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Developing an Equally Effective Alternate-access Plan for Vision-impaired and Blind Students Enrolled in Mechanical Engineering Technology Courses

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Developing an Equally Effective Alternate Access Plan for Vision Impaired and Blind Students Enrolled in Mechanical Engineering Technology Courses

Abstract

Penn State University requires that before any technology intended for classroom use is approved for purchase, including renewals of software currently in classroom use, there must be an equally effective alternate access plan (EEAAP) in place for that technology. The plan must answer the question "What will you do if a person with a disability gets involved in your program and is impacted by the lack of accessibility on this technology." The motivation for this requirement is compliance with the Americans with Disabilities Act (ADA), as amended in 2008 [1]. This paper details the process that faculty at Penn State Behrend undertook to create a standard EEAAP that can be used as a template when purchasing classroom technology for use in the Mechanical Engineering Technology (MET) program. It also includes recommendations for implementation of compliance initiatives at other institutions; specifically, strategies to minimize confusion, maximize faculty buy-in, and contribute to an inclusive, welcoming environment.

Introduction

Prior to the Spring 2019 semester, aside from materials posted on Canvas, the course management system used at Penn State Behrend, and information created for posting on the University's official websites, there was no requirement for faculty or departments to assess the accessibility of tools used in instruction and coursework, with regard to their usability by individuals with vision impairments, including those who are legally blind. New purchases, renewals of existing software licenses, and purchases of other course-related technology were regularly made with the only information required by Purchasing being the cost of the items, and approval by the administrator in charge of that budget. When faculty at Penn State Behrend submitted a request to purchase a renewal of the license to CES, a tool that is used in materials engineering courses in the Mechanical Engineering Technology program, the faculty member submitting the request received an email from the Penn State IT Accessibility Team indicating that the team had determined the software was not accessible to visually impaired students because it did not have text equivalents for all features, could not be fully accessed by assistive technology, nor could it be used by keyboard alone. As such, the purchase of the license renewal would not be approved. The only options given to remedy the situation were to not use the software, to use a different software that met the accessibility requirements, or to develop an equally effective alternate access plan (EEAAP). Never having encountered this before, the faculty member began to exchange emails with their local campus information technology (IT) personnel, and their Office of Disability Services.

The initial, and seemingly most appropriate response from faculty, was that the development of any plan would be done by the personnel at Disability Services, with some input from faculty on course content, because it is not in the realm of expertise of the engineering faculty at Penn State Behrend to understand how to effectively accommodate disabled individuals. In the past, faculty were informed at the beginning of the semester of any accommodations a student required, with accompanying official forms from Disability Services detailing what the accommodations were and how they would be implemented. However, the response from IT was that the EEAAP must be developed by individual faculty teaching the course(s) that use the technology in question, not Disability Services.

Communications with the IT Accessibility Team

The response from the IT Accessibility Team that the EEAAP was the responsibility of individual faculty, not Disability Services, resulted in multitudes of emails, phone calls, and meetings. Much of this process resulted in conflicting statements, including the following:

- Penn State's access policy applies only to enterprise-level software, and there is no policy governing the purchase of courseware
- Penn State's access policy does apply to courseware, there is a policy governing its purchase, but an exception could be made following certain guidelines
- Exceptions can be made for certain technology if there is no equivalent software
- Exceptions cannot be made for any technology that is not universally accessible
- The plan could/should be simple and have general ideas for alternate assignments
- The plan could/should be detailed and cover all activities that would require accommodations

A verbatim quote from a Penn State IT Accessibility Team member email was: "What if instead of trying to figure out a way for the student to take the course as is, we find what's possible and only do what's possible and stick with that, as restricted as it might be. What can the student do? I would think that they can look through documentation on the software tool itself, even if they can't use it. [removed details about providing accessible text documents] That's all I can think of with what I know, but even just that would be better than having them do nothing and MUCH better than turning them away."

When asked if what they were intending to convey in this message was that visually impaired and blind students would have different requirements and different outcomes than other students in a given course, the answer was that yes, this was the case because telling a student that they could not take a course because of their disability was not allowed so they should just do what they could despite potentially not meeting course outcomes. Upon further discussion, it was noted that even the nursing major at the Behrend campus could not say no to a blind student who wished to pursue a nursing degree.

The faculty involved in the purchase of the software, along with those who used it in class, and the MET department chair all became involved in the discussion. The IT representatives were informed of the requirements of the MET program's ABET accreditation and that, in short, a graduate of an engineering technology program is expected to demonstrate outcomes - and our ability to measure student performance on these outcomes is a requirement to maintain accreditation. The concerns about accreditation only resulted in a reiteration of without a plan in place, the software could not be purchased, and that the plan could be very simple and/or eliminate the software-related elements of the course to accommodate a visually impaired individual. Since changing the structure and outcomes of courses was not acceptable to faculty, and could potentially impact accreditation, several members of the MET faculty set out to develop an EEAAP that would meet both the course outcome requirements and create a classroom environment that met the needs of potential students who were visually impaired or blind.

Requirements of the Penn State EEAAP

The official Penn State EEAAP document has this information at the beginning:

> The Equally Effective Alternate Access Plan (EEAAP) is required by our legally binding agreement with The Office of Civil Rights, Department of Education. Penn State University is committed to providing education to all people, regardless of disabilities. In cases where purchased software is not accessible, an exemption from accessibility requirements is allowed, but only if an EEAAP is submitted and approved.
>
> The EEAAP essentially asks the question: "What will you do if a person with a disability gets involved in your program and is impacted by the lack of accessibility on this technology." It is intended to be a "Plan B" that is created and then brought out when needed. The Plan does not require the person to have an identical experience but should offer an experience that can provide a similar body of knowledge and learning opportunities as that gained by people who do not have the affected disabilities. It is usually created at the time that the technology is acquired and is a core part of the University purchasing process. There is no one way to write an EEAAP. Each situation is different, and when put in to use for a specific person will be different.
>
> The EEAAP should be a general idea of what to do to work around the limitations of the technology.
>
> For more information on EEAAPs and how to fill them out, visit accessibility.psu.edu/eeaap or contact accessibility@psu.edu

The topics that must be addressed include:

1. Description of the issue(s)
2. Persons or groups affected
3. Responsible person(s)
4. How Alternative Access will be provided
    a. Are there other products that provide the same functionality, with possibly improved accessibility?
    b. Describe in general terms the accommodations to be provided for the person with the disability. For example, “For this product, the instructor will provide reading materials to give the same educational experience and restructure the groups of the related lab activities, so abilities are complementary.”
5. Alternative Access Resources Required
6. Repair Information
7. Timeline for Unforeseen Events

Discussion with Visually Disabled Access Professionals

Invaluable assistance in developing the EEAAP was obtained from the Pennsylvania Department of Labor, which has a specific bureau dedicated to the accommodation of those who are blind or visually disabled in the workplace. Since academic settings – even in technology programs – often have near-identical counterparts in employment settings, this agency was able to give up-to-date, advice on the aspects of accommodating those with visual disabilities. The following summarizes the "state of the art" for various media as shared by this agency. Readers are advised to check with their own state or local agencies for updated guidance, as the technology in this area is subject to change.

In all cases, the existence of and form of effective solutions for the blind and visually disabled depend upon the media and the content within.

a) Printed prose text is the most traditional and readily accessible media; such material may be "Brailled out" and converted to a form that is readable by those with no vision whatsoever. Reading hardware with optical character recognition (OCR) can supplement this for printed materials that have insufficient lead time to enable the preparation of Braille texts. For example, a textbook used for the semester can be converted to Braille, but the work usually takes between a few weeks to several months to prepare. Printed handouts prepared during the semester can be accessed using technology such as the text-to-speech conversion software, described in a following section, if provided to the students in electronic form. The suitability of these software systems for the individual must be determined on a case-by-case basis by a disability counselor.

b) Equations, commonly found in textbooks on technical topics, are more difficult to render in Braille. An equation that can be written in a single line of text may require an "expanded format" Braille rendering, using larger-than-normal sheet sizes (e.g. 8.5 x 17, 11x17 inch, corresponding to ISO sizes A3 and A2 or larger). Matrix equations are particularly "text dense" and require both large-format paper and extended preparation time on the part of the rendering service. Software options exist and are described in the next section.

c) Like equations, static graphical content is beyond the current capabilities of text-to-speech conversion software, even if provided to the visually disabled student in electronic form. If the graphical data is available in advance, it may be printed using a textured paint or even 3-D printing to give it limited accessibility to a visually disabled person. For example, trends and overall shapes are readily accessible by the visually disabled, but the identification of precise points on a graph, such as in the Moody diagram in Figure 1, would be less accessible. Psychrometric charts, response amplitude operators, and other graphs with similar levels of detail are likely of marginal accessibility for a visually disabled student. Current text-to-speech software is not yet developed to the level of sophistication to allow full accessibility of content in this format for visually disabled students. Tabular format is recommended instead. In cases where static graphical content cannot be avoided, the content can be made accessible by rendering it in tabular form. The student would then have to interpolate between tabulated data points to be able to access the content at a level equivalent to that of a student without such disability.

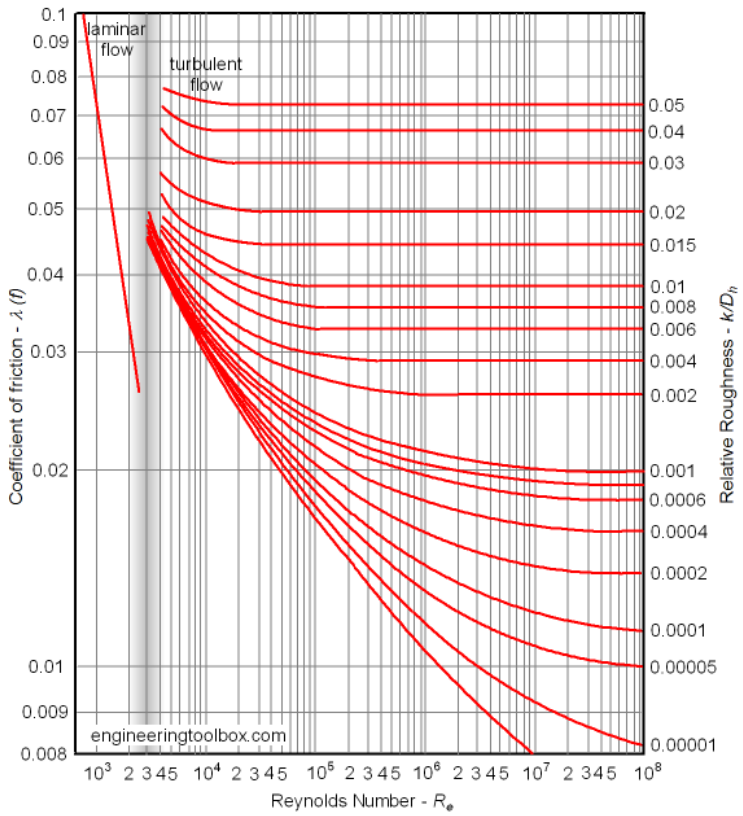

Figure 1: A Moody diagram [2].

d) Dynamic graphical content—graphical content that updates or changes in appearance depending upon user input—is currently not accessible for visually disabled students without human intervention; technology has not developed to the state to allow a visually disabled student to access such content without assistance. Examples of such content include Computer Aided Drafting (CAD) software, where content is manipulated through the mouse and keyboard commands, Finite Element Analysis (FEA) content, Computational Fluid Mechanics (CFD) content, and Materials Selection ("Ashby" diagram) content. In all cases, the content displayed on the screen depends upon the user's input, and the user's input, in turn, depends upon the content displayed on the screen. It is the presence of iterative, non-closed-form, graphical content in these situations that makes them so difficult to access for the visually disabled student. In these situations, a trained assistant is necessary to enable access for the visually disabled student.

Hardware and Software Solutions

Braille readers and displays such as the Hims® Braille Edge™ and Smart Beetle™ Braille displays allow visually disabled students the opportunity to access on-screen text in a traditional format for the visually disabled [3]. Software such as that made available through the Kurzweil® [4] or JAWS® [5] families of software performs a similar task but makes use of text-to-speech conversion. All these options are available with USB or Bluetooth connectivity, enabling a high level of accessibility for the visually disabled student. These technologies afford a degree program the opportunity to make static screen text content accessible to the visually disabled in a

manner nearly transparent to the program faculty—the only limitation is that multi-colored or photo backgrounds can "confuse" these screen-reading programs; traditional black text/white background format works best for these readers.

Equations can be accessed by screen and Braille displays if they are written in MathML (Mathematical Markup Language), which encodes equations in an international open standard and in a manner similar to that used by the markup language used for websites, HTML. Care must be taken to ensure that the equations display as MathML, and not as graphical images of equations, which are inherently inaccessible [6].

Dynamic graphical content requires human intervention as the images cannot be rendered in an alternate accessible format in advance. Since students commonly encounter dynamic graphical content in open-ended engineering design problems at all levels of an engineering program, it is difficult, if not impossible, to anticipate when a human assistant would be required to assist the visually disabled student. The cost associated with having trained assistants on "standby" would likely be prohibitive for most undergraduate programs. However, here technology can be of assistance. Services such as AIRA® [7] employ a user-worn camera (such as on a camera-equipped set of spectacles) and an earpiece. When the AIRA service app is enabled, a trained agent has access to the camera and can start describing what is seen to the visually disabled person through the earpiece. The service can be purchased on a time basis, starting at about 1USD/minute at the time of writing. The service is currently available in the US, Canada, Australia, and New Zealand.

Basic EEAAP Document Information

After consulting with experts and investigating a variety of options to answer the questions required on the EEAAP form, a document was developed specific to Penn State Behrend's MET courses. The general contents are shared here to assist others who may need a template as a starting point if they are required to develop similar equally effective alternate access plans for their programs.

1. Description of the issue(s)

   This description may include information such as:

   - The software does not have text equivalents for all features and cannot be fully accessed by assistive technology such as screen readers.
   - The software cannot be used by keyboard alone.
   - Enrollment in the course will expose the student to challenges beyond those associated with just use of the software, but rather also to the risks and hazards associated with an industrial laboratory environment when completing hands-on practical activities.

2. Persons or groups affected

   In this case, the persons or groups affected, as defined by Penn State, specifically included any person with a visual disability who relies on alternative text to perceive images or graphical content, and any person who relies solely on the keyboard to operate their machine. Among the most highly impacted users will be users who are blind and use

screen readers and assistive technologies to interact with their computers, and users with physical issues who rely on keyboard-based input methods to operate their computers.

3. Responsible person(s)

   For Penn State, this includes the coordinators of the courses using the specific technology, and the campus Disability Services Coordinator. It may also potentially include faculty who teach impacted courses, staff, technicians, and administrators.

4. How Alternative Access will be provided

   a. Are there other products that provide the same functionality, with possibly improved accessibility?

      - Generally, the answer to this will be no, especially if the program, like the MET program described in this paper, is using industry-standard, or possibly industrial advisory board recommended, software such as CES, Ansys, Mathcad, MATLAB, Creo, and so on. The interactive graphical interfaces, and the predominantly graphical outputs of solutions, of most of these types of software, do not lend themselves to be accessed with standard screen readers because they are not primarily text-based.

   b. Describe in general terms the accommodations to be provided for the person with the disability. For example, "For this product, the instructor will provide reading materials to give the same educational experience and restructure the groups of the related lab activities, so abilities are complementary."

      - In many MET courses at Penn State Behrend, software is used throughout the entire semester not only for classwork, homework, and group projects in CAD, FEA, materials, and other courses, but it is also used for in-class practical exams and quizzes that must be completed on an individual basis. Therefore, multiple solutions had to be created depending on the specific type of work being assigned and assessed in a given course.

      Specific items addressed included:

      - Documentation – the Office of Disability Services will convert all course documents to a format the student can use. All documentation shall comply with the course syllabus.
      - Tutors and/or proctors – student will be supplied a software tutor/proctor from the Office of Disability Services along with access to a 3rd party visual description service. This will be available to the student for the entire semester. All course work will be intellectually completed by the student with the physical assistance of the tutor. As such, the tutor can only assist the student with their specific documented disability.
      - Lab Work and Homework Exercises – the student will complete lab work on their own, just as the other students do, but with the assistance of a trained tutor and/or proctor from a 3rd party visual

description service. If using a tutor, the student will work outside of class on homework exercises at the Office of Disability Services. The use of a 3rd party agent allows the student to work alone. In either case, the tutor or agent will provide a description of what is on the screen, and the student will then manipulate the controls (keyboard and mouse) to complete the activity, unless the student is also physically disabled, in which case the tutor will manipulate the controls at the student's direction.

- Written Quizzes and Exams – the student will take all written quizzes and exams in the Office of Disability Services with the tutor, who will assist the student based upon the student's verbal answers.
- Practical Quizzes and Exams – the student will take all software-based practical quizzes and exams in the Office of Disability Services with the tutor and/or 3rd party agent. The tutor/agent will assist the student in completing the quiz per the student's verbal answers. The student will operate the software as guided by the tutor or agent, unless also physically disabled, in which case the tutor will operate the controls at the student's direction. All answers must be the students with no technical support from the tutor/agent.
- Grading – course grading will be consistent across all students enrolled in the course. The tutor/agent will not earn a grade in the course. As such, all work performed must be from the student's perspective, fair and equitable, across the class.

5. Alternative Access Resources Required

List any resources required (including training, equipment, additional staff, etc.) to provide alternate access for the known issue:

- Software-trained tutors supplied by the Office of Disability Services; training of tutors is not the responsibility of course faculty.
- Access to a computer with the course software and appropriate additional software or hardware such as screen readers, enlarged monitors, and other technology appropriate to the individual situation.
- Properly formatted documentation.
- "Speaking" beakers, calipers, voltmeters, electronic balances/scales, or other required equipment for an individual course.
- Personal Protective Equipment (PPE) suitable for use by a visually disabled person in an industrial environment, taking consideration of the additional risk faced by those who cannot visually identify hazards. Such equipment may include face shield, full pyro suit, protective boots, and hands-free 3rd party visual

description technology to wear under the face shield, or, a similarly protected tutor/proctor to guide the student during laboratory activities.

- Technical support to appropriately label laboratory spaces, eyewash stations, etc. with Braille, large font, or color contrast as required.
- Other materials as determined by the specific needs of the student and the evolving nature of the course laboratory component, which incorporates changes stemming from the continuous-improvement process.

6. Repair Information

   Provide a brief description or any relevant information regarding repair of the issue by the vendor or third-party service provider as well as the completion date.

   - This does not refer to damaged equipment or software that needs to be repaired in the traditional sense, but as to whether the problem of the inaccessibility of the software will be corrected by the maker of the software or a third party at some future point.

7. Timeline for Unforeseen Events

   A timeline to plan, create, implement, and follow up on accommodation for access concerns/issues that are beyond campus policy and/or outside of the realm of the questions above.

   In this section, multiple items are addressed to ensure that faculty and staff will have all the necessary items in place to address the needs of the student requiring the accommodations. The Office of Student Disability Services will play a significant role in creating the timeline.

   - The timeline creation will start at the time a student needing accommodation enters the program, typically as a freshman. It may take several semesters to finalize the plan, purchase the required materials and equipment, make the required laboratory modifications, and test the systems for proper and safe operation prior to allowing a student the opportunity to participate. In the case of freshman-level engineering courses, this necessary timeline of several semesters may result in a delay in the program's ability to offer the course to the visually disabled person, and thus a delay in time to graduation for that individual.

   - A complete safety audit must also be completed prior to the enrollment of a visually disabled or blind person in a course. The instructor cannot assume liability for injuries that may result from a student's inability to visually identify hazards. Participation of the institution's environmental health and safety, and also the local bureau of blindness and visual services, will be essential – in this case, the need for additional resources, equipment, or personnel may be identified by experts that were not recognized by the institution's faculty and staff.

- In this section of the document, it is also noted that the EEAAP is submitted without regard to its impact on the Penn State Behrend MET program's accreditation. Any accessibility options described in the EEAAP are not to be construed as to satisfy accreditation requirements for the program or for a person earning an MET degree. While these accommodations may allow a person with certain visual disabilities the ability to pass the course, no guarantee is made that the course, administered with these accommodations, will adequately prepare a student for professional practice to include, but not limited to, successful passing of the fundamentals of engineering (FE) and/or Professional Engineering (PE) exams.

Discussion

From the first email, requesting the creation of what was initially called a "workaround" for visually impaired and/or blind students who may enroll in a course that uses the CES software, until the acceptance by the IT Accessibility team of a completed EEAAP, nearly three months passed. During this time, hundreds of emails were sent, meetings, both virtual and in person, were attended, and countless hours of faculty time were spent in the creation of this plan. All this work resulted in the creation of a template document that could be edited for use when purchasing other software and classroom technology. So far, this template has been used successfully in the renewal of licenses for not only CES for our materials engineering courses, but also Ansys for finite element analysis, EES for thermodynamics, Mathcad used in multiple courses, and Creo which is also used in multiple courses.

Most of the initial emails exchanged with the IT team had recommendations from them that were not feasible for the classroom environment in an MET program, and several times the phrase, "this is only to fulfill our legal obligations" was used without consideration being made to course content or the ability of faculty and staff to actually implement the plan. This disconnect occurred because the personnel on the IT accessibility team has little to no teaching experience and no knowledge of the practicalities of what happens in an MET course, especially one with hands-on laboratory components. A major concern of the faculty in the Penn State Behrend MET program was based on the first line of the official EEAAP document that indicated it was a legally binding document. Faculty were hesitant to simply create a bare-bones document that could be misinterpreted later, or to create a plan that was not actually feasible to implement if the occasion occurred that a visually impaired or blind person chose to major in MET on the Behrend campus. Therefore, it was almost entirely up to the MET faculty, with input from professionals, to create a plan that was adaptable and would encompass most of our courses and fulfill the needs of a visually impaired student taking courses using different software and technology, at various points in the curriculum.

It should be noted that faculty were told the cost to implement the EEAAP was not a factor that should be considered. Thus, when researching available assistance technologies, and considering the need for individual tutors and other potentially expensive items, creating an inclusive scenario where a visually impaired or blind student could receive as close to an equal experience as other students as possible, was the primary goal.

Costs associated with the EEAAP will vary widely. For example, a single course that requires AIRA services for a two-hour laboratory that meets once a week for the semester (30 hours

total), would cost about 1800USD for the laboratory sessions alone; students receiving extended time for work may need to be budgeted at least twice this amount.

The authors have several recommendations regarding the management of EEAAP's or their equivalent at institutions of higher education. These are as follows:

- Actively engage and support inclusion: The process at Penn State is neither active, nor engaged, nor supportive. Specifically, the process is managed in a passive manner, where the first time a faculty member is informed of the requirement for an EEAAP is when a software purchased is denied. An active, engaged, and supportive process would pro-actively inform faculty members of the requirement, set a deadline for compliance, and offer substantive guidance on its development. A supportive process would also serve as a resource for practical guidance and technology recommendations.

- Bring all students along together: Faculty members typically employ a variety of instructional techniques to present content in multiple ways. Not all students learn course content in an identical manner, and a mix of methods typically is the best approach for teaching to diverse student audiences. However, not all of these techniques may be equally accessible to a visually disabled student, and some may be entirely inaccessible. In these cases, the University's policy must always be to add complementary instruction to positively address these instructional gaps as they emerge. For example, a video that lacks descriptive video service, and is hence inaccessible to the visually disabled, should be provided with such—either in advance or in real-time by a trained assistant /AIRA services. However, removing the non-accessible content from the course entirely (as has been advised in more than one case) does nothing to assist the visually disabled student, and only penalizes the other students in the class, many of whom may require accommodations in their own right for other, non-visual disabilities.

- Maintain an open, adaptive posture towards content: Much of the disconnect between the faculty and the IT department can be traced to a disagreement surrounding the meaning of the term "content." In some academic disciplines, the achievement of student outcomes can be measured entirely on a taxonomical scale that stretches from acquisition of knowledge to its understanding and application. However, in many of the technology disciplines, "content" includes "skills and abilities" that a student is expected to demonstrate. When this broader definition of "content" is used, the "alternative content" that was recommended for the visually disabled person de-facto results in "different skills and abilities" for the visually disabled: a segregation of outcome achievement based on disability status, which is the very antithesis of the intent of the ADA as amended. For example, in the preliminary discussions about the EEAAP that occurred before the state labor department bureau of visually disabled services was engaged, it was suggested that a "library or reading assignment" could be substituted for the (inaccessible) software-based exercise. While such a suggestion was certainly not maliciously motivated, at best it displays a less-than-complete understanding of course "content" – certainly not an understanding consistent with the outcomes of a technology program.

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