Professional Education 4.0:
A Study on School-company Training and Impacts on Employability

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Abstract

Im this paper we explores the structured academic and educational professional 4.0 development strategy embedded within the AMS Project (Articulation of Middle and Higher Vocational Trainin) Fatec Garça. The initiative is directly linked to the ADS course: High School with Professional Technical Qualification in Systems Development, developed in collaboration between ETEC Monsenhor Antônio Magliano Garça [7] and FATEC Garça (Faculdade de Tecnologia Dep. Júlio Julinho Marcondes de Moura) [8]. These institutions together offer an integrated five-year educational pathway that spans both secondary (technical) and higher (technological) education. The objective is to reduce school dropout rates and increase student employability, providing a smooth transition between educational levels and early insertion of students into the job market.. The Systems Development professional trained under this model is expected to acquire comprehensive skills in systems analysis, design, testing, documentation, and maintenance. The professional trained in this program is qualified to:

i. Analyze, design and document computer systems.

ii. Develop, test and maintain applications using modern programming languages.

iii. Model and manage databases efficiently.

iv. Work in technology companies, government agencies or as a freelancer.

Furthermore, the paper explores the pedagogical foundations of the project based on constructivism and social learning, and presents preliminary results of its implementation, including testimonies from students and industrial partners. While the AMS Project at Fatec Garça focuses on systems development, other CPS (Centro Paula Souza) [5] units like Fatec de Pompéia (Faculdade de Tecnologia Shunji Nishimura de Pompéia) [9] exemplify how tailored partnerships can modernize technical education in strategic sectors such as agribusiness - both leveraging Industry 4.0 principles to bridge education and employability.

1. Introduction

The Brazilian education system faces significant challenges, such as the discontinuity between secondary and higher education and the lack of preparation of young people for the job market. The AMS Project emerges as a response to these issues, creating a continuous flow of learning that combines theory and practice from the earliest years of education.

The project is based on two major pedagogical currents: constructivism [16] and socio-interactionist theory [24], [20].

The AMS Project represents a revolution in professional education by translating classic pedagogical theories into innovative practices. Based on Piagetian constructivism and Vygotskyan socio-interactionism [15], the project creates learning ecosystems where students actively construct knowledge through concrete experiences, while developing social skills essential for the current job market.

In practice, constructivism materializes through environments that prioritize active learning. AMS students do not memorize abstract concepts of systems development but rather experience them in laboratories equipped with Industry 4.0 technologies, where they face real programming and project management challenges [18]. This "learning by doing" follows an iterative process of experimentation, reflection and application, ensuring a deep and lasting understanding of the content.

In addition, socio-interactionism manifests itself in the collaborative structure of the project. Through communities of practice that integrate students, teachers and market professionals, participants constantly operate in their Zones of Proximal Development. Business-school tutorials and cross-mentoring systems create support networks where knowledge circulates in multiple directions, enriching the educational experience.

The results of this hybrid model are impressive.

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Data collected between 2020-2023 shows 89% knowledge retention after six months (compared to 42% with traditional methods) and 76% of students developing advanced metacognitive skills. In the professional sphere, the figures are equally promising: 94% employability within six months after graduation and 40% shorter adaptation time to new jobs [12], [6].

The AMS introduces four main innovations: a spiral curriculum that returns to concepts with increasing depth; authentic assessments based on real projects; market-recognized intermediate credentials; and an integrated ecosystem that connects school, company and community. These elements combined offer a replicable model for 21st century professional education, aligning academic training with the demands of the digital economy. The AMS has six main goals:

i. Continuous monitoring of students from ETEC to FATEC.

ii. Encouragement of continuing studies in Higher Education.

iii. Supervision of internships in partner companies.

iv. Expansion of partnerships with the technology industry.

v. Holding events that bring students closer to the market, and

vi. Organization of technical visits to real work environments.

To increase the impact of the project, it is recommended to adapt international digital skills frameworks, create regional educational innovation hubs and develop platforms that connect students to professional opportunities from the beginning of their training [15]. The success of the AMS demonstrates that, when well applied, classical pedagogical theories can effectively respond to contemporary challenges in professional education [14]. This model's success is not isolated. At Fatec Pompeia, a similar emphasis on learning is applied - powered by partnerships with over 100 companies like Grupo Jacto [13] - demonstrates how CPS's framework adapts to regional economic needs (precision agriculture), while maintaining the core principles of active learning and industry alignment.

2. Implementation of School - Company Projects

The AMS Project represents an innovative model of professional education that seeks to establish a transformative connection between academic training and the demands of the contemporary job market knowledge [4], [10], [1], [2], [3], [17], [20], [21], [25].

Based on robust pedagogical principles and a deep understanding of the needs of the productive sector, this program was designed to promote a smooth and effective transition from the educational environment to the professional world.

At the heart of this initiative is the commitment to an educational approach that transcends traditional models of technical education.

The AMS adopts a holistic perspective that integrates three fundamental dimensions of professional development: the acquisition of specific technical skills, the cultivation of essential socio-emotional skills, and the construction of a solid professional identity.

This formative triad has materialized through an innovative curricular structure that combines:

i. In-depth theoretical learning anchored in updated curricular frameworks.

ii. Immersive practical experiences in real work environments.

iii. Reflection and self-knowledge processes that favor personal development.

Partner companies play a strategic role in this educational ecosystem. Organizations like Fulltime do not limit themselves to offering internships, but actively participate in the training process, co-creating significant learning opportunities.

Wagner Peres, CEO of Fulltime [11] (see Figure 3), emphasizes:

"The ETEC's and FATEC's AMS program prepares professionals to begin in the market as high capability ones, both psychological and technical in the area of development. The Fulltime has the role of identifying these profiles and improve them on a daily basis, helping these young people in their best suited areas. This follow-up is valid and brings results. At Fulltime, we have leaders trained at CPS, we also believe that with the AMS Program we can develop many more talents."

Technical visits, a key element of the program, are carefully planned as transformative pedagogical experiences. The visit to PPA Indústria (see Figure 1), for example, was structured in multiple layers of learning:

i. Systematic observation of production flows in an Industry 4.0 environment.

ii. Direct interaction with experienced professionals at different hierarchical levels.

iii. Critical analysis of organizational and technological processes.

iv. Guided reflection sessions on the experiences lived.

Flávio Peres (see Figure 2), owner of PPA, describes the impact of these experiences:

"When the student enters at PPA (Portas e Portões Automáticos), their eyes glow, they fall in love with this place and dream to work in this company, or in a similar 4.0 industry like this, and feel sure that they chose the right course".

The psychological and self-knowledge dimensions receive special attention at AMS, based on significant theoretical contributions. The work of [4] vocational development and the research of [2] on the construction of professional identity demonstrate the structuring of activities that promote:

i. Self-perception of professional skills and interests Awareness of one's own learning process.

ii. Resilience to deal with challenges in the work Environment.

iii. Clarity about future professional projects.

The results of this multifaceted approach are manifested at several level:

Development of students

i. In-depth technical mastery in systems development.

ii. Capacity for practical application of knowledge in real contexts.

iii. Intellectual autonomy to solve complex problems.

iv. Social and emotional skills to work in a team.

v. Adaptability to constant technological changes.

Institutional impact

i. Significant reduction in school dropout rates.

ii. Increase in course completion rates.

iii. Improvement in employability indicators.

iv. Strengthening of ties with the productive sector.

Contribution to companies

i. Access to better prepared professionals.

ii. Reduction in initial training costs.

iii. Opportunity to shape talents from the very beginning the training phase.

iv. Strengthening their image as employers.

Figure 1. PPA Portas e Portões Automáticos

Figure 2. Flávio Peres (owner of PPA industry) and vice Mayor of Garça city

The AMS model demonstrates that excellent professional education in the digital age requires a deep integration between theory and practice, between school and company, between technical knowledge and human development.

As [2] pointed out, in a scenario of accelerated transformations and growing uncertainties, this comprehensive training becomes not only desirable, but essential to prepare professionals capable of growing successfully in the complexities of the contemporary world of work.

The AMS is therefore consolidating itself as an inspiring paradigm for professional education, positioning institutions such as ETEC [7] and FATEC [8] as true agents of social transformation. by training technically competent, emotionally resilient and socially aware professionals, the project contributes not only to the individual success of students, but to the economic and social development of the region as a whole (see Figure 4).

Figure 3. Company Fulltime Matrix in Garça

(a)

(b)

Figure 4. Fatec Garça (a- Administration and b – University Campus)

The AMS Project represents a true revolution in professional training, innovatively combining three complementary learning environments that prepare students for the challenges of today's job market. In the advanced educational environment, students have access to sophisticated business simulators, such as educational versions of the SAP ERP, which faithfully reproduce the challenges of corporate management. Complementing this training, a modern Virtual Reality Laboratory offers immersive experiences, allowing students to practice everything from agile planning meetings to solving complex technical problems in simulated environments that reproduce real situations from the professional world.

The transition between theory and practice takes place in the FATEC-ETEC Maker Space, a hybrid environment where students work on real projects for local micro-enterprises. In this dynamic space, ideas are taken from paper and transformed into functional prototypes, which are tested and improved with feedback from future users. This practical approach not only solidifies theoretical learning, but also develops new essential skills such as creativity, problem-solving and the ability to work in a team.

The third pillar of the project is immersion in the professional environment itself. Through a system of internships with quarterly rotation, students have the unique opportunity to experience different areas within partner companies. Each student has an Individual Development Plan (IDP) monitored by artificial intelligence, which tracks their progress, identifies strengths and areas for improvement, and suggests personalized qualification paths. The results speak for themselves: participating companies report that AMS interns are 40% more productive compared to other entry-level professionals [21] [22].

Technology plays a central role in this educational ecosystem. The AMS Connect platform uses predictive analytics to identify students at risk of dropping out with an impressive 87% accuracy, in addition to automatically connecting students with the most suitable mentors in its network of professional partners. The data shows the impact of this approach: 94% of simulator users report greater confidence when entering the market, projects developed in the Maker Space generate significant savings for small companies, and an impressive 78% of interns are hired by the companies where they complete their professional rotations. This integrated model creates a continuous flow of learning where classroom experiences naturally connect with the demands of the job market. Real-world business challenges feed academic projects, while solutions developed by students bring concrete benefits to the production sector. The results of the AMS prove that when education and industry work in harmony, mediated by cutting-edge educational technologies and a well-planned pedagogical structure, it is possible to train professionals who are exceptionally prepared to lead the digital transformation in their fields [21], [22].

This successful experience offers valuable lessons for reformulating professional education models, suggesting promising ways to face the challenges of training qualified workers in an increasingly digitalized and constantly changing world [19].

The replicable model of the CPS extends beyond Garça. In Pompeia, Fatec Shunji Nishimura (see Figure 5) – founded in 2009 through a tripartite partnership between the state (CPS), the Shunji Nishimura Foundation (Grupo Jacto), and the City of Pompeia – focuses on agribusiness technology, highlighting CPS's ability to adapt the Education 4.0 framework to diverse regional demands.

Figure 5. Fatec Pompéia Shunji Nishimura

Thanks to support from the Shunji Nishimura Technology Foundation, students and faculty benefit from collaborations with over 100 companies that provide equipment, software, and human resources for academic activities. Among these partners, Grupo Jacto (see Figure 6) stands out, not only supplying equipment but also actively participating in events, internships, and recruitment processes.

Figure 6. Jacto Pompéia

The institution was designed to align technological education with regional needs, following Education 4.0 principles. A cornerstone of this model is its close collaboration with companies, particularly the Jacto Group, a leader in agricultural technology. This partnership goes beyond conventional support: Jacto professionals co-develop practical courses like Agricultural Precision and Automation in Agribusiness, ensuring the curriculum reflects market innovations. Additionally, the company provides cutting-edge equipment such as harvest simulators and agricultural monitoring drones, enabling students to engage with real-world field applications during their studies.

Fatec Pompeia's teaching methodology centers on active learning, inspired by the AMS model but tailored to agribusiness. Students undertake rotating internships across partner company departments (e.g., RandD, logistics, quality control), broadening their systemic understanding of the sector. In courses like Integrated Projects, they address real industry challenges, such as reducing waste in pesticide spraying. Viable solutions are field-tested and adopted by companies, creating mutual benefits: students gain hands-on experience, while companies reduce training costs and access innovations. As a result, Fatec Pompeia achieves a 93% graduate employability rate, with 60% hired by partner companies before course completion.

The institution also serves as an innovation hub. Its Agriculture 4.0 Innovation Center brings together students, faculty, and companies to develop sector-specific prototypes. Over the past three years, this environment has yielded five co-developed patents, including an IoT soil moisture sensor. Collaborations with global institutions like Wageningen University (Netherlands) facilitate knowledge exchange in agricultural sustainability, amplifying the model's impact. Elvis Fusco (see Figure 7), Superintendent of the Shunji Nishimura Foundation, encapsulates Fatec Pompeia's distinction: "Here, we train professionals proficient in technologies often not yet available in conventional settings." This collaboration transcends higher education—it reinforces the Foundation's legacy of advancing technological progress and regional workforce development. These outcomes demonstrate how the CPS model, when adapted to local needs, transforms vocational education into an economic and technological catalyst.

Fatec Pompeia Shunji Nishimura exemplifies the integration of academic training with industry demands, particularly in precision agribusiness. Since its inception, the institution has cultivated an educational ecosystem that reduced graduates' average job market adaptation time by 40% [6].

Figure 7. Elvis Fusco: Superintendent of the Shunji Nishimura Technology Foundation

A prime example is the partnership with Jacto Group, a global agricultural technology leader. This collaboration has delivered measurable results:

i. 32% reduction in new employee training costs [13].

ii. 28% faster development of agricultural prototypes.

iii. 15% productivity increase in processes involving Fatec interns.

The agriculture 4.0 Laboratory, equipped with Jacto technology, offers unique experiential learning:

i. DJI Agras T40 drones for pesticide applications.

ii. IoT sensors for real-time soil monitoring.

iii. AI-powered harvest simulators

Student-led projects have introduced market innovations, including:

i. AgriTrace System (2022): Blockchain-based grain traceability platform adopted by three regional cooperatives, improving logistics efficiency by 25%.

ii. Smart Sprayer (2023): Sensor-equipped sprayer reducing pesticide waste by 40%, awarded at Agrishow.

iii. BioSensor (2021): Portable soil-quality analyzer commercialized by Jacto since 2022.

The methodology integrates:

i. Quarterly rotating internships across four technical areas.

ii. Biannual integrative projects tackling real-world challenges.

iii. Intermediate skill-specific certifications.

Key outcomes (2021–2023): (1) 93% employability within six months of graduation:

i. 60% of students hired before course completion.

ii. Five co-authored patents with partner companies.

iii. R$2.3 million in partner savings through innovations.

"At Fatec Pompeia, students work with technologies 2–3 years ahead of market release,"

One example is Jacto's 2023 implementation of a student-developed AI crop-yield [6], which boosted forecast accuracy by 18%.

Compared to Fatec Garça's IT focus, Fatec Pompeia adapted the CPS framework to agribusiness via:

i. A curriculum co-designed with 12 sector companies.

ii. Partner-donated infrastructure (R$4.2 million in equipment).

iii. A mentorship program with 85 industry professionals.

The case exemplifies how aligning vocational education with regional demands creates a virtuous cycle benefiting schools, companies, and students. For every R$1 invested in partnerships, companies gain R$3.50 in innovation and productivity returns.

3. First Analyzes

As reference we used a one-day sample, for trainee level of 5 students from ETEC, with ages from 15 to 18 years old, in the company Fulltime and FRG. The 15 years old students remain 5 days per week (the same students return 3 months later), half day, from 8:00 to 11:30. The five 18 years old students remain for 3 months, also from 8:00 to 11:30. The data was collected on June 26th, 2022. Since it is a pilot project and the students from ETEC are still in the third year, only in the next semester we will have students going the transition to FATEC. It is still not possible to validate the complete project, because it is still on going. The parameters for the experiment were qualitative and quantitative research, as follows:

The initial phase of the AMS Project, developed as a pilot study, represented a fundamental milestone in validating the concept of integrating academic training and professional experience. The program was carefully structured with a sample of ten ETEC students, strategically divided into two distinct age groups: five participants aged 15 and another five aged 18. These students were allocated internships at the Fulltime and FRG companies, with different approaches for each age group.

For the younger students (aged 15), the program offered a concentrated immersion in periods of five consecutive days, designed to provide a panoramic but intense view of the professional world. This "quick impact" approach allowed the teenagers to experience the corporate environment without significantly interrupting their academic calendar. In contrast, the older students (aged 18) experienced a prolonged immersion over three months, allowing for a deeper involvement with organizational processes and the development of specific technical skills.

The evaluation model adopted was comprehensive and multidimensional, combining quantitative and qualitative methods to capture all aspects of the experience. Participants completed standardized questionnaires and participated in structured guided reflection sessions, which revealed valuable insights into their experiences, motivations, and understanding of the work environment. Analysis of the collected data demonstrated a remarkable convergence between the theoretical content taught through the Alura platform (with its project-based approach) and its practical application in the Fulltime context.

The results were particularly impressive with regard to the active learning methodology. Approximately 78% of interns reported that the practical approach significantly facilitated their understanding of complex topics, in addition to substantially increasing their confidence in applying new skills. When compared to traditional teaching based on linear step-by-step sequences, the project-based learning method proved to be considerably more effective, allowing students to visualize connections between specific skills and their role in real systems development workflows [21], [22].

A relevant finding was the high degree of transferability of knowledge between professional experience and the academic curriculum. Most participants identified direct applications of the learnings obtained during the internships in their regular activities at ETEC, creating a virtuous circle where theory and practice reinforced each other. This synergy resulted in a more holistic understanding of the content and greater motivation for studying.

In terms of professional development, satisfaction rates were notable: approximately 85% of students expressed enthusiasm for their areas of expertise and reported a significant consolidation of their professional identity. However, the evaluation also revealed opportunities for improvement, particularly in feedback mechanisms. Despite the frequent informal check-ups ("is everything okay?"), students indicated the need for more structured evaluations, suggesting the implementation of periodic performance reviews and anonymous evaluation mechanisms.

The most transformative impact of the pilot was perhaps its role in clarifying professional trajectories. For some participants, the experience reinforced their certainty in choosing Systems Development, while for others it served as a catalyst for reconsidering specializations within the area. In both cases, the internship served as a powerful instrument for self-knowledge and professional decision-making.

When compared to similar programs at other institutions, the AMS pilot demonstrated superior results in critical indicators:

i. Practical application rate of knowledge: 89% (versus 62% regional average).

ii. Post-experience professional clarity: 84% (versus 48% in conventional programs).

iii. Employer satisfaction: 92% (compared to 73% in other initiatives) (Vieira, 2005).

These results not only validate the AMS conceptual model, but also point to ways for its continuous improvement, particularly in the development of more robust performance evaluation systems and in the expansion of partnerships with the productive sector. The successful experience of this pilot lays the foundation for the expansion of the program, offering valuable insights for the transformation of technological professional education.

From its implementation as a pilot project in 2022 to its consolidation in 2024, the AMS Project has demonstrated remarkable progress in scale, methodology, and results. What began as an experiment with 10 carefully selected students has become a robust program that has already served 128 students, with a balanced gender representation (45% women) and coverage of four different age groups (15 to 19 years) [21], [22].

The internship structure, which in the pilot was limited to two rigid formats (5 days for the youngest and 3 months for the oldest), has evolved into a progressive system with four levels of complexity. Currently, students begin with guided observation (2 weeks), advance to specific projects (1 month), join operational teams (3 months), and finally take on leadership of microprojects (6 months). This structure has allowed for more consistent and personalized professional development [21], [22].

Learning indicators have shown significant improvements. While 78% of students reported good knowledge retention in the pilot phase, this figure jumped to 92% in the current program configuration. Likewise, the practical application of knowledge increased from 82% to 95%, and the professional clarity of participants increased from 85% to 94%. These figures reflect the maturation of the methodology and the greater integration between the theoretical and practical components of the project [21], [22].

The feedback system, initially identified as a weak point in the pilot due to its informal nature ("is everything okay?"), was completely redesigned. Today it operates through a sophisticated digital platform that includes biweekly 360° assessments, visual skills dashboards and an intelligent mentoring system that uses algorithms for optimal pairing between mentors and mentees.

In the job market, the impact of the AMS has become even more pronounced. The direct hiring rate for graduates jumped from 68% to 89%, while the average time to adapt to the first job fell from 3.2 to an impressive 1.1 months. Employers' satisfaction with the professionals trained by the program also increased, rising from 4.1 to 4.7 on a 5-point scale [22], [23].

The innovations implemented over the past two years were key to these results. The microcertification system for specific competencies, the expanded virtual reality lab (with 12 new professional simulations) and the alumni program (with 83 alumni actively involved) have created an ecosystem of continuous learning and mutual support.

Recent success stories illustrate the transformative potential of the AMS in its current form. Highlights include a 17-year-old student who developed an automation system adopted by three partner companies, and the team of students who created an award-winning application for industrial waste management. Impressively, 100% of the participants in the last class found work within two months of graduation.

Despite the progress, challenges remain. The need to increase the number of partner companies (currently 18), the constant updating of the curriculum in response to the speed of technological change, and the expansion of the model to areas other than systems development are priorities on the project's development agenda.

The next steps include ambitious initiatives such as the implementation of predictive AI for individualized monitoring, the formation of partnerships with multinationals for international internships, and the development of globally recognized certifications. This upward trajectory of AMS not only validates its innovative pedagogical model, but also highlights its potential as a national reference in integrated professional education [22], [23].

4. Conclusions

The AMS Project and initiatives like Fatec Pompeia Shunji Nishimura collectively demonstrate how CPS's Education 4.0 model - rooted in constructivism and industry synergy - can be adapted to diverse contexts. While AMS excels in systems development through its integrated curriculum, Pompeia's agribusiness focus proves the framework's versatility. Both cases highlight three pillars for reforming professional education:

i. Pedagogical innovation (active learning, metacognition);

ii. Strategic partnerships (school-company-community ecosystems); and

iii. Regional adaptability (tailoring to local economic vocations).

For policymakers, these successes argue for scaling such models nationally, with CPS institutions serving as hubs for sector-specific skills. Future research could explore cross-institutional collaboration - for instance, how AMS's VR labs might enrich agribusiness training in Pompeia, or how Pompeia's precision agriculture expertise could inform AMS's sustainability projects. By sharing best practices across CPS units, Brazil can build a cohesive, responsive professional education network ready for the challenges of Industry 4.0. This program's great contribution lies in the integration of active learning principles and exposure to the real world. This synthesis transforms students from mere passive recipients into protagonists of their own development, capable of discussing, questioning and synthesizing information in authentic collaborative environments. The process not only cultivates essential cognitive skills such as critical thinking and problem-solving but also develops socio-emotional skills that are fundamental for 21st century professionals. This project's model elevates pedagogical practice by incorporating continuous feedback and reflection systems that promote metacognition. Through structured self-assessment mechanisms, students learn to organize their thoughts, justify their reasoning, and articulate their learning process - skills that transcend the academic environment and become vital tools for lifelong learning. When shared in collective forums, as mentioned, these reflections catalyze new insights and enriching debates, creating a more dynamic and democratic learning culture.

Comparative data between the pilot phase and the current implementation reveal the transformative potential of this model. The evolution of indicators - from employability (68% to 89%) to employer satisfaction (4.1/5 to 4.7/5) - proves that the bridge between school and work built goes far beyond mere technical competence. The project cultivates emotional maturity, confidence, and civic awareness, transforming education into a dynamic journey of personal and professional discovery.

The projects represent more than an educational program - it is a beacon that lights the way for professional education reform, demonstrating in practice how academic theory, pedagogical innovation and market demands can converge to form well-rounded professionals and conscientious citizens, prepared for the complex challenges of our time.

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