# PLATO (computer system)

PLATO (**Programmed Logic for Automatic Teaching Operations**) [1][2] was the first (ca. 1960, on ILLIAC I) generalized computer assisted instruction system, and, by the late 1970s, comprised several thousand terminals worldwide on nearly a dozen different networked mainframe computers. Originally, PLATO was built by the University of Illinois and functioned for four decades, offering coursework (elementary–university) to UIUC students, local schools, and other universities. Several descendant systems still operate.

The PLATO project was assumed by the Control Data Corporation (CDC), who built the machines with which PLATO operated

PLATO running a fractional distillation simulation.

at the University. CDC President William Norris planned to make PLATO a force in the computer world; the last production PLATO system was shut down in 2006 (coincidentally, just a month after Norris died), yet it established key on-line concepts: forums, message boards, online testing, e-mail, chat rooms, picture languages, instant messaging, remote screen sharing, and multi-player games.
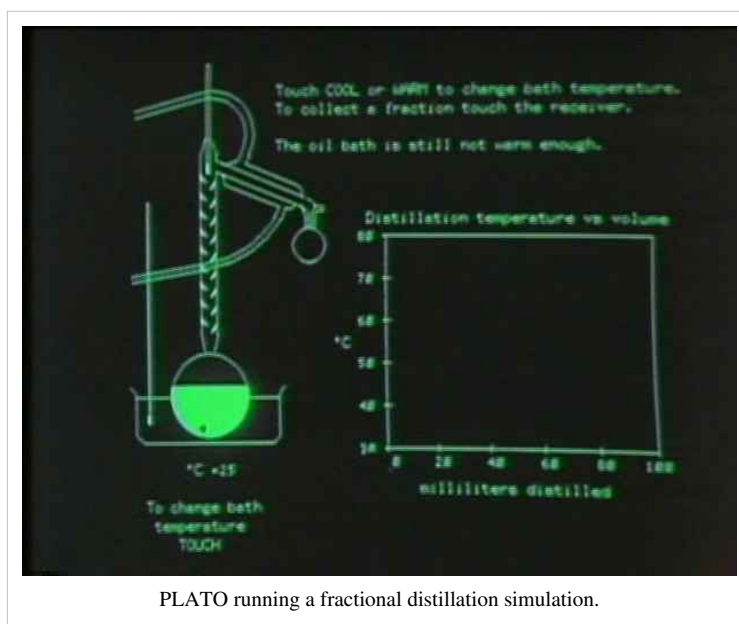
Historic background

Before the 1944 G.I. Bill that provided free college education to World War II veterans, higher education was limited to a minority of the U.S. population. The trend towards greater enrollment notable by the early 1950s, and the problem of providing instruction for the many new students was a serious concern to university administrators. To wit, if computerised automation increased factory production, it could do the same for academic instruction. The USSR's 1957 launching of the Sputnik I artificial satellite energized the United States' government into spending more on science and engineering education. In 1958, the U.S. Air Force's Office of Scientific Research had a conference about the topic of computer instruction at the University of Pennsylvania; interested parties, notably IBM, presented studies.

Genesis

Around 1959 Chalmers Sherwin, a physicist at the University of Illinois, suggested a computerised learning system to William Everett, the engineering college dean, who, in turn, recommended that Daniel Alpert, another physicist, convene a meeting about the matter with engineers, administrators, mathematicians, and psychologists. After weeks of meetings they were unable to suggest a single-design system, yet, before conceding failure, Alpert mentioned the matter to laboratory assistant Donald Bitzer, who had been thinking about the problem, suggesting he could build a demonstration system.

Bitzer, regarded as the Father of PLATO, recognized that in order to provide quality computer-based education, good graphics were critical (this at a time when 10 character per second teleprinters were the norm). In 1960, the first system, PLATO I, operated on the local ILLIAC I computer. It included a television set for display and a special keyboard for navigating the system's function menus; PLATO II, in 1961, featured two users at once.

Convinced of the value of the project, the PLATO system was re-designed, between 1963 and 1969; PLATO III allowed "anyone" to design new lesson modules using their TUTOR programming language, conceived in 1967 by biology graduate student Paul Tenczar. Built on a CDC 1604, given to them by William Norris, PLATO III could simultaneously run up to 20 lessons, and was used by a local facilities in Champaign-Urbana that could enter the system with their custom terminals.

NSF involvement

PLATO I, II and III had been funded by small grants from a combined Army-Navy-Air Force funding pool, but by the time PLATO III was in operation everyone involved was convinced it was worthwhile to scale up the project. Accordingly, in 1967 the National Science Foundation granted the team steady funding, allowing Bitzer to set up the Computer-based Education Research Laboratory (CERL) at the university.

In 1972 a new system named PLATO IV was ready for operation. The PLATO IV terminal was a major innovation. It included Bitzer's orange plasma display invention which incorporated both memory and bitmapped graphics into one display. This plasma display included fast vector line drawing capability and ran at 1260 baud, rendering 60 lines or 180 characters per second. The display was a 512×512 bitmap, with both character and vector plotting done by hardwired logic. Users could provide their own characters to support rudimentary bitmap graphics. Compressed air powered a piston-driven microfiche image selector that permitted colored images to be projected on the back of the screen under program control. The PLATO IV display also included a 16×16 grid infrared touch panel allowing students to answer questions by touching anywhere on the screen.

It was also possible to connect the terminal to peripheral devices. One such peripheral was the Gooch Synthetic Woodwind (named after inventor Sherwin Gooch), a synthesizer that offered four voice music synthesis to provide sound in PLATO courseware. This was later supplanted on the PLATO V terminal by the Gooch Cybernetic Synthesizer, which had 16 voices that could be programmed individually or combined to make more complex sounds. This allowed for what today is known as multimedia experiences. A PLATO-compatible music language was developed for these synthesizers, as well as a compiler for the language, two music text editors, a filing system for music binaries, programs to play the music binaries in real time, and many debugging and compositional aids. A number of interactive compositional programs have also been written.

A standard keyboard for a PLATO IV terminal, circa 1976.

Another peripheral was the Votrax speech synthesizer, and a "say" instruction (with "saylang" instruction to choose the language) was added to the Tutor programming language to support text-to-speech synthesis using the Votrax.

The goal of this system was to provide tools for music educators to use in the development of instructional materials, which might possibly include music dictation drills, automatically graded keyboard performances, envelope and timbre ear-training, interactive examples or labs in musical acoustics, and composition and theory exercises with immediate feedback.[3]

With the advent of microprocessor technology, new PLATO terminals were developed to be less expensive and more flexible than the PLATO IV terminals. At the University of Illinois, these were called PLATO V terminals, even though there never was a PLATO V system (the system continued to be called PLATO IV). The Intel 8080 microprocessors in these terminals made them capable of executing programs locally, much like today's Java applets and ActiveX controls, and allowed small software modules to be downloaded into the terminal to augment to the PLATO courseware with rich animation and other sophisticated capabilities that were not available otherwise using a traditional terminal-based approach.

Early in 1972, researchers from Xerox PARC were given a tour of the PLATO system at the University of Illinois. At this time they were shown parts of the system such as the *Show Display* application generator for pictures on PLATO (later translated into a graphics-draw program on the Xerox Star workstation), and the *Charset Editor* for "painting" new characters (later translated into a "Doodle" program at PARC), and the *Term Talk* and *Monitor Mode* communications program. Many of the new technologies they saw were adopted and improved upon when these researchers returned to Palo Alto, California. They subsequently transferred improved versions of this technology to Apple Inc..

A PLATO V terminal in 1981 displaying RankTrek application, one of the first to combine simultaneous local microprocessor-based computing with remote mainframe computing. The monochromatic plasma display's characteristic orange glow is illustrated. Infrared sensors mounted around the display watch for a user's touch screen input.

By 1975 the PLATO System served almost 150 locations from a donated CDC Cyber 73, including not only the users of the PLATO III system, but a number of grammar schools, high schools, colleges and universities, and military installations. PLATO IV offered text, graphics and animation as intrinsic components of courseware content, and included a shared-memory construct ("common" variables) that allowed TUTOR programs to send data between various users. This latter construct was used both for chat-type programs, as well as the first multi-user flight simulator.

With the introduction of PLATO IV, Bitzer declared general success, claiming that the goal of generalized computer instruction was now available to all. However the terminals were very expensive (about $12,000), so as a generalized system PLATO would likely need to be scaled down for cost reasons alone.

The CDC years

As PLATO IV reached production quality, William Norris became increasingly interested in it as a potential product. His interest was twofold. From a strict business perspective, he was evolving Control Data into a service-based company instead of a hardware one, and was increasingly convinced that computer-based education would become a major market in the future. At the same time, Norris was upset by the unrest of the late 1960s, and felt that much of it was due to social inequalities that needed to be addressed. PLATO offered a solution by providing higher education to segments of the population that would otherwise never be able to afford a university education.

Norris provided CERL with machines on which to develop their system in the late 1960s. In 1971 he set up a new division within CDC to develop PLATO "courseware", and eventually many of CDC's own initial training and technical manuals ran on it. In 1974 PLATO was running on in-house machines at CDC headquarters in Minneapolis, and in 1976 they purchased the commercial rights in exchange for a new CDC Cyber machine.

CDC announced the acquisition soon after, claiming that by 1985 50% of the company's income would be related to PLATO services. Through the 1970s CDC tirelessly promoted PLATO, both as a commercial tool and one for re-training unemployed workers in new fields. Norris refused to give up on the system, and invested in several non-mainstream courses, including a crop-information system for farmers, and various courses for inner-city youth. CDC even went as far as to place PLATO terminals in some shareholder's houses, to demonstrate the concept of the system.

In the early 1980s CDC started heavily advertising the service, apparently due to increasing internal dissent over the now $600 million

Using the CDC Plato network, circa 1979-1980, with an IST-II terminal

project, taking out print and even radio ads promoting it as a general tool. *The Minneapolis Tribune* was unconvinced by their ad copy and started an investigation of the claims. In the end they concluded that while it was not proven to be a better education system, everyone using it nevertheless enjoyed it at least. An official evaluation by an external testing agency ended with roughly the same conclusions, suggesting that everyone enjoyed using it, but it was essentially equal to an average human teacher in terms of student advancement.

Of course a computerized system equal to a human should have been a major achievement, the very concept that the early pioneers in CBT were aiming for. A computer could serve all the students in a school for the cost of maintaining it, and wouldn't go on strike. However CDC charged $50 an hour for access to their data center, in order to recoup some of their development costs, making it considerably more expensive than a human on a per-student basis. PLATO was therefore a failure in any real sense, although it did find some use in large companies and government agencies willing to invest in the technology.

An attempt to mass-market the PLATO system was introduced in 1980 as Micro-PLATO, which ran the basic TUTOR system on a CDC "Viking-721" terminal and various home computers. Versions were built for the Texas Instruments TI-99/4A, Atari 8-bit family, Zenith Z-100 and, later, Radio Shack TRS-80 and IBM Personal Computer. Micro-PLATO could be used stand-alone for normal courses, or could connect to a CDC data center for multiuser programs. To make the latter affordable, CDC introduced the *Homelink* service for $5 an hour.

Norris continued to praise PLATO, announcing that it would be only a few years before it represented a major source of income for CDC as late as 1984. In 1986 Norris stepped down as CEO, and the PLATO service was slowly killed off. He later claimed that Micro-PLATO was one of the reasons PLATO got off-track. They had started on the TI-99/4A, but then Texas Instruments pulled the plug and they moved to other systems like the Atari, who soon did the same. He felt that it was a waste of time anyway, as the system's value was in its online nature, which Micro-PLATO lacked initially.

Bitzer was more forthright about CDC's failure, blaming their corporate culture for the problems. He noted that development of the courseware was averaging $300,000 per delivery hour, many times what the CERL was paying for similar products. This meant that CDC had to charge high prices in order to recoup their costs, prices that made the system unattractive. The reason, he suggested, for these high prices was that CDC had set up a division that had to keep itself profitable via courseware development, forcing them to raise the prices in order to keep their headcount up during slow periods.

In South Africa

During the period when CDC was marketing PLATO, the system began to be used internationally. South Africa was one of the biggest users of PLATO in the early 1980s. Eskom, the South African electrical power company, had a large CDC mainframe at Megawatt Park in the northwest suburbs of Johannesburg. Mainly this computer was used for management and data processing tasks related to power generation and distribution, but it also ran the PLATO software. The largest PLATO installation in South Africa during the early 1980s was at the University of the Western Cape, which served a "coloured" population, and at one time had hundreds of PLATO IV terminals all connected by leased data lines back to Johannesburg. There were several other installations at educational institutions in South Africa, among them Madadeni College in the Madadeni township just outside of Newcastle.

This was perhaps the most unusual PLATO installation anywhere. Madadeni had about 1,000 students, all of them black and 99.5% of Zulu ancestry. The college was one of 10 teacher preparation institutions in kwaZulu, most of them much smaller. In many ways Madadeni was very primitive. None of the classrooms had electricity and there was only one telephone for the whole college, which one had to crank for several minutes before an operator might come on the line. So an air-conditioned, carpeted room with 16 computer terminals was a stark contrast to the rest of the college. At times the only way a person could communicate with the outside world was through PLATO term-talk.

For many of the Madadeni students, most of whom came from very rural areas, the PLATO terminal was the first time they encountered any kind of electronic technology. (Many of the first year students had never seen a flush toilet before.) There initially was skepticism that these technologically-illiterate students could effectively use PLATO, but those concerns were not borne out. Within an hour or less most students were using the system proficiently, mostly to learn math and science skills, although a lesson that taught keyboarding skills was one of the most popular. A few students even used on-line resources to learn TUTOR, the PLATO programming language, and a few wrote lessons on the system in the Zulu language.

PLATO was also used fairly extensively in South Africa for industrial training. Eskom successfully used PLM (PLATO learning management) and simulations to train power plant operators, South African Airways (SAA) used PLATO simulations for cabin attendant training, and there were a number of other large companies as well that were exploring the use of PLATO.

The South African subsidiary of CDC invested heavily in the development of an entire secondary school curriculum (SASSC) on PLATO, but unfortunately as the curriculum was nearing the final stages of completion, CDC began to falter in South Africa—partly because of financial problems back home, partly because of growing opposition in the United States to doing business in South Africa, and partly due to the rapidly evolving microcomputer, a paradigm shift that CDC failed to recognize.

Online community

Although PLATO was designed for computer-based education, manyWikipedia:Avoid weasel words consider its most enduring legacy was to be the online community spawned by its communication features. PLATO Notes, created by David R. Woolley in 1973, was among the world's first online message boards, and years later became the direct progenitor of Lotus Notes. By 1976, PLATO had sprouted a variety of novel tools for online communication, including Personal Notes (e-mail), Talkomatic (chat rooms), Term-Talk (instant messaging), monitor mode (remote screen sharing) and emoticons.[4]

PLATO's plasma panels were well suited to gaming, although its I/O bandwidth (180 characters per second or 60 graphic lines per second) was relatively slow. By virtue of 1500 shared 60-bit variables per game (initially), it was possible to implement online games. Because it was an educational computer system, most of the user community was keenly interested in gaming.

Many popular multiplayer online games were developed on PLATO during the 1970s and 1980s, such as *Empire* (a multiplayer game based on *Star Trek*), *Airfight* (a precursor to *Microsoft Flight Simulator*), *Panther* (a vector graphics based tankwar game, earlier than, but similar in many respects to Atari's *BattleZone*), the original Freecell, and several games inspired by the role-playing game *Dungeons & Dragons*, including *dnd* and *Rogue*. *Moria*, *Dry Gulch* (a western-style variation), and *Bugs-n-Drugs* (a medical variation) — these all presaged MUDs (Multi-User Domain) and MOOs (MUD, Object Oriented) as well as popular first-person shooters like *Doom* and *Quake* and MMORPGs (Massively multiplayer online role-playing game) like *Everquest* and *World of Warcraft*. *Avatar*, PLATO's most popular game, is one of the world's first MUDs and has over 1 million hours of use.[*citation needed*]

These communication tools and games formed the basis for an online community of thousands of PLATO users, which lasted for well over twenty years.[5] PLATO's games became so popular that a program called "The Enforcer" was written to run as a background process to regulate or disable game play at most sites and times − a precursor to parental-style control systems that regulate access based on content rather than security considerations.

In September 2006 the Federal Aviation Administration retired its PLATO system, the last system that ran the PLATO software system on a CDC Cyber mainframe, from active duty. Existing PLATO-like systems now include NovaNET[6] and Cyber1.org.

By early 1976, the original PLATO IV system had 950 terminals giving access to more than 3500 contact hours of courseware, and additional systems were in operation at CDC and Florida State University.[7] Eventually, over 12,000 contact hours of courseware was developed, much of it developed by university faculty for higher education.[*citation needed*] PLATO courseware covers a full range of high-school and college courses, as well as topics such as reading skills, family planning, Lamaze training and home budgeting.[*citation needed*] In addition, authors at the University of Illinois School of Basic Medical Sciences (now, the College of Medicine at Urbana-Champaign) devised a large number of basic science lessons and a self-testing system for first year students.[8][9] However the most popular "courseware" remained their multi-user games and role-playing video games such as *dnd*, although it appears CDC was uninterested in this market.[*citation needed*] As the value of a CDC-based solution disappeared in the 1980s, interested educators ported the engine first to the IBM PC, and later to web-based systems.

Later efforts and other versions

One of CDC's greatest commercial successes with PLATO was an online testing system developed for National Association of Securities Dealers (now the Financial Industry Regulatory Authority), a private-sector regulator of the US securities markets. During the 1970s Michael Stein, E. Clarke Porter and PLATO veteran Jim Ghesquiere, in cooperation with NASD executive Frank McAuliffe, developed the first "on-demand" proctored commercial testing service. The testing business grew slowly and was ultimately spun off from CDC as Drake Training and Technologies in 1990. Applying many of the PLATO concepts used in the late 1970s, E. Clarke Porter led the Drake Training and Technologies testing business (today Thomson Prometric) in partnership with Novell, Inc. away from the mainframe model to a LAN-based client server architecture and changed the business model to deploy proctored testing at thousands of independent training organizations on a global scale. With the advent of a pervasive global network of testing centers and IT certification programs sponsored by, among others, Novell and Microsoft, the online testing business exploded. Pearson VUE, was founded by PLATO/Prometric veterans E. Clarke Porter, Steve Nordberg and Kirk Lundeen in 1994 to further expand the global testing infrastructure. VUE improved on the business model by being one of the first commercial companies to rely on the Internet as a critical business service and by developing self-service test registration. The computer-based testing industry has continued to grow, adding professional licensure and educational testing as important business segments.

A number of smaller testing-related companies also evolved from the PLATO system. One of the few survivors of that group is The Examiner Corporation. Dr. Stanley Trollip (formerly of the University of Illinois Aviation Research Lab) and Gary Brown (formerly of Control Data) developed the prototype of The Examiner System in 1984.

In the early 1970s, James Schuyler developed a system at Northwestern University called HYPERTUTOR as part of Northwestern's MULTI-TUTOR computer assisted instruction system. This ran on several CDC mainframes at various sites.[10]

Between 1973 and 1980, a group under the direction of Thomas T. Chen at the Medical Computing Laboratory of the School of Basic Medical Sciences at the University of Illinois at Urbana Champaign ported PLATO's TUTOR programming language to the Modcomp IV minicomputer.[11] Douglas W. Jones, A.B. Baskin, Tom Szolyga, Vincent Wu and Lou Bloomfield did most of the implementation. This was the first port of TUTOR to a minicomputer and was largely operational by 1976[12] In 1980, Chen founded Global Information Systems Technology of Champaign, Illinois, to market this as the Simpler system. GIST eventually merged with the Government Group of Adayana Inc. Vincent Wu went on to develop the Atari PLATO cartridge.

CDC eventually sold the "PLATO" trademark and some courseware marketing segment rights to the newly-formed The Roach Organization (TRO) in 1989. In 2000 TRO changed their name to PLATO Learning and continue to sell and service PLATO courseware running on PCs. In late 2012, PLATO Learning brought its online learning solutions to market under the name Edmentum. [13]

CDC continued development of the basic system under the name CYBIS (CYber-Based Instructional System) after selling the trademarks to Roach, in order to service their commercial and government customers. CDC later sold off their CYBIS business to University Online, which was a descendant of IMSATT. University Online was later renamed to VCampus.

The University of Illinois also continued development of PLATO, eventually setting up a commercial on-line service called NovaNET in partnership with University Communications, Inc. CERL was closed in 1994, with the maintenance of the PLATO code passing to UCI. UCI was later renamed NovaNET Learning, which was bought by National Computer Systems (NCS). Shortly after that, NCS was bought by Pearson, and after several name changes now operates as Pearson Digital Learning.

Cyber1

In August 2004, a version of PLATO[14] corresponding to the final release from CDC was resurrected online. This version of PLATO runs on a free and open source software emulation of the original CDC hardware called Desktop Cyber. Within 6 months, by word of mouth alone, more than 500 former users had signed up to use the system. Many of the students who used PLATO in the 1970s and 1980s felt a special social bond with the community of users who came together using the powerful communications tools (talk programs, records systems and notesfiles) on PLATO.[citation needed]

The PLATO software used on Cyber1 is the final release (99A) of CYBIS, by permission of VCampus. The underlying operating system is NOS 2.8.7, the final release of the NOS operating system, by permission of Syntegra (now British Telecom [BT]), which had acquired the remainder of CDC's mainframe business. Cyber1 runs this software on the Desktop Cyber emulator. Desktop Cyber accurately emulates in software a range of CDC Cyber mainframe models and many peripherals.[citation needed]

Cyber1 offers free access to the system, which contains over 16,000 of the original lessons, in an attempt to preserve the original PLATO communities that grew up at CERL and on CDC systems in the 1980s.[citation needed] The load average of this resurrected system is about 10-15 users, sending personal and notesfile notes, and playing inter-terminal games such as Avatar and Empire (a star-trek like game), which had both accumulated more than 1.0 million contact hours on the original PLATO system at UIUC. [14]

Innovation

- Plasma display, circa 1964, by Donald Bitzer for PLATO IV
- Touchscreen, circa 1964, by Donald Bitzer for PLATO IV
- *Answer Judging Machinery*, ?date?, a set of about 25 commands in TUTOR that made it easy to test a student's understanding of a complex concept.
- *Show Display Mode*, 1975, a graphics application generator for TUTOR software, precursor to Apple's QuickDraw picture language editor.
- *Charset Editor*, an early precursor to MacPaint for drawing bitmapped pictures stored in downloadable fonts.
- *Monitor Mode* on PLATO, 1974, used by instructors to help students, precursor of Timbuktu screen-sharing software.
- *Pad* and a few months later, system-defined *Notesfiles*, 1973, the first general-purpose computer message board, and precursor to Unix Newsgroups, Digital DECnotes and Lotus Notes.
- *Talkomatic*, 1974, a 6-person real-time chat room (text-based), precursor to Instant Messaging Conferences.
- *Term-Talk*, 1973, precursor to instant messaging.
- Gooch Synthetic Woodwind, circa 1972, A music device for the terminal, precursor to sound cards and MIDI.
- Airfight, 1974, a 3-D flight simulator written for PLATO by Brand Fortner; this probably inspired UIUC student Bruce Artwick to start subLOGIC which was acquired and later became Microsoft Flight Simulator.
- Empire, circa 1974, a 30 person multi-player inter-terminal 2-D real-time space simulation.
- Spasim, circa 1974, a 32-player first-person 3D space battle game
- Pedit5, circa 1974, likely the first graphical dungeon computer game.
- dnd, 1974–1975, a dungeon crawl game that included the first video game boss.
- Panther, circa 1975 by John Haefeli, a 3-D tank simulation and forerunner of Atari's Battlezone game.
- Build-Up, 1975 by Bruce Wallace, based on a story by J. G. Ballard, the first PLATO 3-D walkthru maze game. The maze itself was also 3-D, having holes in the floor and ceiling.
- Think15, circa 1977, 2-D outdoor wilderness quest simulation, like *Trek* with monsters, trees, treasures.
- Avatar, circa 1978, a 2.5-D graphical Multi-User Dungeon (MUD), a precursor to EverQuest.
- Freecell, 1979 by Paul Alfille, which probably spawned the Windows version.
- Mahjong solitaire, 1981 by Brodie Lockard, popularised in 1986 by Activision as *Shanghai*.
- Emoticons, by 1973

References

[1] Email from Don Bitzer

[4] See Smith and Sherwood, 1976, particularly the section entitled *PLATO as a Communication Medium*

[5] "PLATO: The Emergence of Online Community" (http://thinkofit.com/plato/dwplato.htm), article by David Woolley.

[6] Novanet website (http://www.pearsondigital.com/novanet)

[7] *Science*, Smith and Sherwood 192 (4237): 344.

[8] http://eric.ed.gov/ERICWebPortal/detail?accno=EJ209808

[9] http://eric.ed.gov/ERICWebPortal/detail?accno=ED161424

[10] http://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_& ERICExtSearch_SearchValue_0=ED111398&ERICExtSearch_SearchType_0=no&accno=ED111398

[11] http://www.cs.uiowa.edu/~jones/modcomp/

[12] http://www.cs.uiowa.edu/~jones/plato/#tutor

[13] http://bw.newsblaze.com/release/2012111506050800001.bw/topstory.html

[14] see Cyber1.org (http://www.cyber1.org)

Further reading

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External links

- PLATO History site (http://platohistory.org) run by PLATO History Foundation
- Oral history interview with Donald L. Bitzer (http://purl.umn.edu/107121), Charles Babbage Institute, University of Minnesota. Bitzer discusses his relationship with Control Data Corporation (CDC) during the development of PLATO, a computer-assisted instruction system. He describes the interest in PLATO of Harold Brooks, a CDC salesman, and his help in procuring a 1604 computer for Bitzer's use. Bitzer recalls the commercialization of PLATO by CDC and his disagreements with CDC over marketing strategy and the creation of courseware for PLATO.
- Oral history interview with Thomas Muir Gallie (http://purl.umn.edu/107305), Charles Babbage Institute, University of Minnesota. Gallie, a program officer at the National Science Foundation (NSF), describes the impact of Don Bitzer and the PLATO system, grants related to the classroom use of computers, and NSF's Regional Computing Program.
- University of Illinois Computer-based Education Research Laboratory PLATO Reports, PLATO Documents, and CERL Progress Reports (http://purl.umn.edu/40704), Charles Babbage Institute, University of Minnesota. Archival collection contains internal reports and external reports and publications related to the development of PLATO and the operations of CERL.
- Control Data Corporation records. Computer-based education (http://discover.lib.umn.edu/cgi/f/findaid/ findaid-idx?c=umfa;cc=umfa;q1=plato;rgn=main;view=text;didno=cbi00080-04), Charles Babbage Institute, University of Minnesota. Computer-Based Education (CBE) series documents CDC's objective to create, market and distribute PLATO courseware internally within various CDC departments and divisions, and externally.
- *The Friendly Orange Glow: The Story of the PLATO System and the Dawn of Cyberculture* (http:// friendlyorangeglow.com/), a forthcoming book by Brian L. Dear
- Historic PLATO Manuals & Publications (http://bitsavers.org/pdf/univOfIllinoisUrbana/plato/)
- Cyber1.org: An online preservation of the PLATO system (http://www.cyber1.org/)
- =grapenotes=, the crazy rantings of Dr. Gräper (http://www.grapenotes.com/)

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