INSPIRE AFRICA

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Inspire STEAM 3D Printing Programme

INTRODUCTION TO 3D PRINTING

3D printing is a rapidly expanding field. Everyday new use cases for 3D printers are discovered and implemented. The 3D printing process builds three-dimensional objects from a computer-aided design (CAD) model. This is usually done by melting plastic successively adding material layer by layer (known as additive manufacturing).

3D printing has many applications in education, and with the rapidly increasing popularity of 3D printing, this technology will become more and more a part of our lives in the future. One of the areas where 3D printing is creating positive change is education.

THE BENEFITS OF USING 3D PRINTING IN EDUCATION

3D printing is an enabling technology that encourages and drives innovation. It provides one with the unprecedented opportunity to design anything using advanced modeling tools. These modelling tools were previously only covered at a tertiary education level and digital manufacturing only available to large companies. With costs lowering this is enabling increased accessibility to a wider audience and more people able to access this powerful technology.

There are many benefits to using 3D printing technology in education. These benefits extend far beyond learning about the process of 3D printing. 3D printing itself not only enables one to learn about 3D design, material science, the technology behind 3D printers and their practical uses, but also makes the learning environment far more engaging and interesting.

Here are some of the main benefits of using 3D printing in education:

1. **Make learning hands-on again.**
    3D printing is one of very few technologies that can be used to make learning more hands on. 3D printers do not just allow students to learn how to create things, it also allows educators to make concepts tangible. 3D printing allows geography teachers to create landforms, or 3D topographical maps. It allows math teachers to create fractions, or create 3D models of the cartesian plane, assisting students to visualize concepts that were previously challenging to teach.

2. **Solve real-world problems.**
    3D printers allow the learnings of students to make a difference in the real world. During the COVID crisis, some schools presented a challenge to students to help stop the spread of the virus. Students designed and tested masks, handle holders, parts for ventilators, shields used by cashiers and more.

3. **Create inventors.**
    3D printing enables students to access and control the entire design process from concept to rapid prototyping to the creation of end use products. Nothing else can mimic this.

4. **Bring a whole new modern twist to art.**
    CAD enables students to create modern digital art and materialize it in the real world. The Inspire Africa 3D Printing lesson plans show students how to create their own 3D cartoon characters, and then bring them to life.

5. **Teamwork helps build school camaraderie.**
    3D printers give students of all 3D modeling skill levels to create. More advanced learners can collaborate to create composite parts, made up of many components that act together. School-wide 3D printing competitions are a great way to exercise teamwork skills and build camaraderie.

6. **Engage reluctant learners.**
   3D printing is exciting, and everyone wants to get involved. 3D printing creates a wonderful way to teach and motivate students, and there is never a shortage of excitement.

7. **Integrated with other education and 4iR technologies.**
   3D printing allows other modern teaching methods to expand. The Inspire Africa 3D Printing Database has an entire section dedicated to making the DJI Tello more capable and interesting. Print replacement parts, modify the drone, turn it into a lunar lander, design components to give your drone an edge in a drone race!

   If your school is using Minecraft, 3D printers even enable students to print out their Minecraft creations.

THE INSPIRE 3D PRINTING PACKAGE

The Inspire 3D Printing Package is designed to provide schools with a start to finish solution for 3D printing and ensures that educators know exactly how to maximise the use of 3D printers through thorough training.

The curriculum consists of three components:
1. Core Curriculum – 8 lessons
2. STEAM Subject Lesson Plans – 20 lessons
3. Model Database

1. Core Curriculum
The core curriculum consists of video and formal lessons that cover the core concepts around 3D printing and CAD. All this content is provided through the Inspire Africa learner management system (LMS).

The following chapters are covered in the core curriculum:
1. Introduction to 3D Printing
2. 3D Printer Technology
3. Introduction to Fusion 360
4. Introduction to Tinkercad
5. Introduction to Slicers

2. STEAM subject lesson plans
The LMS includes lesson plans for a variety of subjects:

- *Physics*
  Example lessons: The Theory of Catapults, Energy Conservation, Pendulums

- *Technology*
  Example lessons: Future Architect, Bridge Builders, Flashlight (Introduction to circuitry)

- *Chemistry*
  Example lessons: Atoms, Molecules, Light and Waves

- *Mathematics*
  Example Lessons: Easy as Pi, XZY (The Cartesian Plane)

- *Biology*
  Example Lessons: DNA, Cellular Structure, Mitosis, The Human Body

- ***Geography***
  Example Lessons: 3D Topographical Maps, Landform Library

- ***Art***
  Example Lessons: Cartoon Characters, DIY Vase, Open Art Challenge

Lesson plans contain valuable information for educators, such as estimated print times, estimated filament quantity required and more to ensure that educators can prepare for lessons effectively.

*Note that additional lesson plans and supporting 3D models will be released continuously. Educators are also encouraged to come up with their own lessons.

3. Model Database

The model database contains all the models required in the lesson plans. Note that in some cases, students are encouraged to create their own models. Less advanced students may however be provided models via the database.

The model database contains. stl and GCode files for recommended Inspire Africa printers. These models can however be printed on other printers by slicing the .stl files.

Contained in the database are also various teachers aids and supporting printable models to supplement other Inspire Africa educational products.

An .stl file is a file that allows you to view the 3D model in CAD software like Autodesk Fusion 360, this model can be altered within the CAD software. A GCode file is file that is created after and .stl file has been "sliced" (the process whereby the printer is instructed how to print the file, which required the user to have some knowledge of slicing software).

Being able to access pre-sliced GCode models allows novice users to easily print. Users not using the Inspire Africa printers are able to still use the database by slicing the .stl files according to their printer specs.

EDUCATOR TRAINING

As with other Inspire Africa STEAM education products, full teacher training is provided. Our instructors cover the entire core curriculum as well as hardware and software setup. Selected lesson plans will also be covered.

Training takes place over two full days. Prior to training, teachers will be given access to the Inspire Africa LMS, which will guide them on how to set up their CAD software.

Training is provided for two educators but additional educators can be accommodated.

HARDWARE

Inspire Africa has sourced and provide only the highest quality and cost-effective printers. Two printer options are available. Our selected printers are:
- Easy to set up
- Require minimal maintenance
- Extremely reliable
- Easy to use
- Produce high resolution models
- Excellent after sale support

Option One – Weedo Tina 2

A small, easy to use printer, compact in size. This printer has all the specifications of more expensive printers, but a smaller build volume. This printer offers everything you need to get started with 3D printing.

Specifications and features:
- Print volume: 100*105*100mm
- Layer resolution: 0.1mm
- Nozzle diameter: 0.4mm
- Print speed: 40 mm/s
- Features: Small size, magnetic build pad

Option Two - FlashForge Adventurer 3

A larger printer, with remarkable features that are usually only found in high-end printers. This machine allows you to print larger objects at very high quality. This printer's features include a heated bed (up to 100 °C), remote control (via slicing software and network browser), cloud integration, a built-in camera for remote monitoring and a sealed build area, making it safe and odourless.

This printer is beginner friendly, but also has some useful features for more advanced users.

Specifications and features:
- Print volume: 150*150*150mm
- Layer resolution: 0.1mm
- Nozzle diameter: 0.4mm
- Print speed: 10-100 mm/s
- Features: Sealed print chamber, heated bed, camera, 2.8 inch touch screen

Although both options are extremely competitively priced, Option One, the Weedo 3D printer, is slightly lower priced. Option Two, the FlashForge 3D printer provides users with a more high-end machine that is able to print larger objects at faster speeds and print more objects simultaneously. This greatly reducing the amount of time required for facilitators to manage printing, and to increase the rate at which models are manufactured.