

Instructional Design and Teaching Practice of Curriculum-Based Ideological and Political Education Using an AIS Vessel Big Data Project

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Abstract: To address insufficient industry context, weak integration of value objectives with technical tasks, and a lack of process-based evidence of educational outcomes in curriculum-based ideological and political education for big data programs at higher vocational colleges, this study introduces a pedagogically adapted Automatic Identification System (AIS) vessel big data project into the course Big Data Analysis and Development and develops a teaching framework that integrates knowledge, competencies, and values. The course adopts AIS trajectory visualization and analysis as the comprehensive task within the AIS vessel big data project, embedding maritime safety, data compliance, engineering responsibility, and collaboration into data acquisition, trajectory visualization, operational status analysis, and results dissemination. A combination of task-driven learning, question-guided inquiry, and project-output assessment is adopted to strengthen students' awareness of standardized practice and professional responsibility while they complete technical tasks. This paper focuses on the objectives, content, implementation pathway, and assessment methods of curriculum-based ideological and political education. The study provides a practical reference for integrating such education into higher vocational big data courses with distinctive industry characteristics.

Keywords: AIS Vessel Big Data; Curriculum-based Ideological and Political Education; Project-based Teaching; Big Data Analysis and Development; Vocational Education.

1. Introduction

Research on curriculum-based ideological and political education emphasizes integrating value-oriented education into disciplinary teaching and professional competency development [1]. Big data technology has a strong application orientation, broad practical relevance, and extensive social impact. When collecting, governing, analyzing, and communicating data, students must not only master technical methods but also consider whether data have been obtained and used responsibly and ethically, whether processing rules are reliable, whether algorithmic conclusions are applicable, and what effects may arise from publishing the results [2]. Therefore, curriculum-based ideological and political education in big data programs should extend beyond lesson introductions, exemplary stories, or end-of-class summaries. It should be integrated into the implementation of professional tasks so that educational expectations are translated into standards of conduct in data engineering.

Shipping is a typical data-intensive industry. AIS automatically exchanges information such as vessel identity, position, course, speed, and navigational status, supporting vessel identification, target tracking, and maritime situational awareness [3-4]. AIS data are characterized by large volume, strong temporal continuity, clear spatial correlation, and complex data-quality issues [5]. These characteristics align closely with data storage, cleansing, interface invocation, trajectory analysis, and visual representation in big data courses. Errors in AIS data processing may lead to incorrect judgments about vessel position, course, or navigational status. Moreover, releasing relevant information without an appropriate security review may pose risks to vessels and port facilities. Using an AIS project as a teaching vehicle enables students to deepen their understanding of shipping operations and strengthen their awareness of data security and

professional responsibility while practicing data processing, trajectory analysis, and visualization.

Existing practices of curriculum-based ideological and political education in professional courses still have three limitations. First, ideological and political elements are not sufficiently connected with disciplinary knowledge, and value objectives have not yet been adequately translated into professional conduct. Second, industry cases are used mainly for teacher explanation rather than being transformed into data-processing and analytical tasks in which students participate; consequently, students have insufficient opportunities to analyze, judge, and solve problems in authentic contexts. Third, course assessment emphasizes knowledge acquisition and technical outcomes, while insufficient attention is paid to data-processing standards, professional responsibility, and the boundaries of analytical conclusions. In response, this study uses an AIS vessel big data project as the teaching vehicle and designs curriculum-based ideological and political education in terms of course objectives, teaching tasks, and assessment methods. Educational objectives concerning data security, engineering responsibility, and standardized practice are integrated into professional learning objectives; shipping cases are transformed into student-centered tasks involving data processing, trajectory analysis, and visualization; and students' awareness of standardized practice and professional responsibility is assessed through project-process records and learning outputs [6]. Together, these measures form a teaching framework that integrates knowledge transmission, competency development, and value guidance.

2. Construction of the Curriculum-Based Ideological and Political Education Framework for the AIS Project

2.1. Pedagogical Reconstruction of the Project

Authentic shipping projects cannot be transferred directly into the classroom. In accordance with the training objectives for big data professionals, the course team reconstructs the AIS project for teaching purposes. First, the project uses data samples obtained from compliant sources and subjected to necessary masking, while the data volume is controlled to reduce the risk of exposing sensitive information. Second, only fields required for the task—such as vessel identifier, time, latitude, longitude, speed, and course—are retained, and typical data problems, including out-of-order records, duplicates, missing values, and position drift, are incorporated into the samples. Third, the project is divided into progressive stages: data familiarization, data governance, trajectory visualization, operational status analysis, and results dissemination. Fourth, industry norms are translated into project acceptance criteria: data sources must be clear and verifiable, processing procedures traceable, anomaly judgments supported by data, and released content subject to security review.

The reconstruction follows three principles. The first is professionalism: ideological and political education should be grounded in authentic professional problems and must not weaken technical training. The second is appropriateness: only the shipping knowledge required to complete the big data tasks is introduced, thereby avoiding excessive cognitive load. The third is actionability: value objectives should be

translated into concrete behaviors or learning outputs that students can complete and teachers can observe and assess. For example, data security awareness is demonstrated by selecting data fields according to task requirements, masking data, and conducting security checks before release; a rigorous and evidence-based professional attitude is demonstrated through data validation, test records, and anomaly review; and engineering responsibility is demonstrated by explaining the applicable boundaries of analytical methods and expressing analytical results with due caution.

2.2. Coordinated Design of Knowledge, Competency, and Value Objectives

The course coordinates three dimensions: knowledge objectives, competency objectives, and value objectives. Knowledge objectives concern students' understanding and mastery of AIS data structures, data-processing methods, and visualization principles. Competency objectives emphasize the application of relevant technologies to complete tasks such as data governance, trajectory visualization, operational status analysis, and results presentation. Value objectives focus on developing data security awareness, engineering responsibility, awareness of standardized practice, and a rigorous and evidence-based professional attitude during project implementation. Rather than being taught separately, the three types of objectives are jointly embedded in project tasks, teaching processes, and learning outputs so that knowledge acquisition, competency development, and value guidance reinforce one another. The objectives and corresponding learning outputs for each project stage are shown in Table 1.

Table 1. Knowledge, Competency, and Value Objectives for the AIS Project

Project Stage	Knowledge Objectives	Competency Objectives	Value Objectives	Learning Outputs and Assessment Evidence
Data familiarization	Understand the principal AIS fields, data structure, and their business meanings	Identify key fields and explain the data source and scope of use	Rule awareness, industry awareness, and data security awareness	Field description; data-source record
Data governance	Master methods for data validation, sorting, deduplication, anomaly handling, and masking	Formulate and implement data-processing rules	A rigorous and evidence-based professional attitude, quality responsibility, and awareness of standardized practice	Processing rules; execution logs; before-and-after comparison
Trajectory visualization	Understand the basic principles of organizing time-ordered vessel-position records and visualizing vessel trajectories	Organize vessel-position data correctly and visualize vessel trajectories	Commitment to professional excellence, collaborative awareness, and engineering responsibility	Program output; test records; project documentation
Operational status analysis	Understand the relationships among spatial trajectories, speed variations, and vessel operating status	Integrate trajectory, speed, and time data to analyze vessel operating status, identify and review anomalies, and explain the basis for judgments	A rigorous and evidence-based professional attitude and responsibility for maritime safety	Analytical report; anomaly-review record
Results dissemination	Understand visual communication, data-use boundaries, and information-release standards	Present analytical results clearly and explain the limitations of the data and methods	Compliance awareness, communication responsibility, and professional ethics	Visualization output; project description; results-presentation checklist

2.3. Pathway for Integrating Course Content and Value Objectives

Curriculum-based ideological and political education is

grounded in professional tasks and follows a four-step pathway: introducing a business context, implementing project tasks, examining key questions, and assessing learning outputs. First, a smart-shipping context is introduced

to help students understand the application value of AIS data and its relationship with maritime safety. Second, the business problem is transformed into project tasks involving data familiarization, data governance, trajectory visualization, operational status analysis, and results dissemination, with corresponding value objectives embedded in field selection, processing-rule formulation, anomaly review, and the release of results. Third, students discuss the evidence, risks, and possible consequences associated with different data-processing options. They are guided to analyze problems by integrating trajectory, speed, time, and adjacent records, rather than drawing conclusions from a single anomalous record. Finally, achievement of the knowledge, competency, and value objectives is assessed through learning outputs such

as field descriptions, processing logs, test records, analytical reports, and results-presentation checklists.

Each project stage carries corresponding value objectives. Data familiarization and data governance emphasize rule awareness, data security, and standardized practice; trajectory visualization and operational status analysis emphasize quality awareness, engineering responsibility, and maritime safety; and results dissemination emphasizes compliance, communication responsibility, and professional ethics. In this way, value objectives are integrated into the implementation of professional tasks and can be observed and assessed through students' learning behaviors and project outputs. The overall instructional design framework is shown in Figure 1.

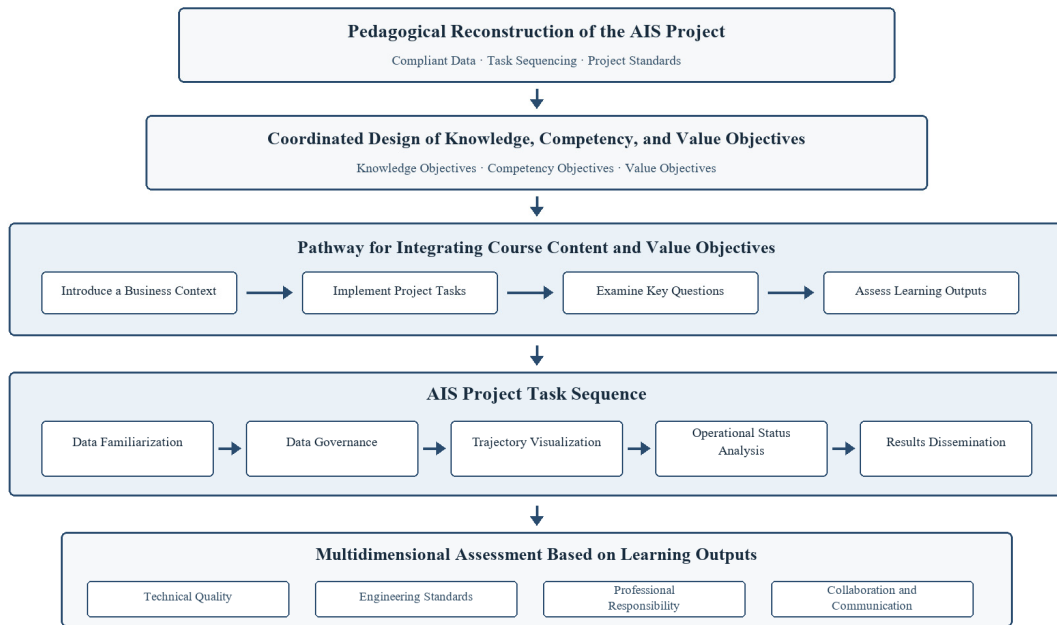


Figure 1. Instructional Design Framework for Curriculum-Based Ideological and Political Education Using an AIS Vessel Big Data Project

3. Teaching Practice through an AIS Trajectory Visualization Task

3.1. Design of the Teaching Task

The course selects AIS trajectory visualization and analysis as the comprehensive task within the AIS vessel big data project. Students are required to transform vessel position, course, speed, and time data into readable, interactive, and analyzable trajectory information. The teaching process proceeds through five stages: data familiarization, data governance, trajectory visualization, operational status analysis, and results dissemination. After completing data inspection, anomaly handling, and necessary masking, students produce visualizations of vessel distribution and individual-vessel trajectories, analyze vessel operating status in conjunction with speed variations, and submit a project description and a completed results-presentation checklist. Map application programming interface (API) invocation, vessel trajectory plotting, and linked chart interactions constitute the principal technical focus of the task. While designing and implementing these functions, students are also expected to consider how data quality affects visualization and status analysis, comply with standards for data processing, result interpretation, and information release, and develop a corresponding sense of professional responsibility.

3.2. Teaching Organization and Value Guidance

Before class, the teacher introduces the business background, learning tasks, and output requirements of the AIS trajectory visualization project. Students become familiar with the main content and application scenarios of AIS data and clarify the data-use requirements to be followed during project implementation. Through questions concerning navigational safety, data accuracy, and information security, the teacher guides students to understand the industry value of AIS data and the importance of using data in a standardized manner.

During class, teaching is organized around the design and implementation of AIS trajectory visualization functions. Task explanation, operational demonstration, student practice, and troubleshooting are combined to guide students through data processing, trajectory visualization, status-information display, and function integration. Functional implementation remains the central teaching focus. While helping students solve technical problems, the teacher highlights requirements concerning data accuracy, standardized practice, and information security, enabling students to recognize that correct program functionality depends not only on technical methods but also on data quality and compliance with operating standards.

During project implementation, students work in groups to allocate tasks, develop functions, test and optimize the application, and discuss problems. Drawing on issues that arise in data processing, program debugging, and presentation of results, the teacher guides students to analyze the causes of errors and develop habits of careful inspection, repeated verification, and timely correction. Through project practice, students improve their functional design and implementation capabilities while gradually developing a rigorous and evidence-based professional attitude, collaborative awareness, and engineering responsibility.

During the project presentation stage, each group demonstrates the main functions of its AIS trajectory visualization project and explains the division of tasks, implementation process, and problem-solving procedures. The teacher and students evaluate the work in terms of functional completeness, operating performance, standardized practice, project documentation, and information security. Students then refine their projects in response to the feedback, further strengthening their quality awareness, awareness of standardized practice, and sense of professional responsibility through functional testing, output

revision, and project review.

3.3. Multidimensional Assessment Based on Learning Outputs

The course combines formative and summative assessment. Project-process records and learning outputs are used to evaluate the achievement of teaching objectives [7-8]. Assessment covers four dimensions: technical quality, engineering standards, professional responsibility, and collaboration and communication. Technical quality focuses on functional completeness, program performance, and the results of testing and optimization. Engineering standards focus on operating procedures, execution records, and project documentation. Professional responsibility focuses on whether students comply with data-use and information-security requirements and recognize their responsibility for quality and safety in functional development. Collaboration and communication focus on task allocation, teamwork, and presentation of results. The weights, criteria, and evidence for each assessment dimension are shown in Table 2.

Table 2. Multidimensional Assessment Design for the AIS Trajectory Visualization Project

Assessment Dimension	Weight	Assessment Criteria	Assessment Evidence
Technical quality	40%	Core functions are complete; the program runs correctly; testing and optimization are appropriate	Program; operating results; test records
Engineering standards	25%	Operations follow standards; process records are complete; project documentation is comprehensive	Execution logs; test records; project documentation
Professional responsibility	25%	Data-use and information-security requirements are observed; project quality and standards for releasing results are taken seriously	Task records; project description; results-presentation checklist
Collaboration and communication	10%	Group responsibilities are fulfilled; communication and collaboration are effective; project results are presented clearly	Collaboration records; presentation and defense

Project assessment follows a four-stage process: output presentation, problem identification, process explanation, and continuous improvement. Students must not only demonstrate project functions and operating performance but also explain task allocation, functional implementation, and their approaches to problem solving. Peers use the assessment criteria to identify problems in functionality, operating procedures, and presentation of results. The teacher evaluates the project from the perspectives of technical implementation, engineering standards, and information security. Students then revise and improve their work based on the feedback. By extending assessment from final results to the implementation process, this approach helps reveal students' performance in professional competencies, standardized practice, quality awareness, and professional responsibility. Given the constraints of the teaching period and the scope of the practical sample, educational outcomes still require continued verification through student interviews, performance on subsequent tasks, and comparisons of project outputs across multiple cohorts.

4. Conclusion

The educational value of an AIS vessel big data project does not lie in simply adding ideological and political elements. Rather, it lies in integrating value objectives—such as maritime safety, data compliance, and engineering

responsibility—into professional practices including functional development, data processing, testing and optimization, and project presentation. Pedagogically reconstructing the project, coordinating knowledge, competency, and value objectives, implementing project-based teaching, and assessing learning outputs can promote the integration of value shaping, knowledge transmission, and competency development.

For professional courses with distinctive industry characteristics, curriculum-based ideological and political education should shift from listing ideological and political elements to deeply integrating value objectives with professional tasks, and from one-way teacher instruction to student analysis, standardized practice, and assumption of responsibility through project work. Future research will refine the assessment rubric through sustained teaching practice, collect student work and process records across tasks and semesters, examine whether students' awareness of standardized practice and professional responsibility transfers to other big data projects, and further expand the range of industry-based teaching cases.

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References

- [1] Mei, Z. (2024). Integration of curriculum ideology and politics in higher education: A case study of English linguistics in China. *Frontiers in Education*, 9, 1389469. <https://doi.org/10.3389/educ.2024.1389469>.
- [2] Atenas, J., Havemann, L., & Timmermann, C. (2023). Reframing data ethics in research methods education: A pathway to critical data literacy. *International Journal of Educational Technology in Higher Education*, 20, 11. <https://doi.org/10.1186/s41239-023-00381-9>.
- [3] Yang, D., Wu, L., Wang, S., Jia, H., & Li, K. X. (2019). How big data enriches maritime research: A critical review of automatic identification system (AIS) data applications. *Transport Reviews*, 39(6), 755–773. <https://doi.org/10.1080/01441647.2019.1649315>.
- [4] Emmens, T., Amrit, C., Abdi, A., & Ghosh, M. (2021). The promises and perils of automatic identification system data. *Expert Systems with Applications*, 178, 114975. <https://doi.org/10.1016/j.eswa.2021.114975>.
- [5] He, W., Lei, J., Chu, X., Xie, S., Zhong, C., & Li, Z. (2021). A visual analysis approach to understand and explore quality problems of AIS data. *Journal of Marine Science and Engineering*, 9(2), 198. <https://doi.org/10.3390/jmse9020198>.
- [6] Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, 102, 101586. <https://doi.org/10.1016/j.ijer.2020.101586>.
- [7] Wang, B., Yu, H., Sun, Y., Zhang, Z., & Qin, X. (2023). An effect assessment system for curriculum ideology and politics based on students' achievements in Chinese engineering education. *International Journal of Advanced Computer Science and Applications*, 14(1), 948–953. <https://doi.org/10.14569/IJACSA.2023.01401104>.
- [8] Zhao, X., Ganapathy, M., & Khan, A. (2024). Evaluation of curriculum ideological and political education in Chinese higher education: A systematic review. *International Journal of Academic Research in Progressive Education and Development*, 13(1), 2602–2620. <https://doi.org/10.6007/IJARPED/v13-i1/19712>.