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Providing a new space for student learning: A pilot implementation of self-generated student stories and informal peer assessments in mechanical engineering technology education

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Providing a new space for student learning: A pilot implementation of self-generated student stories and informal peer assessments in mechanical engineering technology education.

The COVID-19 pandemic and ongoing fallout have increased the need for learning spaces that can support learning through alternate pedagogies and assessment strategies. An example is self-generated stories in which students develop their own story related to instructional content. Stories, along with informal assessments, support learning while providing a lower stake learning space. Moreover, strategies such as peer assessment within these alternate spaces can increase student involvement and interest in the instructional content.

It was demonstrated that pedagogies of self-generated stories and informal peer assessments provide a unique opportunity for students to creatively make connections to academic content [1]. When aligned with instructional goals, student-created stories capture their attention and emotional interests while providing instructors a concrete and memorable insight into their students' learning [2, 3]. Stories also facilitate student learning through engagement, higher order thinking, and elaboration [4, 5]. Besides using the stories to promote technological literacy [6], stories help students make meaning of their own experiences, building self-awareness, making them to see themselves as entrepreneurially minded individuals [7, 8]. Storytelling, through which students share specific work or school situations that might represent a wide variety of ethical concerns [9] also constitutes ways to enhance and to extend the ethics learning outside a typical classroom setting.

The integration of informal peer assessments provides additional opportunities for students to engage with academic content vicariously and to learn from their peers' stories. The informal assessment process lowers the stakes, focuses on students' learning as reflected in each story's narrative, and encourages participation and creativity. Moreover, the processes of generating and sharing stories and the peer assessment process connect to important 21st century soft / engineering skills, namely creativity, communication, and collaboration [10]. Hence, the integration of stories within the instructional framework can be a valuable tool for teachers in any context, including higher education in science, technology, engineering, and mathematics (STEM) fields.

While the literature related to the use of stories as a pedagogical strategy contains many examples in both K-12 and higher education in general, the literature related to their use in undergraduate engineering and engineering technology education is limited. Even more limited are documented accounts in which students develop their own unique story and mechanical engineering technology (MET).

This paper describes the ongoing implementation, effectiveness, and pedagogical value of student-generated stories in a fluid mechanics course part of the mechanical engineering technology curriculum. This application, which addressed Accreditation Board for Engineering and Technology (ABET)'s Criterion 3 and Criterion 5c, was implemented in a four-credit hour (ch) senior-level applied fluid mechanics course, with a 3ch lecture and 1ch laboratory component. The course is the second in fluid mechanics' sequence and covers topics like pipeline systems design, pump selection, flow of air in ducts, lift and drag, etc. The original

instructional design used a blend of traditional in-class lectures and problem-based learning focused on project-based and other laboratory exercises.

To further improve the students' creativity and communication skills, especially written communication, as well as emphasizing real-world applicability of the course's topics, a story-based element was first piloted in fall 2020 semester, and further implemented every time the course was taught by the authors. In such assignments, the students were asked to "Tell a Story," i.e., to develop a unique and individual story related to either a previous laboratory experiment or an in-class problem, and to refer to the learned technical content. All the collected stories were informally peer-assessed on the realistic nature of the scenario, the use of engineering content to solve the story's problem, and of course creativity. A summary of the winning stories and student feedback will be presented. Possible further use as a pedagogy will also be discussed.

Research Methods and Procedures

This research is a continuation of a previous work [11] and describes the most recent implementations (fall 2021 and spring 2022) and evaluation of story-based pedagogy to an advanced fluid mechanics course. The pedagogical practices discussed herein focus on making connections through self-generated or collaboratively created stories, specifically, stories related to pipeline design or HVAC problems.

Study Site and the Course **-** The site for this study is the Mechanical Engineering Technology program, part of the Engineering Technology Department (ET) in the College of Engineering (COE) at the University of Toledo. The MET program is ABET-accredited. The Applied Fluid Mechanics course is an upper division core course and the second in the sequence of fluid mechanics coursework, following an introductory course. The original instructional design used a blend of traditional in-class lectures and problem-based learning focused on project-based and other laboratory exercises.

"Tell a Story" and Creativity Examples

The idea of the story pedagogy was initially started in fall 2020 to improve opportunities for communication and collaboration. Also, it was important to provide opportunities to make meaning connections with the content through these personalized stories and related contexts. The assignment was refined in the following semesters to increase the focus on creativity. The KEEN (Kern Entrepreneurial Engineering Network) framework further influenced the refinement process and integrated entrepreneurial mindset.

<u>Fall 2020:</u> The assignment was introduced as an extra credit and connects to a previous assigned project, namely Assignment #5 (see Appendix 1). The students were asked to brainstorm and to replace the problem description from Assignment 5 with a story while keeping the same pipeline configuration, to brainstorm an application. To help the students get started, the instructor included a story beginning as an example: *"there is a summer camp, and the camp director plans to use water from a nearby lake for some camp activities. The lake is about 50 ft below the camp water tank....* ".

Also, part of the assignment was a peer evaluation, in which all the students were asked to read the stories, and to order them as first place, second place and third place, according to their preference. As an additional extra credit, more additional points were given to the winning three teams.

Fall 2021 and Spring 2022: The assignment, also an extra credit, connects to a previous assigned laboratory, namely Measuring the Parallel Flow (see Appendix 2). The assignments read:

> "This week's laboratory assignment was to measure a parallel pipeline system. Your job is to create a story behind this lab / problem description. Get influence from your home, workplace, or your imagination.
> Example of a story beginning: *there is a summer camp, and the camp manager decide to use water from a nearby stream to water the camps' three garden beds…*
> Notes: 1) I recommend including some pipeline / system design data in your story, so that anyone interested in solving it to be able to do it. 2) I will collect all your stories, post them anonymously on the BB, and ask the class to nominate the best story. The student, or team, with the winning story will get another 10 extra credit points.
> Brainstorm and **Be Creative!** "

Fall 2021 and Spring 2022: In addition to the *Tell a Story* extra credit assignment, a new assignment, for credit, was included in the curriculum, namely, ***Creativity in HVAC Industry*.** This assignment asked the students to work in groups of three and to research and author a short article covering *Creativity in HVAC Industry, including the energy and societal impact of each innovation.* The students were asked to focus on three areas: 1) *Past: the history of HVAC; major innovations that changed HVAC over the years;* 2) *Present: HVAC today; and 3*) *Future: HVAC trends; observe trends and think or innovations that will change HVAC in the future.* To facilitate shared knowledge, a jigsaw model for group work strategy was recommended. As before, each submission was evaluated for content by all others, and the "best article" received 10 extra points.

Peer Assessment and Results

- ***Tell a Story***

Once all the stories were collected and posted anonymously on the online platform, the students were instructed to read them all and to submit their rankings of the top three stories. The winning story will get another 10 extra credit points.

Fall 2020:
Number of stories received: **Six**. Four of the stories were individual submissions and two group works. Out of the four individuals, two received second and third place. Eleven students (31%) participated in this exercise. Students evaluating the stories: 19 students (53%) submitted evaluations. Based on their order, the first three stories were:

First place: The Pumpkin Patch
Second place: The House Over the Lagoon
Third place: Camp Crystal Lake

Fall 2021:
Number of stories received: **Five**. Two of the stories were individual submissions and three group works. Out of the two individuals, one received third place. Eleven students (38%) participated in this exercise. Students evaluating the stories: 24 students (83%) submitted evaluations. Based on their order, the first three stories were:

First place: Brewmaster Butch
Second place: Soybeans Farm
Third place: Backyard Planting Area

Spring 2022:
Number of stories received: **Six**. Five of the stories were individual submissions and only one was a two-person effort. All winners were individual submissions. Seven students (33%) participated in this exercise. Students evaluating the stories: 11 students (52%) submitted evaluations. Based on their order, the first three stories were:

First place: Water Treatment Plant
Second place: 60 Years into the Future
Third place: Crude Oil Pipeline

- ***Creativity in HVAC***

Like the "Tell a Story" assignment, the students were asked to read and grade each of the submitted articles and posted nameless on the online platform. This was a mandatory peer assessment. Fifty percent of the grade was given by the instructor, with the remaining by the class average peer review. A grading rubric was provided by the instructor, as seen in Appendix 3.

Fall 2021:
Number of articles received: **Nine**. Twenty-seven students (93%) participated in this exercise. This assessment was valued at 50 points, and had a class average of 45.44, with a standard deviation of 1.56. Students evaluating the articles: 23 students (79%) submitted evaluations. The article with the highest score is presented under Appendix 5.

Spring 2022:
Number of articles received: **Six**. Eighteen students (86%) participated in this exercise. This assessment was valued at 50 points, and had a class average of 45.47, with a standard deviation of 1.33. Students evaluating the articles: 12 (57%) submitted evaluations. Two articles were tied for first place, and both are displayed under Appendix 5.

Discussion and Conclusion

Students submitted a variety of stories in each semester. Each story aligned with the content but expressed a different and creative application that connected to a real-world situation. This aligns with prior research [2, 3] in which stories provided insight into their understanding and expressions of the content [4, 5]. Moreover, the participating students' stories ranged from a few sentences to multiple pages, reflecting a range of complexity in their stories. This also represents a range of applications of the content and interest in the topics. Regardless of the variation,

participating students were able to use the alternate learning space to further develop and express their learning of the topic. Further, the informal and anonymous peer assessment process gave them an opportunity to see different implementations of the theory in the various stories. Also, the rubric content and guidelines provided a scaffold that enabled them to use guidelines to evaluate the stories, including their own, providing another method to further understand the content. One limitation is the lack of participation by all students. Regardless, the implementation of the story pedagogy will continue because it fills a gap in the learning environment. It offers something different and allows students to express their creativity and learn from each other in this alternate learning space.

Potential adapters should always begin with the course's learning goals and objectives. This should include examining the integration of soft skills such as communication, collaboration, and creativity. The assessment should be feasible within course conditions. For example, in smaller classes, students may be able to work individually, whereas in larger courses, collaborative teams may be required. The story guidelines should be flexible while enabling individualized learning through multiple types of stories for the same content. As seen in the appendices, even though the stories were quite different, each addressed the course topics. Finally, consider making the assessment more informal to further engage students. Stories and the idea for stories will evolve each semester with curriculum changes and instructor expertise. This pedagogy should be considered more broadly in STEM disciplines.

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Appendix 1- Assignment #5 (Fall 2020)

Assignment #5 – Class 1 Series Pipeline

Group Project

Objective:

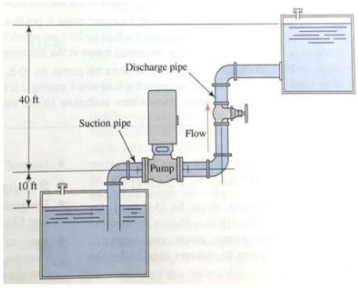
The objective of this project is to solve, as a group, a class 1 series pipeline syste as described below.

Theory:

A series pipeline system is one in which the fluid follows a single flow path throughout the system. For a Class 1, the system is completely defined in terms the size of pipes, types of minor losses that are present, and the volume flow rat of the fluid. The typical objective is to compute the pressure at some points of interest, to compute the total head of the pump, if present, or to compute the elevation of a source of fluid to produce a desired flow rate or pressure at select points.

The problem:

The pump illustrated in the figure below delivers water at 70F from a lower reservoir to the upper reservoir at a rate of 2.0ft^3/s. Both the suction and the discharge pipes are 6-in Schedule 40 steel pipe. The length of the suction pipe leading to the pump is 12 ft, and 24 ft of discharge pipe extends from the pump outlet to the upper tank. There are 3 standard 90° elbows and a fully open gate valve. The upper tank's water surface is 50 ft above the lower tanks' water surface.



Results and Discussions:

1. Develop an excel file to work as a **fluid flow simulator**, and calculate:
   a) Pressure at the pump inlet, in psi;
   b) Total head of the pump, in ft;
   c) Pressure at the pump outlet, in psi.
   d) Required pump input power, in hp, if the pump efficiency is 77%.
2. Modify the design as follows:
   - Replace the 6in Schedule 40 discharge pipeline with 5in Sched 40 steel;
   - Replace the gate valve with a globe valve fully open,

   and calculate:
   a) Pressure at the pump inlet, in psi;
   b) Total head of the pump, in ft;
   c) Pressure at the pump outlet, in psi.
   d) Required pump input power, in hp, if the pump efficiency is 77%.
3. You are the project manager in charge with designing the above system. What option do you choose and why? Explain your decision with data.

Notes:

- Keep your fluid flow simulator for future assignments. Submit **one excel per team** and 1 documentation / response to part 3, detailing your decis regarding the selected system.
- Once I collect all your solutions, I will post them on BB (nameless), and y will be asked to peer review / evaluate the competitive solutions presen by all the other teams, by **detailing the pros and cons of the presented** At that time, I will also post a grading sheet on BB. **This peer review component will be also included in this assignment grade and should be done by each group**. You will have an additional week to finalize this revi component. Due date for peer review will be Sunday, September 27, en day.
- Afterwards, you will be asked to evaluate your team's contribution to th project.

Appendix 2 – Parallel Flow Lab Handout, first page (Fall 2021)

Laboratory Exercise #4
Measuring the Parallel Flow

Objective:

The objective of this lab is to calculate the partition of flow in each parallel branch for the given laboratory setup using experimental measurements and theoretical calculations.

Theory:

Most pipeline systems encountered in practice involve numerous parallel and series connections. For a pipeline than branches in two, three, or more parallel pipes and then rejoins at a junction downstream, the total flow rate is the sum of the flow rates in the individual pipes. Figure 1 below shows the MET's Fluids Lab experimental setup.

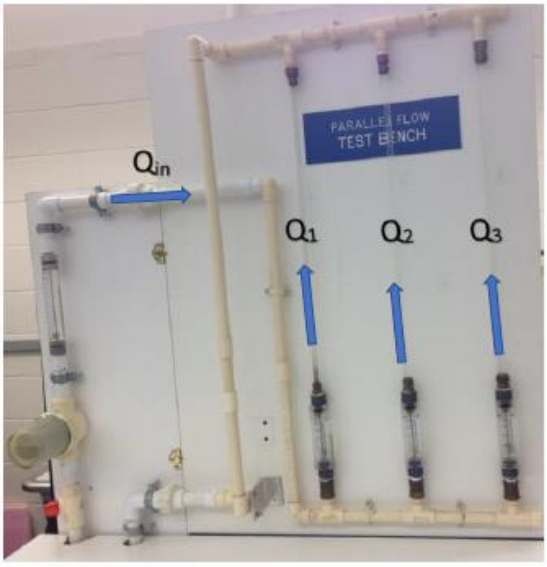


Figure 1: Experimental setup

$$Q_{in} = Q_1 + Q_2 + Q_3 = Q_{out} \quad \text{Eq. 1}$$

Considering that the pressure drop between an inlet and an exit of a branching pipeline system is independent of the flow's path, the total head loss in each branch is the same:

Appendix 3 – Grading Rubric for Creativity in HVAC Assessment

Rubric Detail

Use of Content	**From 0 to 16 points** Limited integration of technical content into paper.	**17 to 25 points** Refers to a wide and appropriate range of technical content into paper.
Critical Thinking	**From 0 to 16 points** Understands key concepts and draws few conclusions about the evolution of HVAC systems. Articulately reflects ideas and approaches.	**17 to 25 points** The team shows deep knowledge of the technical content and make strong connections between past, present, and future of HVAC systems. The quality of work suggests extensive personal reflection on what the future might bring.
Organization	**From 0 to 16 points** Some organization; some logical progression of ideas, but not throughout the entire document.	**17 to 25 points** Very well organized; clear, logical progression of ideas.
Mechanics	**From 0 to 16 points** May have some grammar, punctuation, capitalization, and spelling errors that do not primarily interfere with comprehension; uses a variety of sentence structure, precise word choice; meets required length.	**17 to 25 points** No grammatical, punctuation, capitalization, and spelling errors that interfere with comprehension; uses a variety of sentence structure, precise word choice; meets required length.

Using the rubric detail above, read all the Groups' papers and grade them. Calculate the total; DO NOT grade your own. Do not use an interval of values;

Group Name	Use of Content	Critical Thinking	Organization	Mechanics	TOTAL
A					
B					
C					
D					
E					
F					
G					
H					
I					

Appendix 4 – Samples of Winning Stories from Fall 2020 to Spring 2022

Semester	Winners	Short Title / Story Context
Fall 2020 Reference to prior assignment	1st	The Pumpkin Patch
	2nd	The little girl
	3rd	Camp Crystal Lake
Fall 2021 Reference to a lab	1st	Brewmaster Butch building an attached bar
	2nd	Michigan farmer growing soybeans
	3rd	Backyard planter boxes for fruits, flowers, and veggies
Spring 2022 Reference to a lab	1st	CEO of water treatment plant facing down the competition
	2nd	Toledo solving water crisis 60 years into the future
	3rd	Country 1 designing a crude oil pipeline

- Fall 2020 Winning Story: **The Pumpkin Patch**

"It all started in a small Midwestern town called Greenville, although the town may be small, the history behind the town is quite brutal and dark. For in this town the great people of the Wyandot and Delaware Indian tribes meet their demise from the hands of the United States army back in 1795 on October 31 St. The war was over, and the land was freed but unknowingly to the new landowners there was a curse placed on the main river that flowed through the town by Chief little turtle himself, stating that for as long as there were people who drank and farmed with that water shall face the wrath of every fallen Indian. It was not long after that the town realized about the curse, but it was too late as a deadly plague has already spread through the town killing hundreds. The river was eventually covered up and drained or so they thought at the time and as the years turned into centuries the stories and memories of the curse turned into innocent fables and folklore.

This was until of course a newly married farmer decided to set off and plant himself a pumpkin patch just outside of the town. To farm and grow so many pumpkins he knew he needed a way to get a large amount of water from a reservoir to his agricultural hose that moves up and down the field watering the pumpkins. Like most farmers he decided to dig a well and wanting to save money he did it himself using a backhoe. Since he was using a backhoe, he was not able to dig straight down so he had to dig ten feet down and then move the backhoe down to that new lower level by making a ramp like structure out of the dirt on one of the sides and driving it down. He continued until he located the desired depth of fifty feet. This was where he found the massive reservoir of water that was going to be used to water his pumpkins. To get the water out of the reservoir and up to the top he designed and built a pump system which consisted of a 6 in-schedule 40 steel pipe that was placed partly in the reservoir and used as a suction line.

This pump was then connected to a 90-degree elbow connected to it and then from it there is a 6-inch schedule 40 steel pipe with a gage valve to open and close the water path. The pipe then continues to go up and takes another turn before finally going into another reservoir. Overall, the depth was fifty feet with twelve feet of suction pipe and 24 feet of discharge pipe; there were also three elbows throughout the system as well.

Finally finishing his hard work, the farmer fully opened the gage valve so the watering could start, but what the farmer didn't realize was that the water that he was taking out of the reservoir was in fact the water from the river, the same river that all the Indians where dump into and buried in after the battle and for that reason was cursed. At first there was little to no signs that there was something suspicious was going on until a couple of weeks later when the farmers dog started licking the dripping water that was dripping out..."
"It was only a matter of hours until the dog turned savage almost rabid like and attacked the farmer's wife while she was tending the garden luckily the farmer was close by and was able to save his wife by killing the dog with a branch that he tore from a tree.

After the incident life went on for a couple more months with the sole though that the dog incident was just a case of a dog getting rabies. That was of course until the 31st of October, the anniversary of the battle, which so happens to be when the curse is at its strongest. For on that night every pumpkin the farmer grew and sold came to life with the spirit of one of the slaughtered Indians. Instead of killing everyone the pumpkins seemed to only attack those whose blood line came from the soldiers that fought in the battle. Many people in the town fought and tried the best they could but in the end were too overwhelmed and unprepared and succumbed to the pumpkins. But once the last person was killed all the pumpkins instantly died and fell to the grown because the curse was broken, and revenge was given."

- Fall 2021 Winning Story: **Brewmaster Butch**

"Problem Proposition: Brewmaster Butch wants to build an attached bar to his widely successful brewery. Along his bar, he wants to add a pipeline with 3 taps (in parallel) equally distanced (L1=L2=L3) down the bar-top to have easy access for his bartenders to produce fresh drafts of his world-famous Butch Light. (Assume Butch Light has same qualities as Water at 70 F) for his customers. Using pipe and fittings rated for a Flow Rate of up to 3 gallons per minute, determine the head loss and the theoretical flows from each tap when opened to fill a draft glass. (Assume flow into the tap pipe is equivalent to the flow exiting tap outlet when opened.)

To visualize and understand the flow within the bar's proposed pipeline, utilize the parallel flow apparatus in the laboratory to generate experimental data for comparison to the theoretical flows of the Butch Light. Compare Theoretical and Experimental Flow Rates for 3 gpm, 2.5 gpm, and 2 gpm to determine which total flow can best serve Brewmaster Butch's new bar.
Pipe Qualities and Construction: Material: PVC; L= 3ft; D_1= 0.25in; D_2= 0.375in; D_3= 0.5in
Useful Equations:
$Q_{in} = Q1+Q2+Q3 = Q_{out}$
$h_{L1} = h_{L2} = h_{L3}$
$f1(L1/D1)(v_1^2/2g) = f2(L2/D2)(v_2^2/2g) = f3(L3/D3)(v_3^2/2g)$

v_1/v_2=
v_1/v_3=

Solution Development:

- Utilize a minimum of 3 iterations on each tap to determine the flow rate at each tap outlet.
- Create an Excel file to show the Brewmaster the comparison of the theoretical and experimental calculations, including relative error analysis.
- Create bar graphs to show the experimental vs. the theoretical flows for all 3 taps.
- Explain your findings and elaborate on the best solution.
- Provide 3 recommendations for improving his desired pipeline, as well as a recommendation for a new specialty Fall flavor for Brewmaster Butch's product line. (Include the economics of any recommendations)."

Appendix 5 – Samples of The Best "Creativity in HVAC" submissions:

- Fall 2021 **Final Score: 48.5/50**

"HVAC Innovations: The Past, Present, and Future
Past history of HVAC/major innovations

History of Air Conditioning

The spark of invention leading to HVAC started in the 1840s, with Dr. John Gorrier attempts to find a solution to temper the environment around his suffering patients to help them stay more comfortable and further fight disease. This spark was carried and ignited by Willis Carrier, an engineer at the Buffalo (NY) Forge Company. He was working to solve a humidity problem in a Brooklyn publishing company when he created/patented the "Apparatus for Treating Air." His invention utilized cooling coils that adjusts humidity via the heating/cooling of water. Following the success of his apparatus, he developed an automatic control system that regulates temperature and humidity for product manufacturing environments. Carrier's two patents led to the founding of the Carrier Engineering Corporation, and the accreditation of the invention of Air Conditioning (1902). By 1914, air conditioning had reached residential use and installation. Since its invention, Air Conditioning and Ventilation have become commonplace and widespread across the world, for both industrial and residential applications.

History of Heating

The origin of heating systems goes back far beyond the advent of cooling systems. Benjamin Franklin's cast iron Franklin Stove, invented in 1742, is considered the direct ancestor of the modern furnace. Through most of the nineteenth century, homes were heated by fireplaces and wood stoves. Near the turn of the century (1885), the riveted-steel coal furnace began to become more commonplace amongst residential buildings. During that time period, cast iron radiators were developed and saw implementation into residential environments. The first forced-air furnace was not introduced until 1935, Forced-air Furnaces found their niche across industrial and residential usages following their invention, and are still the most commonplace strategy for heating within HVAC infrastructure.

Innovation and Modernization

By the mid-twentieth century, HVAC systems had become extremely cost effective and widespread throughout residential buildings. HVAC is so widespread in residential life that the DoE has cited that approximately 48% of all energy consumption in American homes is due to HVAC. The implementation of Heating, Ventilation, and Air Conditioning enabled society to foster and expand across the various harsh environments present around the globe, creating a standard of comfort and allowing humanity to survive extreme temperatures. The infrastructure demands for HVAC systems required both the energy infrastructure and the HVAC technology to improve. To meet the aforementioned need, there has been drastic improvement in efficiency and function of HVAC systems since their introduction during the rapid modernization of society through the twentieth century and into the modern era.

HVAC advancements today

Smart Home

HVAC systems of today's age are miles ahead of where they started and even where they were 20 years ago. HVAC systems have adopted the “smart home” mentality of many other brands and homeowners or businesses to make their life easier and simpler. Smart thermostats are the way to go now: these devices can be programmed to cool your house in the hottest part of the day or turn the heat down while you sleep in order to make the home or office more comfortable and also save the user money. Not to mention they can be used remotely virtually anywhere from your phone.

Ductless and Zoning Systems

These smart thermostats coupled with the innovations of ductless and zoning systems make the whole house able to be cooled and heated more evenly. Ductless systems work great in older homes or small offices without central heating ducts as they require no ducts to be run and can be stand-alone units in a room that otherwise would be impossible or expensive to run heating and cooling to. Plus, these ductless systems are more energy efficient as they do not lose any heat in the duct systems as they are prone to leaks and energy loss. Meanwhile in homes or businesses with existing duct systems, zoning systems can be added to allow for even flow of air too hard to each area of the office or home like the upstairs. In homes without zoning systems the upstairs of the home can be as much as 20 degrees different than the main floor of the house with the system installed the entire home can be cooled or heated to the same temperature or to the temperature that these zones called for with smart thermostats.

Geothermal

The efficiency of HVAC systems has increased drastically over the last couple decades and have become more cost effective and cleaner to the environment. However, for those that want to significantly reduce their carbon footprint or not rely as much on non-renewable energy, geothermal is the way to go. Geothermal works by pumping fluid deep underground (where the temperature is not affected by the ambient temperature) where the fluid is either heated up or cooled down and is then pumped back through the house and the HVAC system to heat or cool the house. Although geothermal has a rather pricey initial cost it is by far the most efficient way to heat or cool your house. Although there has been little presence of geothermal HVAC in a large commercial setting as the technology improves and becomes applicable to large buildings and spaces, there could be a surge in the near future.

Future trends and innovations

Latest Trends and Innovations

HVAC companies are advancing in every which way, and this is due to five key technology changes. These changes wouldn’t be possible without the incorporation of artificial intelligence and virtual reality. With these two advancements we get the five major improvements for the HVAC systems. These improvements are sustainable HVAC systems, smart thermostats, preventative maintenance, mobile friendly technology, and virtual reality training. Sustainable HVAC systems are highlighted by the reduction of energy consumption and the need for high powered systems. Furthermore, using WiFi /Bluetooth capabilities, you are now able to connect to a smart thermostat with any smart device one possesses, such as Amazon Echo or Samsung

Smartthings. An app called ecobe4 Smart Thermostat is offered on Samsung Smartthings and can be used by HVAC technology to create predetermined routines. More specifically, a customer can set a predetermined time every morning causing the lights to automatically turn on, the thermostat to heat up, the radio to play, and the coffee to start. 75% of all thermostats are operated using Wi-Fi or Bluetooth capabilities now, which leads to preventative maintenance. With the popularity growing in smart HVAC systems, preventative maintenance has gone down because the system can predict any issues before they happen. An IoT (Internet of Things) system is used to sense data on air quality and equipment status to check for any possible issues before they happen. Mobile friendly technology shows the increase of productivity, mainly dispatch and invoicing on the fly. Virtual reality training has reduced equipment and staff needs. It also offers cost effective training using a training simulator.

Eco-friendly and more cost-effective options

Two of the most cost effective and eco-friendly options becoming more utilized are the usage of solar solutions, and as mentioned above geothermal heat pumps. Other examples of the innovation in HVAC systems are the utilization of energy analysis software, sensor enhanced vents, ice powered air conditioning, and a dual fuel heat pump. Energy Gauge is a new software used by technicians for cost efficiency to both customers and companies and for energy saving purposes. The utilization of energy analysis software has been said to lead to HVAC innovation on a larger scale. Sensor enhanced vents are prominently used by a company called Ecovent. This is done using smart sensors which control the climate in each room by transmitting and sending the climate data to the Ecovent Smart Hub. There is also a company out of Glendale, California introducing ice powered air conditioning units to the market. This unit provides up to six hours of cool air conditioning and also reduces total net energy consumption. The whole unit is powered by ice and in the charging process it freezes 450 gallons of water in its tank during the night. The dual fuel heat pump contains two components, those being an electric heat pump and a full-sized gas furnace. This heating pump is best for people living in areas with low electricity rates and climates that infrequently drop below freezing. The heating pump switches to gas to more efficiently warm the house at sub-freezing temperatures.

Citations

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➢ Spring 2022: **Final Score: 48.5/50**

Tuesday, April 19, 2022

HVAC

The Past, Present, and Future

Issue #1

The Future of HVAC

The latest updates

In years to come HVAC technologies will be further advancing as new tech becomes more available and invented as time passes on.

Some of these advancements include more geothermal heat pumps, solar power, smart thermostats, and even ice-powered air-conditioning to reduce their energy use and overall environmental impact.

Another aspect to look forward to is the automation of HVAC technologies as improvements to automation and data analysis, will improve the sustainability of heating, ventilation, and air conditioning.

As per Carrier's commitment to sustainability in the future, they are the first to announce a worldwide chlorofluorocarbon (CFC) phase-out and the first to use recycled CO2 as a natural refrigerant to lower environmental impact for marine shipping.

Picture Caption: HVAC sysytem is being installed at a new facility

Picture Caption: Old resteraunt building front advertising an air conditioned eating space.

Air Conditioning Blast from the Past to the Present

William Carrier changed the world while influencing today's innovation.

PAST:

Before there was air conditioning there was an engineer named Willis Carrier. Willis was tasked by a Brooklynn publishing company that manufactured magazines to fix the problem they had in their factory. The factory was much too humid, and their pages were wrinkling. Causing a decline in print quality.

This was when Willis Carrier got the idea for a device he called "Apparatus for Treating Air". This device used coils that either humidified the air by heating the water in the coils or dehumidifying it by cooling the water.

After extensive testing, Willis built an automatic version of this apparatus. In turn, this product was a huge success in the textile mills that he sold them to.

This success led to the founding of the Carrier Engineering Corporation in 1915. Willis Carrier started the company himself with the help of six other trusted engineers.

PRESENT:

Since the Founding of the Carrier Engineering Corporation the HVAC industry has been constantly evolving and the Carrier company has remained at the heart it.

Currently, Carrier sells systems for not only residential environments but also commercial refrigeration and trucking refrigeration units.

In 2011 Carrier invented the Infinity heat pump with Greenspeed intelligence offering the greatest heating efficiency of any air source heat pump.

This air conditioning unit has a variable-speed compressor and allows it to literally adapt its output instantaneously to the needs of the home. This innovation has been a much-needed improvement for energy conservation.

This technology is a huge advancement from what Willis invented in 1902 and is something that will continue to evolve as time passes by.