	Qatar	Egypt	Jordan
1.6 - 1.8	1.4 - 1.6	0.9 - 1.0	0.8 - 0.9

Digital Skills Overall



digital resources in Kuwait is influenced by a range of factors, including economic, cultural, and social conditions. For example, respondents aged 18-25 showed twice the level of digital skills compared to those over 40. But these skills aren't always used during work or school. One recommendation is the creation of new policies and practices that better integrate these digital skills into workplaces and schools so that Kuwait as a country can make the most of this latent talent.

One skill that many respondents lacked was navigation skills, in other words, the ability to find, select and evaluate different sources of information. Coupled with the fact that many people in Kuwait are primarily using the internet to find information, this suggests there's a need for accessible and reliable ICT skills and media literacy training.

Unlike many other Arab countries, there isn't a stark gender divide in Kuwait, with women often showing higher levels of digital skills than men. But there is a skills gap, with men showing higher levels of technical, creative, and navigational skills. A significant proportion of Kuwait's population is made up of older expatriates of Arab or Asian origin, who often have a lower level of education. "These communities are buying relatively cheap, disposable technologies that give them basic access to the internet," said Al-Sumait. "They're using the internet primarily to connect with friends and families at home, not to benefit their economic status, to develop their education, or to access ecommerce and online banking sites."

These findings suggest that policies and practices are needed to narrow the gaps between the digital experiences of different communities in Kuwait.

"The data we collected provides the only counterpoint in data for the country on digital access," said Al-Sumait. "The only other source for statistics on ICT users comes from the Communication Information Regulatory Authority (CITRA)." While they produce a lot of high-quality data, they look mainly at issues of access to the internet, which is already very high in Kuwait.

The findings of the DiSTO-Kuwait report help to highlight inequalities in internet access, by providing more detail on exactly how Kuwaitis engage with digital technologies. This level of detail helps inform the policies and practices required for the future — to not only reduce inequalities but help Kuwait prepare for the transition toward a globally interconnected, highly digitized world.

"We now have a nationally representative sample, but we would like to include more languages so we can target a much larger population," said Al-Sumait, who, along with his team, are applying for grants so they can run the survey again, on a larger scale.

"I am extremely grateful for the support of the LSE Middle East Center, and KFAS," said Al-Sumait. "Without their support and dedication to these kinds of research problems, we would be much further behind when it comes to preparing ourselves for the future."

Project-Based Learning Inspires at the Australian University

The innovative approach invites engineering students to undertake hands-on projects with real-world implications for mitigating climate change

By Marianne Dhenin

Mohammad Hani Yassin

Zainab Al-Hajaj

Something unique is happening at the Australian College in Kuwait (AU) Kuwait — a project-based learning approach to undergraduate engineering projects. With project-based learning at AU, engineering students in their senior year will participate in ongoing research to solve real-world problems. “The students get involved in current research, get hands-on experience, and apply the knowledge and theory that they learned during their program,” said Zainab Al Hajaj, assistant professor of mechanical engineering.

One of the most exciting projects students have undertaken as part of the university’s commitment to project-based learning involved creating more environmentally friendly or green concrete. Al Hajaj designed and led the project with Mohamed Hany Yassin, an assistant professor, and acting head of the Civil Engineering Department. The project received funding from the Kuwait Foundation for the Advancement of Sciences (KFAS).

“Nowadays, we’re trying to reduce the impact of climate change, so we want to focus more on natural resources. We thought, ‘Why don’t we substitute some of the manmade materials in concrete with some natural resources that are environmentally friendly and non-toxic?’” said Al Hajaj.

Since the project began in 2019, about fifty students have participated. The students work in groups of four or five to add natural materials to a concrete mixture along with standard components, including sand, aggregate, and water, and test the properties of the resulting concrete. “We did everything from the mixing to the testing,” said Maryam Alshaer, who participated in the project before graduating with her bachelor’s degree in civil engineering.

Alshaer was involved in the first phase of the project, wherein teams incorporated palm tree fronds (PTF) into the concrete mixture. Palm fronds are a common waste product in Kuwait and using them in concrete could keep them out of local landfills. Students in the project’s second phase tested natural fibers from flax plants.

Alshaer said the hands-on approach to learning was more effective than traditional classroom teaching. “When I learn something theoretically, I just memorize it and might forget it later,” she said. “But when I work with my hands, things stick in my mind, and everything makes more sense.”

Using natural materials like PTF or flax fiber in concrete could have many economic, social, and environmental benefits, including creating new jobs, improving workplace health and safety, and reducing carbon emissions from one of the world’s largest carbon emitters — the built environment.

According to the United Nations Environment Program, the built environment accounts for 39 percent of gross annual carbon emissions worldwide. This calculation includes the carbon emitted when producing building materials and output from everyday use, like keeping buildings warm, cool, and lighted. Using natural fibers in concrete reduces the carbon emitted during production. Students working on the project at AU also found that adding PTF to concrete improves its thermal properties, meaning that it would be more energy efficient to heat or cool PTF concrete buildings.

More than any other aspect of the project, tapping into a growing market for green building materials to help mitigate the effects of climate change excited students. Maryam Aldhafeeri, another recent graduate with a bachelor’s degree in civil engineering, said learning about environmental engineering in the first years of her undergraduate program piqued her interest, so she pursued the green concrete project in her senior year. After completing the hands-on

Maryam Alshaer

Maryam Aldhafeeri

project, she is considering a career in environmental engineering. "Now, I am thinking that in the future, I could continue with a master's degree in an environmental subject," she said.

Yassin said that the hands-on projects offered at AU often help students clarify their interests, discover new career paths, and prepare for their next steps. "Throughout the project, the students practice all the skills they need to conduct research or work as professional engineers in the future." Students working on the green concrete project learned how to cast concrete from scratch, work with various machines to test the concrete, and collect, sort, and analyze data.

Yassin said that another significant benefit of experiential learning is that it helps students sharpen their critical thinking skills. When students are responsible for each step of a hands-on experiment, they are forced to make connections between their actions and the results. "The students are thinking, 'Okay, why are we getting this line? Why is this certain feature increasing or decreasing?' They have to come up with the reasoning for that," said Yassin.

Students who participated in the green concrete project said they also learned some unexpected skills. "I learned not only civil engineering but also social skills," said Alshaer. "I learned how to communicate with people and solve conflicts, and I learned about commitment and time management."

The students also practice their communication skills when preparing their results for publication or conference presentations. Several groups of students who participated in the green concrete project have presented their findings at international conferences and competitions in Qatar, Canada, and Indonesia. One group of AU students placed in the top ten teams at the 5th International Concrete Competition in 2022, a design competition where teams presented concrete made with various waste-based materials.

Both Alshaer and Aldhafeeri said they are confident that the skills they learned during the project would serve them well in the future. Because she enjoyed the hands-on environment of the graduation project so much, Alshaer is now pursuing a job as a site engineer. Aldhafeeri is applying for a range of positions, keeping in mind that she might also want to pursue a graduate degree in environmental engineering later. "Many skills that we applied in the project will help me in my career in the future," said Aldhafeeri.

As for Al Hajaj and Yassin, they said they are looking forward to working with more students on similar projects in the future. "This is one of the special programs here at the Australian University," said Al Hajaj. "It is collaborative work, and the professors and students both get great outcomes, which was made possible by KFAS' support."