



The Uniquely Abled Academy® Replication Guide

Element 4: Provide a Vocational Training Curriculum - Teaching and evaluating CNC and CMM Skills

Publication Date: August 31, 2023

1. Introduction: Provide Vocational Skills Training – The Technical Curriculum

This component provides skills training to be a CNC machinist. Since a UAA is created based on an existing CNC training program of the Host School, curriculums are likely to vary from installation to installation. See [Exhibit 4.1 - Example Vocational Training Curriculum](#).

The organization providing the vocational skills training should document the curriculum and intended outcomes.

See Wikipedia for a summary of computer-aided manufacturing (https://en.wikipedia.org/wiki/Computer-aided_manufacturing)

In general, the overall structure of a Uniquely Abled Academy vocational skills program is:

- 16-week program
- 13 weeks of classes
- 3 weeks of being in a manufacturing environment (internship, OJT, plant tours, etc.)
- Classes 8-3:30, Monday – Thursday
- Teaching the basics, read micrometer, basic math, brief experience with various components (software, loading machine with software and blanks, running machine).
- Job readiness and soft skills training (see [Element 5: Provide a Job Readiness Curriculum](#)) which may be taught both concurrently with skills training and in separate dedicated classes.

A UAA may decide that it wants to offer a more comprehensive and longer program than 16 weeks, particularly if it decides to offer NIMS certification (see below).

Important Things to Note:

- Having job skills training on Friday is difficult when the students have an intense Monday-Thursday class schedule. Students have expressed a preference that job skills be included in the Monday-Thursday class schedule, so they didn't have to come in on Friday. A contrasting view is that when on a job they will have to attend 5 days a week, and this gets them ready for that schedule.



- It is recommended that internships and apprenticeships be integrated into the UAA Program (see [Exhibit 2.24 – UAA as an Apprenticeship Program](#)).
- Students want to study from home so ensure they have (and know they have) the appropriate software.
- It is very important to the students that this program leads to a job. Make sure they get enough machine time so they can determine if this career is a fit for them and so they feel job ready.
 - Feedback: most felt comfortable in blueprint reading.
 - The initial students in the Uniquely Abled Academy did say that if their study was extended (other classes, other topics) they would come back.
- It is strongly recommended that field trip(s) be part of the program, even during selection, so they gain an idea of the typical manufacturing environment. Friday (when there are no classes) has been used for scheduled field trips, ideally to firms who have previously hired UAA graduates. It is good to have the successful UAA graduate talk to the class, especially what was surprising, transitions, etc.
- Curriculum evaluation should be ongoingly performed in relation to what skills employers are asking for employment. Job leads should be explored to compare with student's curriculum to ensure it will lead to employment.
- To improve their skills, the following might be offered:
 - Additional coursework (minimum of two semesters/one year program)
 - Additional time on machines
 - A lab where students can practice on machines
- It is strongly recommended that those responsible for the CNC curriculum read "Lessons Learned: Titan Gilroy's Plan to Reclaim American Manufacturing: by Kimberly Holland (available at <https://redshift.autodesk.com/titan-manufacturing/>).
 - "Most schools start kids on a computer and have them sitting at a desk for months before actually making something," he says. "Because of the advances in CAD, CAM, CNC, and tooling, I can teach design, then programming, and then machining—all within the first week of class."
 - By designing their own parts and machining them from the start, students quickly get the hands-on knowledge they could never glean from a book. The trick, Gilroy says, is to run many projects, from very simple shapes to complex parts, through a repetitive process that allows for small advancements with each successive part. "Students need to make a complete part from day one," Gilroy says. "They need to make mistakes and fail. They need to solve problems."



2. NIMS Certification

A UAA may want to consider whether it will offer NIMS certification (<https://www.nims-skills.org/web/nims/6>). An advantage of NIMS certification is that the students can take such credentialization with them wherever they go.

Those designing the Vocational Training curriculum may want to consider whether the program should be part of the graduates gaining NIMS Certification. See <https://www.nims-skills.org/web/nims/6>.

3. Instructors

The UAA is a technical program for people with autism spectrum disorders; it is not a special education program. Therefore, it should be staffed by instructional staff with expertise in the industries that will eventually employ the students, namely manufacturing and CNC operation. An ideal small group learning structure is no more than a 5:1 student to staff ratio to facilitate learning for the student population.

4. In-class TA and/or Student Workers

We have found that having Teaching Assistants/Student Workers help in the classroom is very valuable. A minimum ratio should be 1:5, of teaching personnel (TA's and instructors) to students.

TA's should be experienced on the CNC machines and knowledgeable concerning class topics. They should also receive the same training as the instructors concerning how to teach the selected uniquely abled population.

Ensure that there are CNC qualified tutors available for non-class time.

5. Classes

For both teaching activities (CNC skills and Job Readiness Skills) it is useful to develop policies and procedures for various situations, e.g., students being sporadically absent, not returning from breaks on time, etc. In other words, handling when students do not act in accordance with the Student-UAA Agreements.

Another question is the structure of the classes. For example, should topics be taught one at a time, sequentially, or should each day involve teaching multiple topics. There is some indication that the latter structure may work better.

There is also some indication that motivation is enhanced if students are put on the machines and make something very early in the program (see Titan of CNCs Academy curriculum).



6. Software Support

Educational Support:

ToolingU is the most frequently used software in UAAs for educational support in learning CNC operation. It is produced by Tooling U-SME. More information may be accessed at www.toolingu.com.

Students benefited from being able to practice that night on what they had learned during the class day. Instructors also benefited from being able to track students' learning, e.g., where they may be having trouble.

Selection of CAD/CAM Software:

Generally, the installation doing the CNC skills training will have already selected a particular software package. Among the leading packages are MasterCam and AutoDesk Fusion 360. It would be useful to do an informal survey of the packages used by the potential employers in your area.

Software is needed for the following functions:

- CAD – computer aided design
- CAM – for programming the CNC machine

The specifications for a product are usually delivered in a CAD file.

In general, the software packages have already been selected by the CNC training facility, and thus there is not a choice for the UAA.

There are many software packages available for each function, for free, for discounted price, and for full price. Google on “CAD software” and “CAM software” to gather information, see “Computer Aided Manufacturing” on Wikipedia. Some of the major packages are:

- Autodesk, Autodesk Fusion
- Mastercam

Consider using **Immerse to Learn** software for practice simulations (see <https://www.immerse2learn.com/web/> and <http://cncmanual.com/immerse-2-learn/>)

Titans of CNC has a large number of videos available on YouTube at <https://www.youtube.com/user/titanamericanbuilt>

Titans of CNC has available a free Academy on the web at <http://academy.titansofcnc.com/>

7. Student Feedback (From Previous Cohorts):

- Students did not like classes being held on Friday (despite the communication



that their jobs would be 5 days/week).

- Classes might be scheduled for only 4 days, with each day going from 8:00am to 3:30pm, and incorporate soft skills training into the regular class day (instead of by itself on Friday as was scheduled for the first cohort). Fridays might be used for company visits.
- There was a preference expressed for a 9am-4pm class day.
- There was an observation that after 2pm the students were losing focus, thus decreasing the chances of long-term student success.
- With a four-day program schedule and including soft skills, it might be a challenge including all needed material.
- Students felt the Soft Skills class was great because “we can be us, with great discussions and with caring instructors.
- A common complaint was they did not get enough time on the machines.
- They felt there was too much time wasted sitting around waiting for machine time.
- Students requested more TAs (for a small ratio than 1:5)
- Students reported that they felt there was an overwhelming workload/too much book work.
- Students want to be able to study, etc. at home.
- Students indicated they would come back if the program were extended.

8. Notes for Instructors (From Previous Cohorts):

- Academic support from Teaching Assistants was very important and therefore ensure have enough for the class size (minimum of 1 instruction person, i.e., instructor(s) plus TAs, per 5 students).
- During training instructors need to ensure that there is a mental connection between the computer and physically making the part.
- The term algorithm is used a lot. An algorithm is a self-contained sequence of actions to be performed – defining this term for students may be helpful.
- For students this course will be akin to learning a new language.
 - The 1st time is learning, the 2nd time is getting proficient (feeling more confident). Thus, repetition is desirable. Some students chose to audit the UAA classes in a subsequent semester to get additional experience on the machines.
- Would be nice to provide some way of students coming back to get additional training on software, especially as it is updated.
- May look at some way of being able to take some classes (esp. soft skills) twice to reinforce.
- In establishing the subject schedule, suggest subjects be split up (rather than have one subject a whole day) to allow student time to digest subjects.
- The certificate ideally is one that is recognized as the student is ready to get started in field.
- The students wanted to learn a variety of machines and have machine time.



- A field trip is needed early in the program to a manufacturing plant so that the students can see if manufacturing is for them.
- The students must know the schedule of classes from the first day. Otherwise they get lost in knowing where they were to be and when. Those on the spectrum must be shown roadmaps for the program, for each class, for each day, and for each class session.
- Hands on is good when the class is taught that way.

See [Exhibit 4.2: Notes on the Vocational Training Curriculum](#) for additional information.



9. Resources

“Lessons Learned: Titan Gilroy’s Plan to Reclaim American Manufacturing” by Kimberly Holland

<https://redshift.autodesk.com/titan-manufacturing/>

Titans of CNC Academy

<http://academy.titansofcnc.com/>

EdgeFactor: Has extensive information about careers, including CNC machining.

<https://edgefactor.com/>

EduFactor, Resources and tools, based on the Edge Factor Stories, for educators and business leaders to inspire the next generation of makers.

edufactor.org (may not be available. Check Edge Factor Library).

National Institute of Metalworking Skills (NIMS)

<https://www.nims-skills.org/web/nims/home>

Immerse2learn online training solutions are used to develop a skilled workforce in the fields such as engineering, manufacturing and automation.

<https://web.immerse2learn.com/>